NEW CHALLENGES WITH GEOTOURISM

PROCEEDINGS OF THE VIII EUROPEAN GEOPARKS CONFERENCE

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FOREWORD

Geotourism is a segment of tourism that has been developed worldwide in recent years. In fact, since long time ago people come to visit "geological wonders", like mountains, caves, volcanoes, fossil remains and canyons. However, only in recent times there was a real challenge for this sector and a market with very specific and novel characteristics, based on research's interpretation, protection of the geological heritage and edutainment, is being developed.

Excellence in Nature Tourism is supported by the sustainable use of natural heritage, raising Nature awareness through news ways of interpretation. This niche of tourism has been growing worldwide in the last years and nature tourists look for certified, high-quality destinations, as are the ones being developed by the Geoparks under the auspices of UNESCO. Geotourism is an emerging segment of Nature Tourism in which the main object is Geodiversity. A new niche was created for business with new specificities and new contingencies that accompanies not only the general trends of tourism but it is also imposing own trends. Geoparks are pioneers in Geotourism and an example of sustainable local development.

Geotourism needs awareness for Geological Heritage. Geological processes with high scientific and educational interest can be associated to aesthetics/monumentality and become geosites with tourist potential. With Geotourism is intended to stimulate the knowledge of Geodiversity, Geoconservation and use them for sustainable development.
It is crucial that Geotourism has other values than Geodiversity to diversify and enrich the offer: one site with rich geological heritage should have also cultural, historical and natural (bio and geo) points of interest and approaches. But it is also important to have good interpretation and supportive structures (lodging, restaurants, activities/events) to receive the high-demanding geotourists.

The aim of the 8th European Geoparks Conference was to discuss new methodologies for developing Nature tourism *sensu lato* and Geotourism, to explore the establishment of Geoparks as high quality destinations for alternative sustainable tourism, to promote recent developments in protection and promotion of natural heritage in combination with local development as well as in management and operation of Geoparks. It was also intended to:

- unify Geoparks for a stronger European Geoparks Network,
- promote EGN towards local, national and international authorities,
- project UNESCO Geopark brand as a reference in national and international tourism,
- develop geoconservation measures for sustainable use of geosites,
- raise awareness of EGN as example for the development of other continental networks.

For the success of this Conference on "New Challenges with Geotourism" was highly important the key-note talks made by the distinguished coordinators of the European Geoparks Network (Prof. Nickolas Zouros and Dr. Patrick Mc Keever) and the Global Geoparks Network of UNESCO (Dr. Margarete Patzak), the world-known expert on Geotourism, Prof. Ross Dowling, and one of the most eminent researchers on Geonconservation, Prof. José Brilha. But more than 90 communications from researchers and territories from all over Europe and abroad, with a special note for the Brazilian experiences, made the Naturtejo's European Geoparks Conference one of the most participated and lively discussed events from the European Geoparks Network. The subjects in discussion were:

1. **Geoparks and Tourism**

Geology and Tourism is a new combination that Geoparks are promoting. The territories need not only beautiful landscapes but also tourist strategies that promote regions in a responsible way. Geotourists ask for new challenges;

2. **Geotourism and local development**

Geotourism was born from a happy association of Geology with Tourism. It is a new kind of Nature Tourism that aspires being the solution for local development of rural areas and that involves several agents such as geoscientists, politicians and local managers;

3. **Geoparks and Science**

Geopark's definition stands at the geodiversity concept. It is necessary to support the geotourist practices with scientific research to produce stronger knowledge about Geology. We can't forget that Geology is a Science and we can't promote Tourism if we don't know deeply our territories;

4. **Geoconservation best practices and wrong ways**

Geoconservation is one of the main aims of a Geopark. Each EGN member has to find the best way to protect their geological heritage;

5. **Marketing strategies for a strong EGN brand**

Marketing strategies must be a pillar in each Geopark for tourism development based on high-quality standards. It is necessary to create strategies to promote Geodiversity and land products that link the Geopark's territories for a stronger EGN brand;

6. **Man and Nature: cultural landscapes**

Local culture is important for sustainable development and geotourism. Traditions usually combine man and nature in a symbiotic approach. Man has been using nature by constantly interact with the environment for thousands of years;

7. **New Geoparks and their tutors**

It is not easy to develop new European and Global Geoparks. It is necessary to prepare a territory and to promote new strategies towards sustainable development using Geodiversity. EGN aks for a strongers and bigger network with new projects supported by experienced Geoparks in long-term projects.

Established in 2000, the European Geoparks Network (EGN) aims to protect geodiversity, to promote geological heritage to the general public, as well as to support sustainable economic development of geopark territories, primarily through the development of geological tourism. The network has drawn together territories from across Europe that share these aims and now work together in an active and dynamic way in order to achieve them. Originally consisting of four territories, the network has been expanded to include, from April 2009, 34 territories across 13 European countries.

Special thanks must be given to all the abstract reviewers for their kind cooperation and patience even when work throughout the weekend was needed. The IOP Publishing editors were as friendly as effective working against the (un)predictable delays to finish the book in time for the Conference. A special word of affection for all the anonymous collaborators and friends that supported with their unstoppable enthusiasm the success of this Conference. In fact, Geotourism, as life, is made of experiences and emotions to be shared.

The Editors

FROM THE GEOTOURIST'S POINT OF VIEW

[...]When we arrived to Penha Garcia we soon got started to take photos to the amazing landscape and then we went to the bathroom (...); the bathroom were clean, an impressive feature for those who live in the city where public toilets are always filthy. Meanwhile, a Geology and Biology teacher, now working as a ranger, came to us and we followed her up to the hill and to a museum, starting the Fossils Trail searching for trilobite vestiges. The trail starts in the old town. After the visit to the museum we went to lunch. Then, we climbed to the castle from where we could appreciate the views of the river gorge. We were following the trail and seeing rocks full of trace fossils, or the activity of living beings that once inhabited in this region and now we find them preserved in slates and quartzite outcrops of this river gorge. It was also in one of the gorge's slopes, where traditional stone-houses were recently recovered, that we found Mr. Domingos Costa (...), storing the loosen trace fossil slabs. In this house arranged on the floor or in improvised shelves there are many *Cruziana*, which are fossils of typical trilobite behaviour showing how they moved in the water and burrowed into the mud for feeding themselves. Mr. Domingos Costa is not a scientist, but he is fascinated by this kind of traces: he searches for, collects and takes care of the trace fossils from the Ponsul valley. But besides the trace fossils here we were amazed by the quartzite folds and vertical beds. This outdoor exhibition is most important in the world for the comprehension of trilobites' behaviour, and one of the few places in the world where one can find these trace fossils with such impressive preservation. Observing those traces and patterns is like diving into the Palaeozoic oceans. Studying the trilobite traces from Penha Garcia is a way to identify animal behaviours that only now are starting to be understood. Fossils such as these are truly time machines. This natural complex may have clues about the origin of life on Earth. Walking through the geological record of this book of Time written on the rocks may be useful and important for those who want to understand from where we came and to where we are going. What we have got in Penha Garcia is a first chapter of a much longer story being deciphered in the last two hundred years by the palaeontologists. A book where the last page may be forever missing, but also counting with the contribution of the geologist for helping to understand a four-dimension puzzle, being Time the most significant element. In the Ponsul valley 400 m of sediment thickness are recorded and each single mud bed may comprehend dozens of thousands of years. In the Fossils Trail, the rocks are the tourism attraction. The remains found in these rocks dated from 480 million years ago, 250 million years before the first dinosaurs!

Patrícia Santos
16 years old
Tomar

INDICE

Key Note Talks

EUROPEAN GEOPARKS NETWORK AND GEOTOURISM

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Established in 2000, the European Geoparks Network (EGN) aims to protect geodiversity, to promote geological heritage to the general public, as well as to support sustainable economic development of geopark territories, primarily through the development of geological tourism.
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In 2001 the European Geoparks Network signed a formal agreement with the UNESCO Division of Earth Sciences, whereby UNESCO gave the network its endorsement.
A further agreement was signed with UNESCO in 2004 whereby the EGN was given the responsibility for regulating membership of European Geoparks in the UNESCO Global Geoparks Network. As a result the EGN acts as the European sector of GGN.
The European Geoparks Network operates through continuous electronic communication, biannual coordination meetings and the establishment of common projects through which territories can exchange ideas, experience and best practices, thereby supporting each other on geotourism development.
UNESCO recommends the creation of similar regional Networks, reflecting local conditions, elsewhere in the world. Today, except for the European Geoparks Network, the Asia-Pacific Geoparks Network (A.P.G.G.N.) formed in 2007 is also active and several other regional Networks are under consideration in Latin America, North America and Africa.

The structure of the European Geoparks Network is relatively simple and comprises an Advisory Committee (11 members including representatives of UNESCO, IUGS and IUCN) and a Coordination Committee (comprising of two representatives from each member). Decisions concerning the network are only taken by the Coordination Committee. As part of the Coordination Committee, there is an elected EGN Coordinator and Vice Coordinator to represent the whole Network. They coordinate contacts with other international bodies (E.U., UNESCO, IUGS, IUCN, Council of Europe etc.) and prepare the agenda of the meetings in cooperation with the meeting hosts.
The European Geoparks Network adopted a common logo which is registered in all European countries. An EGN member has the right to use the European Geopark logo in its communications thereby contributing over time to creating a common image of quality, linking the enhancement of European Earth heritage with sustainable development.
Membership of the EGN entitles a Geopark to use the logo of the EGN in its promotional material and is entitled to call itself a European Geopark. According to the Madonie Declaration it is also entitled to use the appropriate logo of the Global Network of Geoparks. These logos must only be used on products produced directly by the Geopark management.

In order to achieve high quality standards in Geoparks, the EGN decided to establish an evaluation procedure for all new applications. Evaluation missions are undertaken by two Geopark experts who are sent to the applicant territory to evaluate the application and to discuss the application with the relevant national and local authorities as well as stakeholders

and local communities. Furthermore, the evaluators are also requested to make comments on the integrity and future management of the proposed Geopark. These recommendations have been, in many cases, critical to strengthening the success of applications in the long run. With a view to ensuring a continuing high quality in the operation of a Geopark and the services provided to visitors, EGN membership is limited to a period of 4-years after which it can be renewed following the same procedure. The review will take the form of a revalidation process involving the submission of a revalidation dossier and questionnaire document and a visit by two evaluators from a different country nominated by the EGN CC and UNESCO, coming from a different state from the revalidating Geopark.

FIGURE 1: Map showing the location of the 34 members of the European Geoparks Network as of April 2009. **1.** Réserve Géologique de Haute - Provence– FRANCE, **2.** Vulkaneifel European Geopark – GERMANY, **3.** Petrified Forest of Lesvos – GREECE, **4.** Maestrazgo Cultural Park – SPAIN, **5.** Psiloritis Natural Park – GREECE, **6.** Terra.Vita Naturpark – GERMANY, **7.** Copper Coast Geopark–IRELAND, **8.** Marble Arch Caves Geopark–N. Ireland, UK and IRELAND **9.** Madonie Geopark –ITALY, **10.** Rocca di Cerere Geopark – ITALY, **11.** Naturpark Steirische Eisenwurzen – AUSTRIA, **12.** Naturpark Bergstrasse Odenwald – GERMANY, **13.** North Pennines AONB – England UK, **14.**, Park Naturel Régional du Luberon – FRANCE, **15.** North West Highlands – Scotland UK, **16.** Geopark Swabian Albs – GERMANY, **17.** Harz Braunschweiger Land Ostfalen– GERMANY, **18.** Mecklenburg Ice Age Park – GERMANY, **19.** Hateg Country Dinosaurs Geopark – ROMANIA, **20.** Beigua Geopark – ITALY, **21.** Fforest Fawr Geopark – Wales UK, **22.** Bohemian Paradise Geopark – CZECH REPUBLIC, **23.** Cabo de Gata – Nijar Natural Park – Andalucia – SPAIN, **24.** Naturtejo Geopark – PORTUGAL, **25.** Sierras Subbeticas Natural Park – Andalucia – SPAIN, **26.** Sobrarbe Geopark – Aragon – SPAIN, **27.** Gea Norvegica Geopark – NORWAY, **28.** Sardenia Geominerario Park – ITALY, **29.** Papuk Geopark – CROATIA, 30. Lochaber Geopark – Scotland UK, **31.** English Riviera Geopark - England UK, **32.** Adamello-Brenda Geopark – ITALY, **33.** Geo Mon Geopark -Wales UK, **34.** Arouca Geopark PORTUGAL.

A European Geopark integrates the range of resources found within its broader region, including existing geological attractions and sites, landscapes, wetlands, sites of natural beauty and ecological value, as well as cultural monuments and traditions including gastronomy and local crafts and agricultural products.

A broad range of activities combines the main components for the operation of each Geopark, including scientific research, the creation of an inventory and map of geological sites, protection of the geological heritage operation of thematic museums and interpretation centers, interpretation and promotion of geological sites, the conservation of fossils, the creation of parks for visitors, the establishment of a network of walking trails linking geological sites to ecotourism infrastructures, the development of environmental education

programmes on geological sites, the organization of scientific and cultural events, and the promotion of monumental geological sites.

Geotourism activities in Geoparks include:

- Creation of thematic geo-museums and interpretation centres,
- Organization of temporary travelling exhibitions,
- Exchange of know-how and best practice on geotourism development,
- Creation of a geotourism data base describing tourism activities offered by the Geoparks (museums and info-centers, trails, events etc.),
- Organization of geotourism-activities in Geoparks i.e.: exploring the geological history of the Geopark, nature observation, bird watching, conservation of fossils, mountain biking, trekking, rafting,
- Organization of working holidays in Geoparks and volunteer activities,
- Organization of conferences with a thematic focus on landscape, heritage interpretation and tourism,
- Promotion of common geotourism packages and organization of events promoting alternative tourism in Geoparks,
- Exchange of knowhow on geosite assessment, conservation and interpretation (e.g. publication of books and visitors guides, creation of interpretation panels, production of multimedia presentations and DVD's) in order for visitors to explore the fascinating story preserved in the rocks and the landscape of the Geoparks.

Geoparks also promote themselves as ideal destinations for educational activities. Geopark activities focus on young European citizens, aiming at the promotion of a common European geological heritage as a key factor for environmental understanding and sensitisation on nature protection.

Main target group for Geoparks are schoolchildren and University students. Ages ranged from 4 years upwards to university level and the interpretation and information material produced was tailored to the needs of each age group.

Educational activities for universities and school classes include:

- Preparation and organization of field trips for university students that included guided tours, provision of scientific data, organization of field work, organization of student camps, and the organization of research activities and projects related to the main scientific objectives present in the Geopark (e.g. palaeontological excavation works) as well as areas of conservation (wetlands, nature parks),
- Organization of Intensive courses on Geoparks with the collaboration of academic staff. A special course for scientists and staff members working in Geoparks, technicians, rangers, postgraduate students as well as local enterprises wishing to improve their knowledge about the Geopark's function and activities,
- Establishment of children's geology clubs in Geoparks, focusing on fun and discovery through activities suitable for children. There is an exchange of good practice in organising and promoting the clubs,
- Organization of special educational programmes according to age (nursery school, primary school, secondary school, higher education college) including tools such as theatrical plays, puzzle constructions, and experiments,
- Production of educational resource material for use by schools and colleges,
- Creation of common thematic teaching kits that reflect the differing natures of each Geopark, e.g. kits on impact craters, volcanoes and the water cycle, which are either, shared or exchanged providing "A Trip through the Geological History of Europe",

- Creation of teaching kit focusing on the geological history of each Geopark including the production of information leaflets, special guides for teachers and students, maps, videos, and CD - ROMS.
- Children's books: Specially designed books for children in order to familiarize them with the geological history of Europe which illustrate the structures and processes that can be seen in the Geoparks,
- Workbooks: Special workbooks for students of all grades. These workbooks will familiarize the reader with geological processes that lead to an understanding of the Earth's history,
- Educational CD-ROM will inform students in a clearly understandable format about the geological heritage of the Geopark (including photos, videos and maps) in an engaging manner,
- Special guides for teachers will provide instructions on delivering classes on geology in order to familiarize pupils with geological processes,
- Special publications on educational activities in Geoparks, natural monuments and museums in the Geoparks,
- Training: Vocational training activities can offer an example of the potential of cooperation between Geoparks. Vocational Training Centres have been created with the aim of training young unemployed people to cover new development needs.

EGN Promotional activities and promotional tools:

- Publication of the European Geoparks book, presenting the EGN operation as well as all European Geoparks. The book with a preface from the UNESCO DG and ADG is promoting the importance of geological heritage and the beauty of geological objects in order to attract people to conduct educational activities in the Geoparks,
- EGN - Website: A common website (www.europeangeoparks.org) has been developed with links to all European Geoparks in order to promote their services and geotourism products. The site is managed by the Network Coordination Committee.
- European Geoparks Magazine is published once per year and distributed to universities, schools and agencies responsible for the promotion of geotouristic and educational activities within the Geoparks. It includes articles on the Networks activities, on geo-tourism, on geological preservation and protection and educational activities in Geoparks. It also contains the profiles of the individual Geoparks. By 2009, six issues had been published with a total print run of 15,000 copies per issue,
- European Geoparks Week: Organization of a series of events in each Geopark to be organized during the first week of June and dedicated to geotourism and educational activities. During the EG Week, visitors in each Geopark participate in common events, and become familiar with other Geoparks in the Network at the same time,
- Participation in Tourist Fairs and Events (e.g. ITB Berlin, ATB Salzburg, FITUR Madrid, "Reisepavillon" Hannover etc) offers to Geoparks contacts visibility among tourism enterprises and agencies. The participating Geoparks cover the participation costs for the promotion of the entire network,
- Organization of promotional activities for local products and handcrafts. Geoparks organize agrotourism fairs and festival to promote quality local products (organic, traditional) produced within their territory and to familiarize visitors with the way of life of local people,
- Publication of Geopark books and field guides promoting and interpreting landscapes and geosites in each Geopark,

- Geoparks Corner - EGN Information point: Information points for visitors have been created in each Geopark providing information on the Network and its members common activities in the protection and promotion of our geological heritage, the possibilities of geotourism activities in the Geoparks, educational activities and programmes as tools of the Geoparks as well as the various products of individual Geoparks (fossil casts, books, leaflets, museum-kits etc.),
- Common Information material such as leaflets, posters, tickers, calendars, postcard set, etc. has been published in different languages to promote the Network and its activities as well as the activities of the individual Geoparks members. Information and promotional material are distributed to tourist agencies and other interested enterprises including hotels, restaurants, airports, bus and train stations.

Geoparks address the strong need for the effective management of important geological sites and for the sustainable economic development of rural areas through the development of geotourism thus enhancing the value of their Earth heritage, landscapes and geological formations.
The Geoparks initiative adds a new dimension to the 1972 Convention concerning the Protection of the World Cultural and Natural Heritage by highlighting the potential for interaction between socio-economic and cultural development and conservation of the natural environment.
European Geoparks are potentially powerful new tools for a new holistic approach to nature conservation and sustainable economic development through geotourism.

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THE GROWTH OF GLOBAL GEOTOURISM

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1. Introduction

Geotourism is emerging as a new global phenomenon (Dowling 2008a). Reflecting the explosive growth in global geotourism there has been a large number of conferences on the topic held in the last two years. They include the *Inaugural Global Geotourism Conference* held in Perth, Australia in August 2008; the *World Heritage and Geotourism Conference* hosted by the Geological Society of South Africa, held in Pretoria from 4-5 June 2009; *Geotour 2009* held in the High Tatra Mountains, Slovakia from 6-10 September 2009; and now the 8^{th} *European Geoparks Conference* held at Geopark Naturtejo. Planning is well underway for the *Second Global Geotourism Conference* which will be held on the island of Borneo, at Gunung Mulu World Heritage Region, Sarawak, Malaysia from 17-20 April 2010.

Another development has been the establishment of the International Association for Geotourism (IAGt), set up in eastern Europe (www.iageotour.com). They recently announced plans to host what they have billed as the *First World Congress of Geotourism* next year. In addition there has been a number of books on the subject including *Geotourism* (Dowling & Newsome, 2006) and *Geotourism in Ethiopia* (Asrat *et al.* 2009). Two global books arising from the 2008 Inaugural Global Geotourism Conference will be published in 2010. They are *Global Geotourism Perspectives* and *Geology and Geotourism: The Tourism of Geology and Landscape* (both Dowling & Newsome, In Press, due April 2010).

2. Geotourism

Geotourism is sustainable tourism with a primary focus on experiencing the earth's geological features in a way that fosters environmental and cultural understanding, appreciation and conservation, and is locally beneficial (Dowling & Newsome, 2006). It is about creating a geotourism product that protects geoheritage, helps build communities, communicates and promotes geological heritage and works with a wide range of different people. According to James & Hose (2008) geotourism is a form of special interest tourism and focuses on geology and the formation of landscapes. Tongkul (2006) defines it as utilization of geological heritage resources for education-based tourism.

Whichever way it is defined or described, the 'geo' part in geotourism means geology and geomorphology. Geology is the study of the earth and geomorphology is the study of landforms. The natural resources includes landscapes, landforms, rock outcrops, rock types, sediments, soils and crystals. The 'tourism' part means visiting, learning from, appreciating and engaging in geosites. Overall, geotourism comprises the geological elements of 'form and process' combined with the components of tourism such as attractions, accommodation, tours, activities, interpretation and planning & management.

3. Principles of Geotourism

Geotourism may be further described as having a number of essential characteristics. These elements combine to shape geotourism in its present form. It comprises a number of interrelated components all of which should be present for authentic geotourism to occur. There are five key principles which are fundamental to geotourism. They are that geotourism is geologically-based (that is, based on the earth's geoheritage), sustainable

(ie: economically viable, community enhancing and fosters geoconservation), educative (achieved through geo-interpretation), locally beneficial, and generates tourist satisfaction. The first three characteristics are considered to be essential for a product to be considered 'geotourism' while the last two characteristics are viewed as being desirable for all forms of tourism.

1. Geologically Based

Geotourism is based on the earth's heritage with a focus on its geological forms (features) and/or processes (Fig. 1). Unlike ecotourism which occurs in, and depends on, a natural setting, geotourism may occur in either a natural or an urban setting. The focus on the earth and its geological features (at a range of scales from rock outcrops to entire landscape vistas), is essential to the planning, development and management of geotourism.

FIGURE 1: Geologically based *Bridge Between Two Continents, Iceland* (Left: North America, Right: Europe).

2. Sustainable

Geotourism fosters economic viability, community enhancement and geoconservation. The challenge to geotourism in any region or country is to develop its tourism capacity and the quality of its products without adversely affecting the geo-environment that maintains and nurtures it. This involves ensuring that the type, location and level of geotourism use does not cause harm to geological features or their surrounding areas, especially in natural settings.

3. Geologically Informative

Earth education and geo-interpretation are important tools in creating an enjoyable and meaningful geotourism experience (Fig. 2). Geotourism attracts people who wish to interact with the earth environment in order to develop their knowledge, awareness and appreciation of it. By extension, geotourism should ideally lead to positive action for the earth by fostering enhanced conservation awareness.

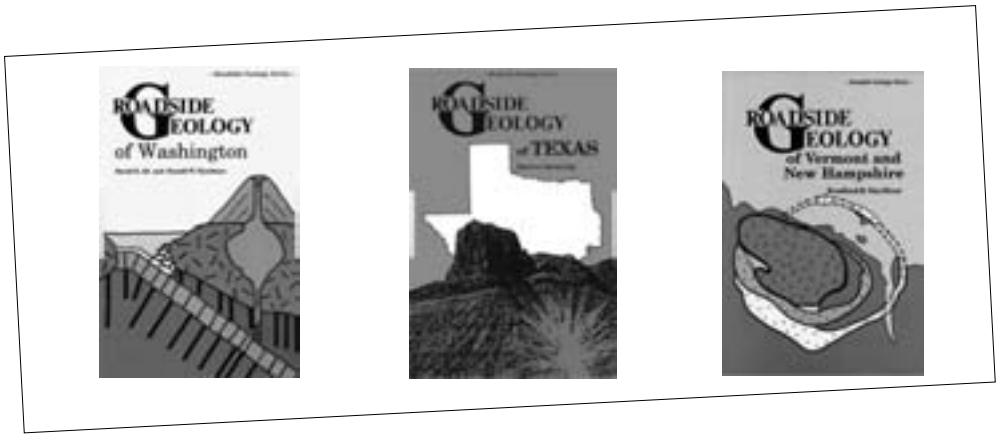

Figure 2: Geologically informative *Roadside Geology Books, North America* (Washington, Texas, Vermont & New Hampshire).

4. Locally Beneficial

The involvement of local communities not only benefits the community and the environment but also improves the quality of the tourist experience. Local communities can become involved in geotourism operations, and in the provision of knowledge, services, facilities and products. Geotourism can also generate income for resource conservation management in addition to social and cultural benefits. The contribution may be financial with a part of the cost of the tour helping to subsidize a geoconservation project. Alternatively it could consist of practical help in the field with the tourists being involved in geological data collection and/or analysis.

5. Tourist Satisfaction

Satisfaction of visitors with the geotourism experience is essential to the long-term viability of the geotourism industry. Included in this concept is the importance of visitor safety in regard to site visits. Information provided about geotourism opportunities should accurately represent the opportunities offered at particular geotourism destinations. The geotourism experience should match or exceed the realistic expectations of the visitor. Client services and satisfaction should be second only to the conservation and protection of what they visit.

4. Geotourism Development

Geotourism is about creating a place in which both locals and tourists are free to enjoy a region's local geological landscapes (Dowling & Newsome 2008). It generates an experience which brings together the local landscape, the community and its visitors, all of whom have different interests in the earth's formations. Local businesses and community groups work together to promote and provide a distinctive, authentic visitor experience. Geotourism places a major focus on informing tourists and local communities about the earth through geological interpretation and education. Geotourism businesses are usually operated by local communities and may include interpretation, tours, accommodation and food outlets. These in turn generate business for the local residents creating a larger workforce and economic aid. The goals of sustainable geotourism development are:

1. To develop greater awareness and understanding of the significant contributions that geotourism can make to the environment, local communities and the economy
2. To promote equity in geo-development
3. To improve the quality of life to the host community

4. To provide a high quality of the geological experience for the visitor, and
5. To maintain the quality of the geoheritage on which the foregoing objectives depend.

5. Geotourism Trends

There are a number of key trends which are occurring in the development of geotourism. They include its unlimited potential, emerging partnerships, excellent interpretation, and UNESCO's geoparks initiative.

Unlimited Potential

One of the key aspects of Geotourism is that it has unlimited potential. It can be developed on a range of scales from small to large, and unlike ecotourism it is not exclusively confined to natural areas. It can take the form of a sign at a roadside cutting, right through to be the underlying tool to foster development for a region. A number of countries around the world have considerable potential for geotourism development. Some examples include the granitic peaks and rock faces of Madagascar, mountainous scenery and show caves in the Sultanate of Oman, and proposals to develop geotourism in the Kamienna River Valley, Poland.

Emerging Partnerships

Partnerships are the key to successful geotourism growth and these can take on a range of styles including those involving governments, businesses and /or non-profit organisations. One example is the 'Grand Canyon Sky Walk' in the USA which lies on Indian lands outside the Grand Canyon National Park (Fig. 3). The skywalk was created for, and is owned by, the Hualapai Tribe, and since its opening in early 2007 it has become one of the biggest attractions at the canyon. The skywalk is a 130 foot horse-shoe shaped bridge cantilevered over the edge of the Grand Canyon suspended 4000 feet above the canyon floor. It has a glass bottom and visitors have a bird's eye view of what the floor of the canyon actually looks like as well as viewing the different landforms and geological occurrences that the canyon has gone through. The Hualapai hope that by sharing this land and the breathtaking landscape they will provide their present and future generations with economic self sufficiency.

Figure 3: Emerging partnerships: *Grand Canyon Skywalk, USA* (Source: Lonely Planet, 2007).

Excellent Interpretation

An emerging trend is the development of excellence in geotourism interpretation. One example is the 'Roadside Geology' series of North American geotourism guidebooks published in the United States. It contains 24 volume which describe different 'geotourist trails' in the USA and parts of Canada (Majka 2007). All of the books are written by professional geologists in a manner easily understandable by members of the general public. The books introduce the historical and regional geology, landforms of the area, and rocks and minerals which occur there. The books are well illustrated with maps, diagrams and photos. The majority of the trails can be covered in a car in one day with all sites along the trails being located near the road or close to parking lots.

UNESCO's Geoparks

A major tool for geo-development can be fostered through UNESCO's Global Network of National Geoparks (UNESCO 2006). It provides a platform for an active cooperation between experts and practitioners in geological heritage. Under UNESCO's umbrella, and through exchange between the global network partners, important national geological sites gain worldwide recognition and profit through the exchange of knowledge, expertise, experience and staff with other Geoparks.

6. Geotourism's Challenges

As with any form of new tourism development, there are a number of issues related to its growth. They include the meaning ascribed to the word Geotourism, fostering community involvement, discerning geotourists, delivering quality products, and sustainability.

The Name 'Geotourism'

An issue central to the development and growth of geotourism globally is the meaning ascribed to the word geotourism. Generally it is understood to be 'geological' tourism but the US National Geographic continues to use the word to mean 'geographic' tourism. Type the word geotourism into google and the first entry that comes up is wikipedia's definition based on the National Geographic one. 'Geotourism is best practice tourism that sustains, or even enhances, the geographical character of a place, such as its culture, environment, heritage, and the well-being of its residents. This definition is confusing to the movement and is completely out of sync with the rest of the world. I call on the geotourism leaders to right this error and approach Wikipedia to insert the more accepted and universally recognised definition of the term.

Discerning Geotourists

Geotourism is a new discipline and relatively little has been written about either its supply or demand sides. However, research has recently been undertaken to explore the potential market of geoscientists to test their interest in participating in commercial geotourism products as a means of developing niche geotourism opportunities in Australia (Mao *et al,* 2009). The findings show that potential geotourists are very discerning and already have learned a lot about their geotourism destination before visiting it (Fig. 4). They also wish to further increase their knowledge of geological sites and landforms whilst onsite. Key points to emerge from the study are that comprehensive information about the site should be provided to tourists before their visit by way of websites, in brochures or information

at visitor centre. During their visit they seek accurate, quality information in road signage, exhibit boards, maps and by tour guides.

Figure 4: Discerning Geotourists Purnululu World Heritage Region, Australia

Delivering Quality Products

Two examples of quality geotourism attractions are being developed in Iceland. They are 'Bridge Between Two Continents' on the Reykjanes peninsula and the 'World of Fire' buried village, on Heimaey, in the Vestmannaeyjar Islands (Dowling 2008b). The Bridge Between Two Continents is situated on the lava-scarred peninsula where two of the Earth's tectonic plates split. The 'bridge' spans the two continents and is situated in the Alfagja rift valley, a chasm marking the boundary of the Eurasian and North American continental tectonic plates. Crossing the bridge takes visitors from North America to Europe (Fig. 1).

The 'Eldheimar – World of Fire' geotourism attraction is based on a 1973 eruption which continued for five months engulfing 400 houses in lava and tephra. The attraction aims to eventually excavate fourteen of the former buried houses which were buried in tephra by the eruption. At present excavations have commenced and the tops of some houses are exposed. Interpretive signs have been erected and it is already attracting many visitors. The excavation project has been called 'The Pompeii of the North'.

Sustainability

Another key issue is that of environmental (ecological, cultural, and economic) sustainability. Since the natural environment underpins geotourism, it is essential that it be protected and conserved. Geotourism activity that degrades the environment, adversely affects the local community or fails to return worthwhile economic benefits, is not sustainable in the long term. Thus it is important that geotourism operators undertake best practice methods to minimise adverse environmental impacts caused by visitor activity, transport and facility use. In addition the need for environmental protection provides a compelling argument for governments to put more money and resources into geological conservation and protection.

7. The Future

I predict that the face of the future of tourism generally will be shaped by alternative forms of tourism especially geotourism, which I see as the 'new' ecotourism. Geotourism provides the opportunity for many countries and regions within them to promote an identity that is unique to that place. It can create new and exciting tourism experiences, promote excellence in tourism, present and protect geoheritage, benefit local communities, and encourage commercially successful and environmentally sound tourism operations.

Geotourism can also act as an exemplar for other forms of environmentally responsible tourism, promoting best practice in planning, design, management and operation. Any geotourism development should capture this vision by incorporating the following key elements:

- geotourism is dependent on geoheritage,
- geological protection and geoconservation are prerequisites for the development of a geotourism industry,
- geotourism enhances awareness and appreciation of the geological environment,
- geotourism should add to community wellbeing,
- geotourism should add to a sustainable, viable tourism industry,
- geotourism can be an exemplar for other forms of tourism.

The key to capitalising on the potential benefits offered through geotourism development is to maximise the opportunities and minimise the adverse impacts through environmentally sustainable development planning and development. If this is carried out then a sound base will have been established for geotourism to flourish in harmony with the natural and cultural environments on which it depends.

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GEOLOGICAL HERITAGE AND GEOCONSERVATION IN PORTUGAL

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1. Introduction

During the last decade, geoconservation in Portugal has begun to increase its importance and to make its appearance in different domains. Some 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, etc. Nevertheless, geoconservationists still battle for the real involvement of the Institute of Nature Conservation and Biodiversity (INCB, the national institution responsible for protected areas management), which has no strategy for geoconservation. This paper aims to present a brief updated status of Portuguese geoconservation, emphasising the legal setting and the main initiatives.

2. 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.

Nevertheless, Portuguese environmental legislation began to include geoconservation principles only in 2000. 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 recent law on Nature Conservation and Biodiversity (2008). Following ProGEO-Portugal's proposals, for the very first time "geosites" 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 a felony subject to penalties. 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 and the Natura 2000 Network and National Ecological Network regulations achieve indirect geosites protection.

3. National initiatives

3.1. Geosites inventory

Present knowledge about Portuguese geological heritage is dispersed and incomplete justifying the urgent establishment of a geoconservation strategy by the geological community. For instance, a national geosites inventory has never been conducted using a systematic methodology by any institution with legal responsibility to accomplish this task. This is

the main reason why a working group comprising geoscientists from twelve Portuguese institutions is developing a three-year project aimed at the identification, classification and conservation of the most relevant geosites by Portuguese authorities. Amongst the different outcomes expected for this project (sponsored by the national science agency) we emphasize the following: 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 IUGS and ProGEO. 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 with nature conservation, land-use planning and tourism; iv) publication of an illustrated book about the Portuguese geological heritage.

The first aim of this geoconservation strategy is complete 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-nine frameworks were defined, according to their scientific value, at both national and international levels, resulting from a discussion forum within the working group. 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 up-to-date 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 of conservation. Constituting 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 of 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 are proposed by geoscientists with expertise in each geological context.

In the Azores, 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 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.

3.2. Geosites conservation

Protected areas

The protected areas network covers about 8% of the surface of Portugal's mainland. Presently, 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 have 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.

All seven Natural Monuments have been designated for their geological features. Dinosaur footprints at Ourém, Carenque, 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 present interesting geological features but, in most cases, they are not included in the management plans or conservation projects.

Geoconservation Award

Considering that the Portuguese municipalities are being more active in geoconservation compared with the INCB, 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.

The criteria taken into account in making the award to a municipality are based on the following actions: i) geosites inventorying and corresponding scientific support; ii) implementation of geosite conservation actions; and iii) valuing and interpretation strategies. Six 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.). Finally, Porto Municipality received this distinction in 2009 for the conservation and interpretation facilities of the urban geosite "Foz do Douro Metamorphic Complex".

3.3. Education and training

One of the most remarkable aspects of Portuguese geoconservation is related to educational issues. 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.

Contact with the general public is also promoted. Presently, several educational and interpretation facilities are available in Portugal (table 1), despite the fact that, for some of them, the link with geoconservation is not clearly expressed.

3.4. Geoparks

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 EGN/GGN (2006), being one of the largest and most active geoparks in Europe. By the middle of 2009, the Arouca Geopark was the second Portuguese geopark to enter these 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) and the Porto Santo Geopark in the Madeira Archipelago (under the direction of the respective municipality), both with the support of national universities and Naturtejo and Arouca Geoparks.

FACILITIES	LOCATION	THEME
Algar do Carvão	Terceira island (Azores)	Volcanology
Algar do Pena	Alcanede	Karstic caves
Carsoscópio (Ciência Viva Centre of Alviela)	Alcanena	Karst features
Caves and Volcanism Centre	São Vicente (Madeira)	Volcanology
Cova dos Mouros Mining Park	Alcoutim	Mining
Ciência Viva Centre of Estremoz	Estremoz	Geology
Geological Interpretation Centre of Canelas	Arouca	Giant trilobite fossils
Geological Museum	Lisboa (Geological Survey)	Mineral, rock and fossil samples
Geological Museum	Vila Real (University of Trás-os-Montes e Alto Douro)	Mineral, rock and fossil samples
Interpretation Centre of Capelinhos Volcano	Faial island (Azores)	Volcanology
Interpretative Centre of Foz do Douro Geological Trail	Porto	Pre-Cambrian metamorphic complex
Iron Museum	Torre de Moncorvo	Mining heritage
Lime Route and Museum	São Vicente (Madeira)	Limestone (science/ applications)
Lourinhã Museum	Lourinhã	Dinosaur fossils
Machado Fagundes Volcanological Museum	Terceira island (Azores)	Volcanology
Mineralogical and Geological Museum	Coimbra (University of Coimbra)	Mineral, rock and fossil samples
Mountain House	Pico island (Azores)	Volcanology
National Natural History Museum	Lisboa	Mineral, rock and fossil samples
Ourém/Torres Novas Natural Monument	Fátima	Dinosaur footprints
Palaeozoic Park	Valongo	Trilobite fossils and mining heritage
Serra da Estrela Interpretation Centre	Seia	Granitic landscape and glacial morphology
Stone Museum	Cantanhede	Limestone (science/ applications)
Torres Cave	Pico island (Azores)	Volcanology (lava tubes)
Volcanological and Geothermal Observatory of Azores	São Miguel island (Azores)	Volcanology

Table 1: Portuguese educational and interpretational facilities, directly and indirectly, related with geological heritage.

4. 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 the geosciences. All these successful steps are due to the development of collaborative work between experts from different institutions grouped together under the ProGEO-Portugal structure. Nevertheless, there are still two major faults: there is no structured strategy integrating the inventory, conservation, valuing, interpretation and monitoring of geosites, and there is no proper national institution responsible for the implementation of such a geoconservation strategy. Despite this, 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.

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UNESCO AND THE GLOBAL GEOPARKS NETWORK - GEOLOGICAL HERITAGE AND SUSTAINABLE DEVELOPMENT WORLD WIDE

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UNESCO, the United Nations Educational, Scientific and Cultural Organization is currently establishing an international network of national Geoparks to promote territories around the world which integrate significant examples of the Earth's geological heritage in a strategy for regional economic sustainable development. The *Global Network of National Geoparks* or short *Global Geoparks Network* (GGN) (Fig.1) provides a platform of cooperation and exchange between experts and practitioners in geological heritage on a world wide scale. Under the umbrella of UNESCO and through cooperation with global network partners, important national geological sites gain worldwide recognition and profit though exchange of knowledge and expertise with other Geoparks. The establishment of Geoparks on country level is based on a strong concept and political will, financial long-term support, and sound professional management structures.

Figure 1: Global Geoparks Network logo.

The issue of protecting and developing geological heritage within the Geoparks initiative is of special interest to UNESCO due to the fact that it is an excellent tool for educating the broad public in an 'easy manner' about the environment and the Earth sciences. Furthermore, the record of the Earth's history must be conserved because of its aesthetic, cultural, scientific significance and its potential to generate income through sustainable economic development. UNESCO enjoys the unique position of being the only agency within the United Nations System to have a specific programme on Earth sciences and capacity building in geosphere–related areas. Its new Division of Ecological and Earth sciences - in cooperation with international partners - is committed to support ad hoc efforts within individual Member States as appropriate. It is against this background that Geoparks activities and the creation of a UNESCO Network of National Geoparks can to be considered as complementary to the 'World Heritage' and the 'Man and the Biosphere Reserve' programmes.

The concept of the Geoparks initiative is directly in line with the mandate of UNESCO (the **U**nited **N**ations **E**ducational, **S**cientific and **C**ultural **O**rganization) as it is striving to combine science, culture, education and communication under a new innovative concept:

Education - Popularization of science and a broad range of educational activities are going on in all Geoparks for all groups of populations. Programmes for pupils and adults are informing about geology and Earth history, general environmental matters, like climate change or biodiversity, but also cultural history and local traditions.

Science - The science part is represented by geological settings and academic backing-up of research going on in Geoparks.

Culture - Cultural aspects, significance and traditions of a region are of high importance for the concept of Geoparks and while preparing a Geopark project. Tangible culture, local products, as well as intangible culture like traditions, customs, music, are an integrate part of the holistic concept of Geoparks.

Communication – Without a sound communication concept all the above cannot function. Communication is therefore an essential part within Geoparks and members of the Global Network are not just members of a simple list but actively communicating/networking with each other across geological and continental borders, leading to cooperation projects, and true exchange.

In 2000, the European Geoparks Network (EGN) was founded, four years before the GGN came alive within UNESCO and already 34 European members are participating in the GGN, following an official agreement whereby the EGN was given responsibility for regulating membership for the Global Geoparks Network in Europe. The growing interest in the Geoparks initiative makes the Global Geoparks Network community gaining in weight and numbers. More and more countries are interested in the Geoparks idea and are planning Geopark projects. Although currently only 18 countries have established
Geoparks all over the world, many new regions are in the process of preparing Geoparks which will spread the network over continents like the Americas or Africa.

UNESCO provides the global framework to protect and guide the global activities, with respect to Member States' interest. UNESCO has the chance to be in the driver's seat and lead this very attractive and popular (geo-scientific) outreach initiative which has the power to release the Earth sciences from their ivory tower and make them a living, dynamic force. To host the 'Global Network of National Geoparks' at UNESCO assures the guiding role of this UN-Organization on the political level, as standard setter. The Geoparks concept is truly innovative for education, science, culture and communication, which integrates sustainable development of local communities.

Network Members (July 2009):

- Australia (1)
  - Kanawinka
- Austria (1)
  - Nature Park Eisenwurzen
- Brazil (1)
  - Araripe Geopark
- PR China (20)
  - Mount Lushan Geopark
  - Geopark Wudalianchi
  - Songshan Geopark
  - Yuntaishan Geopark
  - Danxiashan Geopark
  - Shilin Geopark
  - Zhangjiajie Geopark
  - Huangshan Geopark
  - Xingwen National Geopark
  - Hexigten National Geopark
  - Yandangshan National Geopark
  - Taining National Geopark
  - Fangshan Geopark
  - Leiqiong Geopark
  - Funiushan Geopark
  - Wangwushan-Daimeishan Geopark
  - Jingpohu Geopark
  - Taishan Geopark
  - Longhushan Geopark
  - Zigong Geopark

- Croatia (1)
  - Papuk Geopark
- Czech Republic (1)
  - Bohemian Paradise Geopark
- France (2)
  - Reserve Geologique de Haute Provence
  - Park Naturel Regional du Luberon
- Greece (2)
  - Petrified Forest of Lesvos
  - Psiloritis Natural Park
- Germany (6)
  - Vulkaneifel European Geopark
  - Nature park Terra Vita European Geopark
  - Geopark Swabian Albs
  - Geopark Harz Braunschweiger Land Ostfalen
  - Mecklenburg Ice age Park
  - European Geopark Bergstrasse-Odenwald
- Iran (1)
  - Qeshm Island
- Italy (4)
  - Madonie Natural Park
  - Parco del Beigua
  - Parco Geominerario Sardegna
  - Adamello-Brenta Geopark
  - Rocca di Cerere
- Malaysia (1)
  - Langkawi Geopark
- Norway (1)
  - Gea-Norvegica
- Portugal (2)
  - Naturtejo Geopark
  - Arouca Geopark
- Republic of Ireland (1)
  - Copper Coast
- Rumania (1)
  - Hateg Country Dinosaur Geopark
- Spain (4)
  - Maestrazgo Cultural Park
  - Subeticas Geopark
  - Sobrarbe Geopark
  - Capo de Gata
- United Kingdom (7)
  - Marble Arch Caves & Cuilcagh Mountain Park
  - North Pennines AONB Geopark
  - North West Highlands - Scotland
  - Fforest Fawr Geopark - Wales
  - Lochaber - Scotland
  - English Riviera Geopark - England
  - Geo Mon Geopark - Wales

1. Geoparks and Tourism

UNITED BY NATURE FOR THE PEOPLE

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The Geopark Naturtejo Meseta Meridional has an entirely new concept in the view of the Portuguese tourism. This destination of Nature Tourism seeks to promote the bonds of communion between culture and landscapes linking the Municipalities of Castelo Branco, Idanha-a-Nova, Nisa, Oleiros, Proença-a-Nova and Vila Velha de Ródão, in favour of a sustainable development. An apparent monotony of flatness, broken only by the harsh mountains and the depth of their river valleys, the Geopark Naturtejo leads us to discover the landscape that characterized the 4600 Km^2 of its territory, and which now wishes to be extended to the territory of Portalegre municipality, in the continuity of the Alto Alentejo, that only the Municipality of Nisa represents. This significant land area has a main role in Portuguese Centre and Alentejo Tourism.

The Geopark offers today a vast and rich Natural, Historical and Cultural Heritage, natural destinations, 16 geomonuments that contextualize 600 million years of Earth's dynamics, protected areas due to their biological diversity, Schist Villages, Historical Villages and 70 classified monuments, reporting an ancient unity between Men and Nature.

A territorial unit as large as diverse in the points of view of geological and geomorphological evolution of the landscapes, their biodiversity, history, its architecture, traditions and customs of their people that enriches the immaterial patrimony widespread in their language, art and music. This heritage is an important part of the Portuguese culture and contributes during millennia until today for their enrichment and distribution in the world. All these are assets that Naturtejo as a promotional tourism company, responsible by the Geopark Naturtejo, give to know to Europe and the World also.

This concept of Geopark, rather than the classification method that characterizes the area, with well defined limits, is a project of sustainable development, based on its heritage, to create wealth, influence the territory's GDP (PIB), create jobs and ensure the preservation of that heritage for future generations. The geosites that characterize the Geopark as well as the biodiversity and historical and cultural heritage, are those values to be preserved with the action of local people and the union of public and private actors, nurture and preserve what we have of more genuine and authentic. Goals such as sustainable development, training, conservation and scientific development, education, exploring excellent methods and activities organization for all the people, communicating knowledge and practice of environmental and cultural concepts, all of this is so fundamental in defining the foundation bases of Naturtejo Geopark.

THE RISING OF THE GEOPARKS' CONCEPT, ACTIVITIES AND PROJECTS IN BRAZIL

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The acceptance of Geopark Araripe (Herzog et al., 2008) as an effective member of UNESCO Global Geoparks Network, the first in the Americas and Southern Hemisphere, has gained notoriety in Brazil and raised the interest about this new kind of protection of natural and cultural heritage under UNESCO auspices, mainly dedicated to geological heritage conservation, Earth Sciences education, and local sustainable development.

In 2007, the Ministry of Culture honoured the set of activities of Geopark Araripe with the Brazilian most prestigious cultural prize, the Rodrigo Mello Franco de Andrade Prize, in the natural and archaeological heritage preservation category.

All of these activities raise the attention and interest of individuals who are working in different institutions and states of Brazil, in the subject of protection and diffusion of Brazilian geological heritage. In addition, this Earth heritage (including all the branches, like geomorphology and paleontology) had not yet been explicitly identified as cultural heritage. Also the "geopark" brand begins to be viewed as a good pathway to overcome an unbalanced situation, where the geological heritage is less recognized than the biological counterpart, probably one of the reasons that Brazil is worldwide known mainly as the country of mega-biodiversity.

This growing interest conducted to a series of qualified events, with the frequent participation of members of the Global Geoparks Network. Started in Rio de Janeiro and São Paulo, these first short events quickly expanded to conferences, courses and workshops devoted to specific topics of Geoparks and the discussion of new projects in Brazil. We can cite the follow examples:

a) a thematic symposium at the 44th Brazilian Geological Congress (Curitiba, Paraná State, October 2008), entitled *Geological Monuments, Geoconservation, Geotourism and Geoparks*, with 61 scientific contributions and the special participation of the European Geopark Network Coordinator. Also during this event, the short-course *The process of a Geopark creation* was conducted by a representative of the Geopark Araripe;
b) an International Seminar on Geoparks and Geotourism (Fortaleza, Ceará State, November 2008);
c) workshops dedicated to the discussion of the Bodoquena-Pantanal Geopark project,

first at Bonito town (September 2007) and recently at Campo Grande City (June 2009), both in Mato Grosso do Sul State, and of the Quadrilátero Ferrífero geopark project, at Belo Horizonte City (June 2008). At the Bonito meeting was produced the document "Serra da Bodoquena Chart" (or "Cultural Landscapes and Geoparks Chart");

d) a workshop entitled *Geopark: strategy of geoconservation and educational projects*, promoted by the state universities of São Paulo State, at São Paulo City (July 2009), focused on the educative mission of the geoparks;
e) intensive courses to improve the understanding of basic topics like Earth Heritage, Geoconservation and Geotourism, conducted by top-skilled professors from the Master Course on Geological Heritage and Geoconservation of the Minho University (Portugal). These courses have been promoted in several Brazilian states (Bahia, Rio de Janeiro, Paraná, Santa Catarina) from the initiative of federal and state universities.

Inspired by the successful pioneer project Geopark Araripe, national and local initiatives over Brazil are now working to establish new geoparks in the country, where the most advanced projects are the Bodoquena-Pantanal, the Campos Gerais, the Quadrilátero Ferrífero and the Alto Vale do Ribeira. The main geological features of these areas are:

1) Bodoquena-Pantanal (Mato Grosso do Sul State)

The area of this potential geopark is partially superposed with the so-called Pantanal wetlands, recognized as a World Natural Heritage site. Here we can find the geological record of the terminal Neoproterozoic Era as well as the Quaternary evolution of the Pantanal and the karstic landforms of the Serra da Bodoquena, with seven points accepted by the Brazilian Commission of Geological and Paleobiological Sites (SIGEP) (Boggiani & Lima, 2008).
Diamictites and iron formations (these with mining activities) are attributed to the Marinoan glacial event, with some authors interpreting them in the context of the "Snowball-Earth" Theory. The first steps of the diversification of metazoan life are represented by Late Ediacaran fossils *Corumbella* and *Cloudina*, while stromatolites exemplify the predominant life-style in the Precambrian times. Crystalline streams, abundant carbonate tufas in rivers and hypersaline lakes in the Pantanal, all of them testify aspects of the rich water resources.

2) Campos Gerais (Paraná State)

The "Campos Gerais do Paraná" is located at the dip slope of a cuesta landform, around the regional cliff that defines the "Segundo Planalto Paranaense" border to the east, at the central portion of the Paraná State (Guimarães *et a*l., 2008). This region has a very special geodiversity, with a geological heritage composed by: Devonian marine fossils (invertebrates of the Malvinokaffric Realm and ichnofossils like *Cruziana*, *Rusophycus*, *Planolites* etc.); a great number of stratotypes from Paleozoic units of the Paraná Basin (one of the principal intracratonic basins of South American Platform); a very well preserved record of the Gondwana glaciogenic features of Permo-Carboniferous age (diamictites, striated pavements, dropstones).
But more spectacular is the geomorphological heritage, with tectono-magmatic controlled canyons (Cretaceous dyke swarm, faults and fractures related to the South-Atlantic opening), hundred meters high escarpments, a lot of rapids and falls, and a world-level example of quartz-sandstone regional karstic landscape, with features like ruiniform relief, underground segments of water streams, and sinkholes, among others.

3) Quadrilátero Ferrífero (Minas Gerais State)
The name of the area of this probable geopark (and also the proper state name) points to the deep connection with the geodiversity. Here is an excellent window to the beginning of the geological history of the Earth, with very good expositions of Archean and Paleoproterozoic rocks.
Undoubtedly the geological relevance of the "Quadrilátero Ferrífero" is strongly related to the iron and gold mineralization (and other ores, like manganese), with a very rich mining heritage. Another important group of Earth heritage is the mountain ranges that individualize the landscape of this segment of Minas Gerais State.

4) Alto Vale do Ribeira (São Paulo and Paraná States)
Situated at the region of the political boundaries of the São Paulo (at south) and Paraná States, the area covers a wide span of the geological time table, being of great relevance for the understanding of the Brazilian Precambrian tectonic evolution (Theodorovicz, 2008).
The predominance of metalimestone rocks led to the development of a huge concentration of caves, with a didactic, scientific, ecological, geotourist and aesthetic valuable karstic landscapes. Also gold and lead-silver-zinc mineralization, with a long history of mining activity (now almost totally inactive), complete a scenery where the geological and the history of mining heritages overlap.

But if a high valuable set of geological attributes are critical to the existence of a geopark, also it is not sufficient. There is the necessity of a linkage with the people who live at the territory, with educational and tourist activities, besides the valuing of intangible concerns, all playing a decisive role to reach the objective of harmonic development.

The present stage of elaboration of geopark projects in Brazil mirrors the concerns above mentioned where the headers of the proposals belong to universities and science agencies, and state or national geological surveys and cultural institutes.
An interesting example where we can find a connection with cultural aspects is the planning of an essentially urban geopark, the Baía da Guanabara Geopark in the Rio de Janeiro State, highly focused on the concept of Cultural Landscape. 600 million years of geological history, since a continental collision, passing by the opening of the Atlantic Ocean, up to the modern processes of landscape modeling, bring together an augen gneiss, diabase dykes and landforms like the iconic tourist sites of the "Pão de Açúcar" and "Corcovado".
This entire geological heritage must be seen closely associated with the cultural heritage, since they: a) build a local and national identities; b) are used, mainly the augen gneiss from quarries, as an important dimension stone in architectural monuments of the Rio de Janeiro City; or c) controlled, at the early beginning, the so distinctive Brazilian cultural expression: the "samba"! It was at sculptured stairs on this particular rock-type (at the "Pedra do Sal" site) that slavers gathered, including to religious ceremonies and to sing their traditional and new songs (Mansur et al., 2008).
The activities above cited have contributed to the dissemination of the geopark concept in Brazil and to the promotion of new projects. Some of the next steps include the adjustment and equalization of procedures and public talks from the people who are elaborating some geopark proposals. Exchange of well-suited experiences and the identification of common difficulties will serve to the consolidation of the present projects and will guide new works. These appointments strongly show how pertinent and necessary is the creation of a national geoparks network. One movement in this direction was the establishment of a discussion group at the world wide web (hosted at http://groups.google.com.br/group/rede-brasileira-de-geoparques), dedicated to the formation of a Brazilian Geoparks Network.

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GEOTOURIST TRAILS IN GEOPARK NATURTEJO

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1. Pedestrian Trails

Geopark Naturtejo promotes geodiversity through 16 *geomonuments* or geosites with high relevance and monumental character, which represent the geological dynamics of the region since Proterozoic (ca. 600 million years) times. This outstanding geodiversity can be discovered through signalled pedestrian trails, boat and kayak trips, mountain bike rides, adventure sports (slide, rappel, hiking), thematic visits (Visit to the Granite Boulders, Visit to the Roman Gold Mine, Visit to the Holy Waters, etc) and educational programmes.

Pedestrian trails are a nature-friendly activity made in natural or traditional paths and signalized allowing to the trekkers to walk through mountains, valleys, plains, forests, and farms and, at the same time, evolving them in the Nature. This activity has been growing very fast in Portugal and almost all the municipalities are investing to develop trail networks, one of the best ways to really and deeply know a territory, its nature and history.

Pedestrian trails make the pedestrianists raise awareness for Geodiversity which composes the landscapes. Sometimes these trails are the unique access to some important geosites, which tell the geological history of a region.

2. Geotourist Trails

In the Geopark Naturtejo, there are 439 km of signalled pedestrian trails and footpaths along all the multiple richness of the territory, including geodiversity, biodiversity, history and culture. As one of the most important trekking areas in Portugal, these paths transport the visitors not only through the landscapes but also into Time...

Of these 439 km, 103 km have relevant geological interest – Geotourist Trails (Table 1) and can be explored in educational programs and geotourist routes(Fig.1), being mainly dedicated to geological themes, such as fossils, mines or landforms. In these specific trails not only the Geodiversity is exploited but also the related historical and cultural aspects and the biodiversity which altogether compound the Geopark's territory.

2.1. Interpretation

The interpretation is essential in this strategy and can be done through guided visits that give to the visitor a personalized visit, full of personal stories with the interpretation adjusted to the specificities, or through panels in signalled trails. The trekker finds all over the trails signs from the Portuguese Pedestrianism Federation and also some interpretative panels that add information and help the visitor to learn the landscape (Fig.2). The panels, the leaflets and the signs provide information and interpretation to the trekker in a self-guided visit.

3. Local development through Pedestrian Trails

Pedestrian trails are somewhat a new niche in Portugal that is acquiring increasing number of participants that come not only from all the country but also abroad. These trekkers come to Geopark Naturtejo from everywhere with the propose of walk and for this they need tourist infrastructures like restaurants, tourism offices, lodging, shops to support their visit.

The "Fossils Trail" in Penha Garcia was the beginning of several improvements in the village tourist infrastructures. The trail was created in 2003 and, in the year of 2008, was visited by

11500 trekkers. During the last years several traditional houses and the Templar castle were recovered, the "Casa de Santa Margarida" guest house was opened by a local entrepreneur, and the Outdoor Company "Trilobite.Aventura" has started.

Castelo Branco	km
PR1 CTB Rota da Gardunha	17,5
PR2 CTB Caminho do Xisto de Martim Branco	9,5
PR3 CTB Caminho do Xisto de Sarzedas	15
Total	42
Idanha-a-Nova	
PR1 IDN Rota dos Abutres	10,5
PR2 IDN Rota da Egitânia	8,5
PR3 IDN Rota dos Fósseis	3
PR4 IDN Rota das Minas	10
PR5 IDN Rota dos Barrocais	7
GR12 IDN Rota da Idanha	80
GR22 Rota das Aldeias Históricas	50
GR29 Rota dos Veados	30
Total	199
Oleiros	
PR1 OLR Caminho do Xisto de Álvaro	7,3
PR2 OLR Caminho de Xisto de Álvaro	6,3
PR3 OLR GeoRota do Orvalho	9
Total	22,6
Proença-a-Nova	
PR1 PRN A história na Paisagem	8,3
PR2 PRN Os Segredos de Vale Mourão	6,5
PR3 PRN Rota das Conheiras	10,6
PR4 PRN Pela linha da Defesa	14,5
PR5 PRN Rota dos Recantos e Encantos	11,4
PR6 PRN Viagem pelos Ossos da Terra	18
PR7 PRN Rota dos Estevais	7,8
PR8 PRN Caminho do Xisto de Figueira	6
Total	83,1
Nisa	
PR1 NIS Trilhos das Jans	12,6
PR2 NIS Descobrir o Tejo	4,3
PR3 NIS Olhar sobre a Foz	5,8
PR4 NIS Trilhos do Conhal	9,8
PR5 NIS À descoberta de S. Miguel	9,2
PR6 NIS Rota dos Açudes	10,6
PR7 NIS Entre as Azenhas	6,5
PR8 NIS Trilhos do Moinho Branco	14
Total	72,8
Vila Velha de Ródão	
PR1 VVR Rota das Invasões	8
PR3 VVR Caminho do Xisto "Voo do Grifo"	11
Total	19

Total	km
Castelo Branco	42
Idanha-a-Nova	199
Nisa	72,8
Olerios	22,6
Proença-a-Nova	83,1
Vila Velha de Ródão	19
	438,5

Pedestrian Trails	438,5 km
Geotourist Trails	102,4 km

Table 1: List of the Pedestrian Trails in the Naturtejo Geopark.

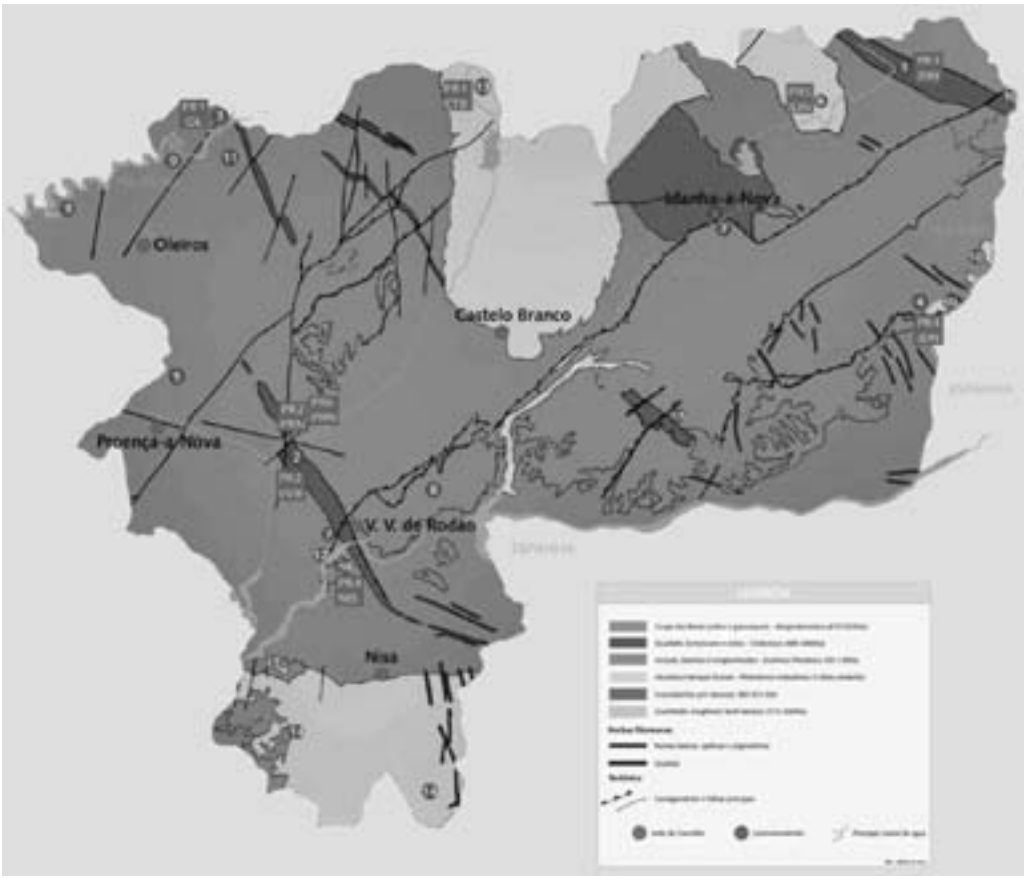

Figure 1: Geotourist Map of Naturtejo Geopark with Geotourist Trails localization.

In Orvalho village it was recently opened the trail "GeoRota do Orvalho" that is bringing cents of people to a village with two geomonuments among an important natural heritage but without tourist infrastructures. Nowadays, several investors are preparing strategies to receive these visitors all over the year. It is already being prepared a new pedestrian trail to increase the offer to this kind of geotourists.

A

B

Figure 2: Geopark trails: a –Signalization on Gardunha Trail, b – interpretative panel in the Fossils Trail..

4. Geotourist trails

4.1 .Gardunha Trail (17,4 km)

Geological interest points: boulder fields, granite morphologies, water springs, Ocreza valley, Cordilheira Central mountain range. This trail takes to the top of Serra da Gardunha, passing by rocks sculpted by weathering and erosion agents, pure and cold water springs, and waterfalls showing crystal-like water running and by water mills hidden by lush flora.

4.2.Fossils Trail (3 km)

Geological interest points: trace fossils, Ponsul fluvial gorge, Penha Garcia-Cañaveral Syncline, tectonic folds and faults, sedimentary structures. Walking through Penha Garcia village and Ponsul river valley is possible to understand the profusion of marine life that inhabited Earth, in this area, almost 500 million years ago. From Ocean to the mountain, the geological evolution of a unique landscape, from history of people and from a special culture rooted in Nature.

4.3. Mines Trail (10 km)

Geological interest points: mines, washing plant, mineralization, metamorphic contact granite-schist, Segura Fault. Through Erges river steeps the visitor finds ancient mining ore of tungsten, tin, lead, gold, barite and sees traces of technological evolution for mining exploitation.

4.4. Boulders Trail (7 km)

Geological interest points: *inselberg*, granite morphologies at meso- to mega-scales, chemical weathering, Castelo Branco Plain Surface, granite lithofacies. Walking through the typical granite landscapes with boulders of Monsanto visitor finds amazing and imposing landforms sculpted by erosion across times. Starting from the "Most Portuguese Village" it unravels all the evolution that granite rocks suffered since their formation deep in Earth, until their final exposure in a granite "archipelago" that stands slashed from the schist acrid plain.

4.5. "Conhal" Trails (9,8 km)

Geological interest points: Tejo epigenic gorge, iron and gold mines, Ponsul Fault, Arneiro Graben, quartzite ridges, arkoses and fluvial terraces. Crossing hills, contemplating the silent flight of birds and appreciating geological phenomena of Serra de S. Miguel is what the visitor can do along this trail, while appreciating Tejo valley, Portas do Rodão Natural Monument and Roman remains of the giant Conhal do Arneiro gold mine.

4.6. Secrets from Almourão Valley (6,5 km)/Travel across the Bones of Earth (18 km)

Geological interest points: Variscan tectonics (folds and faults), Ródão Syncline, Ocreza River gorge, mines, fossils. There is no better perspective of the deep Almourão gorge and of the Portas do Almourão Geomonument than from these trails, by the marvelous natural landscapes viewed from thematic viewpoints. Quartzite shows up here as a powerful upstanding rock, with an ancient history that reveals the build of a mountain that Ocreza river ripped in his path, across time.

4.7.Schist's Path "Vultures Flight" (11 km)

Geological interest points: tectonic folds and faults, Ocreza fluvial canyon, fossils, Talhadas mountain. This is a trail trough outstanding natural landscapes framed by Talhadas mountain incised by Ocreza river valley through the geomonument Portas de Almourão, a site with rocks of about 500 million years old filled with traces of an Ocean that once existed here.

4.8. Orvalho Trail (7 km)

Geological interest points: Fraga da Água d'Alta waterfalls, Água d'Alta stream, "Laurissilva" forest remains, Cabeço Mosqueiro viewpoint, Penedo das Sardas Rock. Walking along this trail the visitor crosses Água d'Alta stream valley with the last remnants of "Laurissilva" pre-Glaciar forest and a succession of cascades in Fraga da Água d'Alta, where the water was stronger than the rock. The energy spent by climb to the Cabeço Mosqueiro viewpoint is rewarded with the magnificent scenery over the surrounding mountains Alvelos, Açor, Estrela and Moradal.

4.9. Conheiras Trail (10,6 km)

Geological interest points: gold mines, quartzite ridges, fluvial terraces, deep-incised Ocreza valley. Along this trail you can discover the history of Ocreza River incision while you walk among the Roman remains of gold exploitation.

5. Conclusions

The growth of pedestrian trails is creating a strong trend inside nature tourism market. In Naturtejo Geopark there is a regular schedule of pedestrian trails involving groups from 40 to 650 participants coming from the territory but also from abroad. These trail parties involve local community and usual have local guides/story tellers apart from Geopark guides. There are regular participants that make more than 300 km to come to such events which join the sport with cultural and natural approaches. There are also specific groups coming from Spain (e.g. Madrid) by specialized tour operator partners to be amazed by, at least some of the Naturtejo Geopark's 439 km trails going into the most remote and fascinating spots of this special place of Earth.

a

b

c

d

Figure 3: a - "Fossils Trail"; b - Guided pedestrian trail in the "Fossils Trail"; c - "Conhal Trails"; d - "Secrets from Almourão Valley".

INTELLECT AND EMOTION: WATER AND GEOTOURISM IN THE EISENWURZEN GEOPARK

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With few exceptions, the satisfactions gained by the achievements of knowledge and by tourism affect totally different levels of our consciousness. The first is an intellectual procedure, the second emotionally controlled. Any form of science-based tourism needs therefore media to bridge this gap. This is also the case in Geotourism if it is understood as a touristic offer which includes the deliberate reception of geological features. Caves, large fossils of all kinds, and water exert great fascination on visitors of all ages. They are ideal media to communicate geology and meet therefore basic demands of Geotourism.

Morphological features due to water activities are among the most important geotouristic sites of the Eisenwurzen Nature Park. They comprise karstic structures including springs, caves and exogenic features, gorges and wide-spread river deposits, especially from the Great Ice Age. The geological background is communicated in general by conventional methods: By museal approaches in exhibitions and by programs for various target groups at trails and other natural sites.

Besides these Park-specific methods, communication with the public is done in the following ways:

GeoRafting. It combines sports and the fun of white-water rafting with explanations of the geological features along the river by especially trained raft-guides.

Interactive methods. Computer-based installations in cooperation with our GeoLine partner, the adjacent Gesaeuse National Park, demonstrate that geological processes are dynamic.

The playful approach: The Water Adventure Park Eisenwurzen. It is the blockbuster of the Park which mobilizes over 50.000 annual visitors, mainly families with children. Many of them have come over quite large distances. On a vast area, the visitor may joyfully experience the physical and biological properties of water by canoeing, operating locks in small streams, using all sorts of technical devices and experiencing the importance of water for historical workshops and manufactories for which the Eisenwurzen region was famous up to the 19th century.
An 11 x 9 m landscape model represents the geological approach to water activities. A thunderstorm is triggered by pushing a button. The rising of the water table in the mountains may be observed through peep-holes and springs begin to release water at hill-sides. Streams merge to rivers which finally open out into the sea. Visitors may step on the model, they may add sand to the water and get a feeling of sedimentation in rivers and estuaries. The water flow can be regulated with locks and inundations prevented with sand-bags. The model is therefore an experimental playground which has immediately been accepted by children and adults.

Special touristic packages for all ages including the visit of natural sites and the Water Adventure Park contribute to the joyful experience of water in the Eisenwurzen Geopark.

THE ENGLISH RIVIERA GEOPARK – DEVON'S NEWEST AND MOST EXCITING NEW VISITOR ATTRACTION

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In September 2007 the area of Torbay in Devon, UK became the 32nd member of the European Geoparks Network (EGN). The Torbay Geopark is known as the English Riviera Geopark (ERG) and has a strong urban characteristic with a population of 134,000 in an area of 62km^2 and 42km^2 of sea.

The Geopark territory has a rich and well-exposed geological heritage, from Devonian reefs to Pleistocene bone-caves. This geology has strong links to the history of the science and culture, not least as Torbay includes sites crucial to the initial characterisation of the Devonian Period. The area includes one of the highest concentrations of protected geological sites in the UK with 11 nationally protected sites ('SSSIs') and 15 regionally important sites ('RIGS'). A single organisation has direct responsibility for the management of the majority of these sites, as well as a range of educational and community functions linked to the sustainable use of Torbay's natural heritage.

In December 2008, the local government administrative authority, Torbay Council, engaged Close Focus Tourism Marketing Consultancy to review its current tourism strategy and develop a five year tourism strategy to arrest the decline and reinforce the perception of the English Riviera as a leading destination.

In the review, the consultants identified the English Riviera Geopark as Devon's new, iconic and all year round visitor attraction and a very special place to visit. The Geopark is an integral, not separate, component of the English Riviera Brand and the review clearly identifies the Geopark as one of the core growth areas for the next 5 years for the English Riviera. The will now be promoted as Devon's newest and most exciting new visitor attraction.

The unique combination of a superb geological resource, a well established and mature tourism infrastructure, an innovative conservation trust with well-developed partnerships with public, private and voluntary sectors, makes the English Riviera Geopark well placed to develop in a dynamic and successful way within the Global Geopark Network.

THE INTERNATIONAL APPALACHIAN TRAIL – CROSSING THE ATLANTIC

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The key note speech by Klaus Liedtke of the National Geographic Magazine at the 2008 Osnabruck Global Geopark conference was a call to inspire the public's imagination. His theme of marketing was based on the creation of relationships between iconic ideas, Geology, and Geoparks.

The proposal to 'cross the Atlantic' with a world renowned footpath using Geology as the link is more than just a superb marketing opportunity. This is a chance to explain the creation of the North Atlantic, to increase the awareness and interest in geological processes and to the raise profile of the Geopark movement.

North America's longest National Park is the Appalachian Trail. This 2,175 mile footpath runs along the eastern US states from Georgia to Maine and was originally conceived in 1921 but not completed until 1937. It has recently been estimated that there are 40 million visits to hike some of the Appalachian Trail every year!

In 1994 the idea of an *International* Appalachian Trail was proposed to ...'connect two countries and cultures' linking together the bioregion on both sides of the US – Canada border. Since 1995 the trail has continued to be extended northwards and in 2009 a link in the underlying Geology brought about the idea of extending it across the Atlantic.

Lochaber Geopark, North West Highlands Geopark and the British Geological Survey are working with enthusiasts, outdoor professionals and politicians to examine the possibility of extending this iconic brand of the Appalachian Trail into Scotland. The introduction of this idea could affect present identification and there is, therefore, a need for careful assimilation into the existing footpath recognition.

This presentation looks at the story of the International Appalachian Trail and to examine how Geology provided a vital key to making a 'tectonic' shift in the idea of linking countries and cultures.

A NEW STRATEGY TO PROMOTE SUSTAINABLE TOURISM IN BEIGUA GEOPARK (ITALY)

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On becoming an international recognized Geopark (member of the European Geoparks Network and of the Global Geoparks Network assisted by UNESCO) in 2005 the Beigua territory has obtained increasing attention from local authorities, tourism organization and operators, entrepreneurs, farmers, universities and research institutions, schools, volunteers and environmental associations.

A new local territorial framework needs a new strategy to promote sustainable tourism. In that direction Beigua Geopark launched a well-organized network of touristic offers as a result of a cooperative and participate debate with all the stakeholders in the area.

Connecting landscape, cultural heritage, speciality traditional foods, sports facilities with unique geological and geomorphological features, Beigua Geopark presents multiple services to encourage regional economical development.

Several actions have been developed to promote alterative opportunity for sustainable and responsible (geo)tourism. In the Beigua Geopark outdoor sports find wonderful and well equipped training grounds for hiking, nordic walking, orienteering, climbing, bouldering, canyoning (Fig. 1), paragliding, horse trekking, mountain-bike, etc.

Figure 1: "Canyoning activity in Beigua Geopark"

Monumental buildings, historical houses, castles and rural architecture increase cultural tourism and give additional opportunities with gastronomy and local products.

Educational programmes on a regular basis, school field trips and scientific training courses extend and deseasonalize the tourism offer in the area.

New flexible transport services and a quality network of touristic facilities (promoted and monitored by the Geopark authority) guarantee best performances and customer satisfaction.

Beigua Geopark is also strongly involved in coming projects to promote its territory in collaboration with the Regional Tourism Agency acting through innovative tools and methodologies.

Finally a renewing challenge to emphasize and increase (geo)tourism in Beigua Geopark as alternative opportunity to give benefits at a local and regional level, with a stronger chance to combine the enhancement and the conservation of the geological, cultural and traditional heritage of the area.

DEVELOPING A VIRTUAL GEOPARK – HOW GOOGLE SOFTWARE CAN BE USED TO PROVIDE A GEOPARK EXPERIENCE FOR DISABLED PEOPLE WITH MOBILITY PROBLEMS.

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Most Geopark events and activities involve physical activity, whilst the majority of resources (maps, guide books, trail leaflets etc.) are designed to ensure that ramblers or walkers will be able to understand the geoheritage they are crossing, or to guide them to specific sites or features. However many elderly or disabled people are not able to visit the real thing, yet may well have an interest in the landscape and geology not only of their local area, but of areas across Europe.

This paper presents work using Google Maps, Google Earth and Picasa online software to create a virtual Geopark for Geomon/Anglesey Geopark. Trail leaflets have been converted to virtual tours, individual sites are illustrated using images and descriptions, and a forthcoming book following the long distance coastal footpath around the perimeter of the Geopark is transformed into a virtual tour of the coastline.

The creation of these online resources is relatively simple, following some of the basic rules of HTML, the internet source language, and the tools contained within the software itself. An image bank or photo-album has been created using online tools like Picasa or Flickr from which images can be inserted into the Google Earth resource.

Users simply install a KML or KMZ file from the Geomon website and upload the information onto Google Earth (or map) and can then view any of the sites or follow trails.

There is an increasing need to provide resources for disabled people following the second Disability Discrimination Act passed by the UK parliament in 2005, the adoption of sections of the EU Human Rights Directive across member states, and the UN Convention on the Rights of Persons with Disabilities which has been signed by 139 countries worldwide, but not too many EU member states as yet!

TERRAGAZE MOBILE, A GPS-POWERED GEOLOGICAL GUIDE: INFORMATION DEPENDING ON WHERE YOU ARE

ANDREA BAUCON[1, 2]

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1. Introduction

To the geologist's mind, the landscape comes alive and talk. Every stone, every form of cost or mountain or valley tells its story, evoking the vicissitudes of its history and its becoming.

- Michele Gortani (1956), pioneer of Italian Geology

Every geologist felt the emotion of Gortani's words when interpreting a landscape. Indeed geologists read intriguing stories through the rocks, and understand the millernary processes that shaped the Earth.

Few tourists own the scientific and cultural tools for interpreting autonomously the landscape. Consequently, a question might arise: how to render these emotions during an outdoor geotourist experience?

Traditional media fails to fulfill this target:

- Printed field guides (books, pamphlets,...) provide limited multimedia experiences, as texts and pictures are the only possible media. Moreover, the information is not geolocalized. Indeed books don't provide specific content depending on where visitors are, and what they are viewing;

- Panels indicate geological features on the field, but they invalidate the wilderness of an area and oblige the tourist to visit a defined set of geotopes. Moreover, they represent a notable break in the outdoor experience;

- Museums and interpretative centers provide interesting multimedia experiences and prepare the tourists to the outdoor activities. Nevertheless, they are still indoor experiences and for this reason they lack of the magic of a walk in the wilderness.

2. *TERRAGAZE mobile*: an overview

The previous point highlighted a gap in outdoor geotourist experiences. Indeed a comprehensive tool for outdoor geoturism is lacking. With this evidence in mind, *TERRAGAZE mobile* has been developed (Baucon & Neto de Carvalho, 2008).

TERRAGAZE mobile (Fig. 1) is a portable multimedia system directed specifically to geotourism and geoscience education. It is a geological guide running on a consumer electronics device, capable of displaying several kinds of media (texts, audio, pictures and animations; Fig. 1a). *TERRAGAZE mobile* is dedicated to outdoor enthusiasts interested in visiting geologically significant locations. It is a great tool to accompany hikers and trekkers, but its flexibility finds use also in cycling and automotive geotourism.

Recently, *TERRAGAZE mobile* has been improved with GPS support. With this technology, *TERRAGAZE mobile* provides specific content to visitors depending on where they are, and what they are viewing.

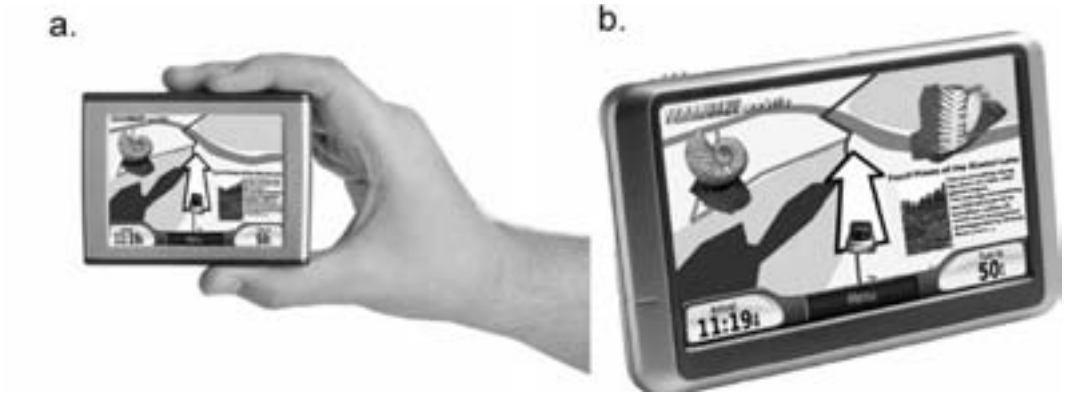

FIGURE 1: TERRAGAZE mobile: **a**. TERRAGAZE mobile is a pocket multimedia hand. Its technical specifications (width: 120 mm, height: 76 mm, weight: 180 g) make it ideal for outdoor geotourism. **b**. Close-up of a device powered by TERRAGAZE mobile.

3. Location-based media: specific geological information depending on your position

GPS technology allows precise determining of one's position by accurately timing the signals sent by the GPS satellites high above the Earth.

GPS support allows *TERRAGAZE mobile* to provide relevant information to tourists depending on their location. In other words, specific information (texts, audio files, pictures, animations) automatically begins to play when the visitor pass by a geological point of interest. With location-based media, *TERRAGAZE mobile* creates immersive geotourist experiences and allows geotourists to interpret autonomously the cultural and natural heritage (Fig. 2). Together with this revolutionary function, *TERRAGAZE mobile* offers great tools for route planning:

- It finds the closest geosite respect to the visitor's position,
- geological information is browsable off-place (the visitor can plan its route depending on what features he intends to visit).

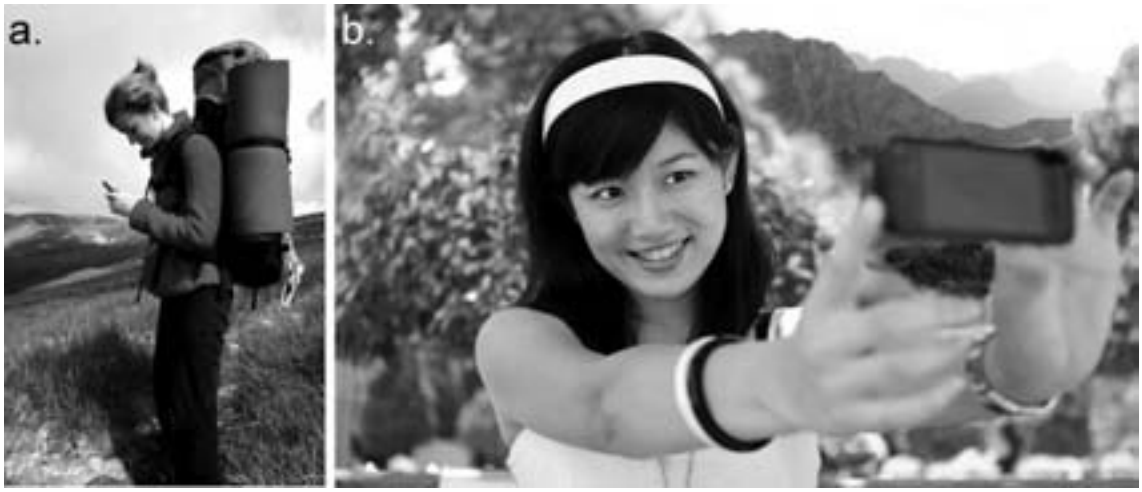

FIGURE 2: TERRAGAZE mobile: the ideal solution for geotourist hiking. a. TERRAGAZE mobile is designed for accompanying hikers trough the exploration of the geological heritage. b. With a GPS-powered geological guide in the palm of their hands, visitors receive content tailored to their current location.

4. Realizing a *TERRAGAZE mobile* solution: field data acquisition

Every *TERRAGAZE mobile* solution is specifically tailored to client's Geopark as it represents a custom geological guide. To achieve this result, a detailed geotourist survey is a key-phase in the realisation of a TERRAGAZE-powered multimedia guide.
The geotourist survey consists of three phases:

1. Survey design is the key consideration in ensuring a successful geotourist program in any application. All components in the survey are carefully considered, including survey dimensions, geological heritage, project target (i.e. hikers or cyclists), accessibility, geoconservation issues, topography, and other parameters.

2. Data acquisition involves all aspects related to physical acquisition of high-quality geotourist data. GPS coordinates; photos, movies and audio are collected for including in the final multimedia guide.

3. Quality assurance services are rendered in the field for ensuring that all results are of the highest quality before departing the project area. All data are checked and verified to ensure that errors are minimized - thereby maximizing survey value.

Only after field data acquisition, software engineering is performed to develop the final product (more information at www.terragaze.com).

5. Applications

TERRAGAZE mobile delivers all the essential tools for today's field geotourists, including hikers, cyclists, drivers. For instance, the TERRAGAZE-powered players attach easily to the stem or handlebars of your bike and they are also designed for various kinds of automotive veichles (cars, motorbikes, ...).
This section collects a number of such inspiring applications of *TERRAGAZE mobile*:

5.1. Walking with *TERRAGAZE mobile*

Hikers come in the interpretative center of your Geopark where a multimedia guide (powered by *TERRAGAZE mobile*) is given for rent. This is the standard application of *TERRAGAZE mobile*: accompanying hikers and delivering information on the geological heritage of a specified area. With a GPS-powered geological guide in the palm of their hands, visitors receive content tailored to their current location. Walking with *TERRAGAZE mobile* is an intense experience as it is capable of creating engaging activities:

- leading folks to items of interest,
- expanding on various attractions or geosites by running related multi-media audio and picture clips,
- threading stories around exhibits and attractions, injecting them with new energy,
- generating pop-ups indicating show start-times or even cafeteria specials,
- overlaying new tours on existing content to provide fresh experiences thereby encouraging repeat visitors,
- absorbing people of all ages in entertaining contests and games.

5.2. Geological bike tour

It is a leisure travel activity which involves travelling by bicycle and exploring the geological heritage of your Geopark (Fig. 3).

The idea is to rent out bicycles equipped with *TERRAGAZE mobile* and deliver to your visitors an exciting mixture of outdoor sports, geotourism and innovative technology. With GPS-support, *TERRAGAZE mobile* provides site-specific information. Imagine: when the cyclist crosses a geological point of interest, relevant information (texts, audio and visual data) is automatically displayed. A great way to diversify your tourist offer and attract new tourists to a Geopark.

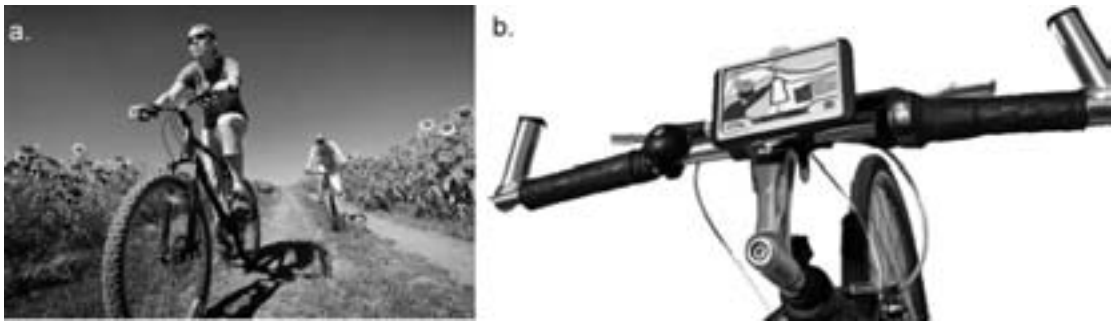

FIGURE 3: TERRAGAZE mobile and cyclotourism. a. Geological bike tour powered by TERRAGAZE mobile. b. TERRAGAZE mobile attach easily to the stem or handlebars of bicycles.

5.3. Geologic location-based games, geocaching and alternate reality games

A location-based game is one in which the game play evolves via a player's location, turning the entire Geopark in a gigantic game board. For those who are familiar with videogames, imagine to play "the Secret of Monkey Island" in the real word.

How does it work?

Imagine to play a high-tech treasure hunting game where clues are given by the *TERRAGAZE mobile* unit. For instance, the "treasure" could be a geomonument to find by solving geological riddles and quests. Create interactive narratives that use the real world as a platform to tell a story that may be affected by participants' actions. You can even set the story in the Ice Age: for instance, when the player reaches a moraine, *TERRAGAZE mobile* displays that place 10.000 years ago.

With this concept in mind, *TERRAGAZE mobile* could be also used for Geocaching, a game played throughout the world by adventure seekers equipped with GPS devices.

With *TERRAGAZE mobile*, creativity is the only limit!

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INTERPRETATION IN THE NORTH PENNINES – "THE MEMORY MAKING BUSINESS"

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Interpreting the natural world is one of the most important aspects of the working life of a Geopark. This presentation looks at the different and often innovative techniques used by the Geopark team and their partners in the North Pennines.

The presentation covers more traditional forms of interpretation using print and face to face techniques, as well as new (and now not so new) media such as audio, film, soundscapes, animation and puppetry. It also makes links between our educational programmes and interpretive activities, interpretation and tourism and also interpretation and conservation.

See women in beards, adults dressed as fairies, a human boat and more, as we explore why it's important that our Geoparks are places where interpreters lead as well as follow, and how great interpretation can leave lasting memories for people.

THE ROLE OF THE EDUCATIONAL PROGRAMS ON TOURISM DEVELOPMENT OF NATURTEJO AND AROUCA GEOPARKS

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1. Introduction

Naturtejo and Arouca geoparks are the two Portuguese geoparks integrated in the European and Global UNESCO Geoparks Network since 2006 and 2009, respectively.

Naturtejo Geopark is located in central Portugal near the eastern Portuguese-Spanish border. The Naturtejo's territory comprises 4617 km^2 and includes six municipalities: Idanha-a-Nova, Castelo Branco, Proença-a-Nova, Oleiros, Vila Velha de Ródão and Nisa, with 96 337 inhabitants (Census, 2001). The management structure of the Naturtejo Geopark – "Naturtejo – Empresa de Turismo" (Tourism Company) - is an intermunicipal major state-owned company with 7 public institutions and 25 private enterprises, established in 2004.

Arouca Geopark is located in the north of Portugal and has an area of 328 Km^2, corresponding to the area of the municipality of Arouca. According to the data from Statistics National Institute (2001), Arouca has got a population of 24.228 inhabitants. AGA – Arouca Geopark Association - is an entity created in 2008 to manage the Arouca Geopark. It is constituted by 18 associates (7 public institutions and 11 private companies).

This work aims to give an idea about the applicability of the Educational Programs in the Portuguese EGN geoparks, and their positive impact on tourism, geosciences education, nature's preservation and the sustainable economic development of their territories.

2. The Educational Programs of Naturtejo and Arouca Geoparks

2.1. Educational Programs characterization

According to the EGN and GGN, a Geopark is a territory with well defined boundaries comprising a wide area which allows a local sustainable social, economic, cultural and environmental development. These territories must include geosites of scientific, educational and aesthetic relevance, of rare occurrence, associated to ecologic, archaeologic, historic and cultural values (Zouros, 2004; 2006; Eder & Patzak, 2004). In order to preserve geological heritage we must educate and raise the scholar public's awareness for the preservation and respect for nature/ wildlife within a holistic perspective. Thus, with the goal of approximating schools and calling the educational community's attention for the natural and cultural treasures from Naturtejo and Arouca geoparks, Educational Programs were created by those geoparks in the school years of 2007/2008 and 2008/2009, respectively. To conceive the mentioned programs, one has regarded the curricula programs from the Portuguese Ministry of Education with the aim of complementing them and providing teachers and pupils with useful tools.

Two types of educational programs were created by the Naturtejo Geopark: "Geopark Goes to School" (GGS) and "School Meets the Geopark" (SMG), in October 2007. The Arouca Geopark in November 2008 decides to adopt these two types of programs, but with adaptations. In the first program, the geopark's team goes to a school and operates activities inside the classroom or in an outdoor area near the school building. In the second one, the teachers and their pupils go to specific places of the geopark and take part in field trips organized by the geopark trained staff. Both programs are addressed to teachers and pupils from the Nursery School level, the 1st, 2nd and 3rd levels of Primary School; the Secondary level, the Professional Teaching and also from the University. Those schools belong to the Geoparks' territory, to the ones from the rest of the national territory and those from abroad. Therefore,

there is an urge for an adjustment and adaptation of language and scientific content to the school level. The monitors of the Educational Programs are qualified technicians with a degree and pedagogic training in Geosciences and/or Geological Heritage. Despite the focus on Earth Sciences, the programs approach is a multidisciplinary one, once Biology, Wildlife Conservation, History, Physical Education, Tourism and Culture, among others, are also mentioned subjects. Each Geopark has created its own booklet for the promotion of the Educational Programs which were sent to Portuguese schools in 2008 via mail or presented in both Geopark websites: www.geoparknaturtejo.com and www.geoparquearouca.com.

Naturtejo Geopark has implemented its Educational Programs in the school year of 2007/2008, starting in October 2007 (Catana & Caetano Alves, 2008). In the two kinds of programs the Naturtejo Geopark provides one qualified Monitor for each 30 pupils. That same school year, the Educational Program School Meets the Geopark comprised five interdisciplinary field trips: A – "In the fossils trail of *Penha Garcia* searching for the trilobite trace fossils"; B- "In the granitic *inselberg* of *Monsanto*"; C- "The *Penha Garcia* fossils and the granitic boulders of Monsanto"; D- "The Natural Monument of *Portas de Ródão* and the Tagus valley" ; E- "The forest in the Living Science Centre, the secrets of the *Mourão Valley* and the fossil trunks on the Tagus House of Arts and Culture" (Catana, 2008). During the school year of 2008/2009 four new field trips were added: F- "Meeting the singular granitic forms of *Castelo Velho* at *Serra da Gardunha* (Gardunha's Mountain Ridge)"; G- "Exploring the trails that lead to the Roman gold mine of *Conhal do Arneiro*"; H- "Searching for the Waters"; I- "Searching for the Rocks". The field trips can last for half day, one or two or even more days. As far as the other educational program is concerned – Geopark Goes to School – a proposal for a field trip was presented and named J- "Geodiversity around our School", free from charge and addressed to schools from the Naturtejo territory (Catana, 2008a). Those schools are invited to participate actively in the celebrations of thematic days and in the activities of the European Geoparks Week (Catana & Caetano Alves, 2008a). This way, schools are able to develop their annual Educational Projects (e.g. Project *Anim'a Rocha*). In the school year of 2008/2009 the Naturtejo Geopark has developed two annual projects called *Discover the Geosites in your Municipality* and the Workshop *Rock Detectives*. The first project was put into practice with the collaboration of Idanha-a-Nova Municipality and eight of its 1st level Primary Schools. The pupils had a pre-field trip class at school, a field trip to meet some geosites in the Municipality of Idanha-a-Nova, a workshop on fossils moulding and an Environmental Festivity in the *Inselberg* of Monsanto, on the International Environment Day (with all the participants in the project - pupils and teachers). The Workshop *Rock Detectives* was organized by the Naturtejo Geopark in collaboration with the Studies of High Tagus Association for pupils of the 2nd level of Primary School from the Municipality of Vila Velha de Ródão. The activities comprised a pre-field trip class and a field trip about the geological heritage of Portas do Ródão. During the school year that pupils were invited in the Visual and Technological Education discipline to develop the illustrations for the book "Ródão – A mais fantástica viagem de um grão de areia" (= Ródão – The most amazing travel of a sand grain) recently published about the newly protected Portas de Ródão Natural Monument.

On the 24th November 2008 – the National Day of Scientific Culture – the Educational Programs of Arouca Geopark were officially implemented. However, since the beginning of the school year, much before the date above-mentioned, the Geopark monitors had already developed some educational activities.
Regarding the Educational Program "School Meets the Geopark", there are five one-day field trips and one visit for two days. The former were entitled: A- "Discovering the Geological Heritage of Arouca Geopark"; B- "*Serra da Freita*: endless landscapes"; C- "The mines of *Regoufe* and of *Rio de Frades*: enemies joined by wolfram"; D- "The Palaeozoic trail"; E- "Arouca Geopark: stories of the Gondwana and the Pangaea". The field trip F organized for

two days was also named after the field trip A. This is a program which reunites several visiting points from the one-day scheduled visits (Rocha, 2008).
As far as the Educational Program "Geopark Goes to School" is concerned, Arouca Geopark organized six thematic meetings fitting different school levels with the duration of approximately 1H30. They were called "Let's find Arouca Geopark!", "Build your Trilobite!", "The Geopark and the Natural Heritage of Arouca", "Trilobites: three times older than the Dinosaurs!", "The Geopark and the Conservation of the Geological Heritage of Arouca" and "Geoconservation in Portugal" (Rocha, 2008).
Throughout the school year an Educational Project named "*Geoteca"* ("Geolibrary") was developed. With it the Geopark trained staff aimed at going to 1st level school libraries and creating a physical area devoted to Geology and Arouca Geopark.

2.2. Presentation and analysis of the Educational Programs data

The number of participants on both Geoparks Educational Programs is shown on the tables below (School Meets the Geopark – SMG and Geopark goes to School – GGS).

NUMBER OF PARTICIPANTS IN THE EDUCATIONAL PROGRAMS OF NATURTEJO GEOPARK						
School year	**Pupils**			**Teachers**		
	SMG	**GGS**	**SMG + GGS**	**SMG**	**GGS**	**SMG + GGS**
2007/2008	732	186	918	66	17	83
2008/2009	1950	567	2517	148	147	295
Total	**2682**	**753**	**3435**	**214**	**164**	**378**

Table I

NUMBER OF PARTICIPANTS IN THE EDUCATIONAL PROGRAMS OF AROUCA GEOPARK						
School Year	**Pupils**			**Teachers**		
	SMG	**GGS**	**SMG + GGS**	**SMG**	**GGS**	**SMG + GGS**
2008/2009	3078	878	3956	277	54	331

Table II

On the analysis of tables I and II, one may conclude that the number of pupils and teachers who have taken part in the program "School Meets the Geopark" is higher compared to the program "Geopark Goes to School" in both geoparks. This happens because the latter was not too much put into action at schools, especially those outside their territories and also because the majority of schools requested to visit the geoparks.
Considering the capacity of attracting tourists, both programs have a great potential, but one has decided to make a careful data analysis on the program "School Meets the Geopark, once the number of participants is more significant and that the program seems to be more appealing, since the participants get in touch with wildlife and have the opportunity to explore the geosites, which enables them to apply the theoretical knowledge learnt in the classroom along with the practice of Nature sports. They are able to spread the word about something they have already experienced, which will be more effective in others as far as promotion is concerned. Moreover, some schools belong to the Geoparks territory and others come from other places, allowing a wide geographic promotion, both in Portugal and abroad. The participants in the Program "Geopark Goes to School" are mainly from schools of the Geoparks territory.
During the school year of 2007/2008, between February and July 2008, there were 18 field trips in the Naturtejo's territory. The participants from 15 different schools belonged to 4

Portuguese districts. They came from Castelo Branco (nine field trips=FT), Braga (five FT), Lisbon (three FT) and from the district of Aveiro (one FT).
In the school year of 2008/2009, between November 2008 and June 2009, Naturtejo Geopark has already organized 44 field trips, with participants from 48 schools belonging to 9 Portuguese districts and 3 from Spain. There again the majority of participants came from the district of Castelo Branco (20 field trips), then from the districts of Santarém (four FT), Lisbon (three FT), Portalegre (two FT), Leiria (two FT), Braga (two FT), Beja (two FT), Setúbal (two FT) and Coimbra (one FT). From Spain came the students and their teachers from the Universities of Madrid (three FT) and Murcia (two FT) and a group of teachers from Extremadura (one FT).
Arouca Geopark organized 61 field trips during the school year of 2008/2009, between September 2008 and June 2009, with participants from 46 different schools belonging to 8 districts: Aveiro (20 field trips), Porto (19), Braga (9), Viseu (4), Coimbra (3), Viana do Castelo (3), Lisbon (2), Leiria (1). We therefore deduce that the Arouca Geopark welcomed visitors from a range of 300 km.
Data shown in the graph below (Fig. 1 and Fig. 2) contain the number of participants in the program "School Meets the Geopark"

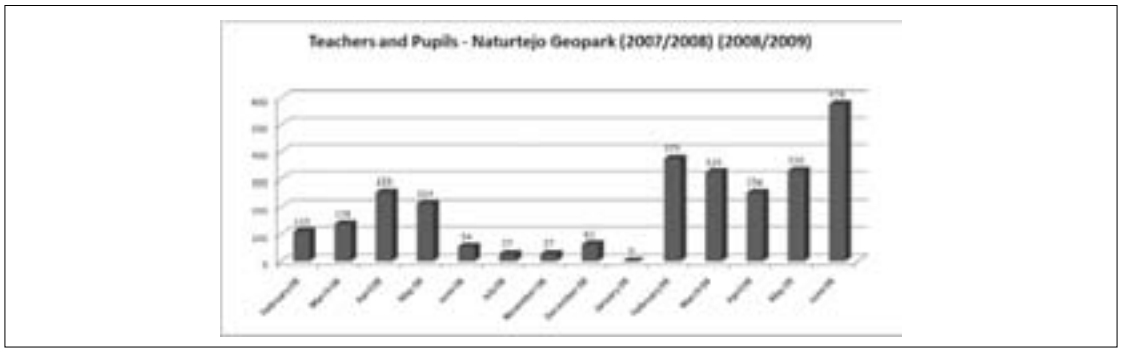

Figure 1: Number of participants in the program "School Meets the Geopark" (School years of 2007/2008 and 2008/2009).

A total of 798 pupils and teachers engaged in the Program "School Meets the Geopark" of Naturtejo Geopark, but the number rise to 1948 participant pupils and teachers in the school year of 2008/2009. From the data analysis one can see an increase of 144% of that number, when comparing the second year with the first one of that program's implementation. This occurs due to the fact that there was a higher participation in more months thanks to the promotion of the Educational Programs prior to the beginning of the school year of 2008/2009. This numbers are impressive since Naturtejo Geopark is at least 250 km away from the biggest and over populated cities of the Portuguese coast.

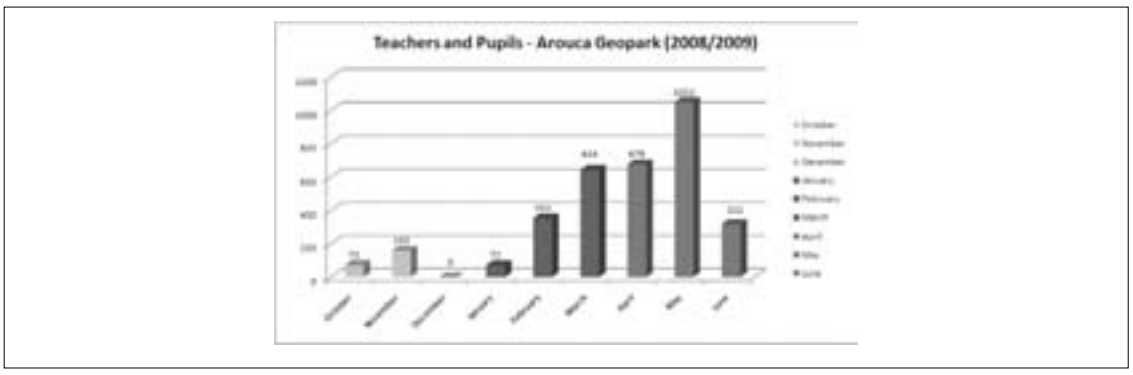

Figure 2: Number of participants in the program "School Meets the Geopark" (School year of 2008/2009)

A total of 3078 pupils and 277 teachers engaged in the program "School Meets the Geopark" of Arouca Geopark and after an analysis of the frequency all through the school year depicted in the graph of Fig. 2, one can infer that, despite rare exceptions due to schooling restrictions, there was a gradual increase of the school visitors number to Arouca Geopark. This increment makes us predict that the successful program is firmly expanding.

3. Conclusion

In the end of each field trip both pupils and teachers fill in a questionnaire on it, leading to its subsequent improvement. The geopark's promotional materials, such as geographic maps, a geotourist map, and promotion leaflets with the distinctive types of the geopark's heritage are taken by pupils and teachers and shared with their families and friends. They are also invited to visit the geopark's website as well as both EGN and GGN ones. A booklet with programs for tourists is handed out to teachers and schools.

After a data analysis of the two Educational Programs one may infer that the participants who come from different Portuguese districts or from Spain may be elements for the promotion of the Geoparks. They lead to a rise of the tourist flows that visit them and stay there, increasing their economic status. Furthermore, the participants in the Educational Program "School Meets the Geopark" contribute directly for a sustainable economic development of geopark territories, through the use of restaurants, accommodation, museums, handcraft, traditional products along with the practice of Nature sports.

Today's pupils and teachers will certainly be tomorrow's tourists bringing their families and another friend!

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AMAZING AND RARE FOSSILS IN BRAZILIAN NORTHEAST HINTERLAND: THE DIFFERENTIAL OF THE ARARIPE GEOPARK

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1. Introduction

The Araripe Geopark is located in the Brazilian northeast hinterland, a semi-arid region of tropical climate with marked seasonality, ranging from torrential short-term rainfall to prolonged caustic dryness. The dominant vegetation is the caatinga of scattered shrubs with twisted trunks, cactaceans and spiny bromeliaceans that grow in poor stony soils. The landscape is bright and greyish, typical of areas of adverse climate… This is the Brazilian northeast hinterland.

But, in this hinterland, in the old region inhabited by the brave indigenous 'Cariri', because of its distinct geological features, there are several crystalline water springs and a forest with species, the 'jatobás', 'paus-d'arco', 'muricis' and 'janagubas'. The native trees of this forest produce sweet fruits, as 'mangaba', 'cajuí' and 'pequizeiro', frequently used in the local gastronomy. Present day fauna is not very diverse, but it includes rare species of birds (as the red-hawk and the 'soldadinho-do-araripe'), small mammals (anteaters, brush-cats, armadillos and raccoons), strange lizards and chameleons, and a countless variety of beetles and other insects. The height of a sandstone plateau provides an amazing view of the magnificent settings that occur during Summer. Without atmospheric pollution, moonlight nights are fantastically illuminated. The symphony of the singing birds at dawn enchants any attempt ear. It is wonderful!

This land is inhabited for a humble and friendly people, always ready to laugh, to dance and to amuse themselves during traditional 'festejos juninos' (June parties). They are also very religious, an inheritance of their, predominantly, aboriginal origin and the Portuguese Jesuitical colonization. The colourful of the life is in the typical clothes, in the dishes of the centennial culinary art, in banderoles hanging along the streets and in an open soul and heart to receive all with harmful affection. The population is long-known to have special economical needs, and their illiteracy index is high (32%, according to Aguiar *et al*., 2006). Thus, their life is simple, the houses are modest, and the streets are narrow and poorly preserved.

Privileged by Nature, the economy of the region is based on the exploitation of quarries for gypsum and laminated limestone, and on the cultivation of rice, beans, maize and sugar cane. The regional cuisine is composed of cakes and candies made with maize, 'rapadura' (brown sugar cane blocks), manioc and coconut: 'pés-de-moleque' (a cake of 'puba' and rapadura with cashew chestnut), cakes of creamy maize, 'grudes' of tapioca gum, 'quebra-queixos' of coconut and 'rapadura', 'broas' (little breads) of maize and 'fubá' or of coconut and cheese, *etc*. Meals are composed by equally genuine and flavourful dishes, as the 'paçoca' of dry meat and crackling, the 'mungunzá' of pig and maize, the 'baião-de-dois' of beans and rice, banana, and rapadura, the 'pequizada' with cream, *etc*.

The Araripe Geopark is located in this nice and singular region, true tropical oasis in full Brazilian northeastern 'caatinga'. But natural and beautiful landscapes and secular cultures also occur in many parts of the world, always interesting and worthy of our admiration. Thus, what makes the Araripe Geopark such a special territory?

2. The paleobiota to take off the breath

What the Araripe Geopark territory has of exceptional in relation to other regions is the exceptional taphonomic conditions that led to the unique occurrence of conservations and mineralization of fishes and other vertebrates that inhabited our planet 110 million years ago, preserved in three dimensions (and not deformed as normally occur with these types of fossils). And more: these fossils are so abundant and well preserved a real lagerstatten, that it is almost impossible to visit a limestone quarry in the region without finding one!

The fossils are part of the life of all children who inhabit this region. They get used to play with 'pedras-de-peixe', sometime asking their parents and teachers how the fish of the river end up inside the rocks. Most probably, this same question also occurred to the indigenous 'Cariri', that since the XVII, if not before, inhabit the Brazilian northeast hinterland. In fact, their name may derive from the aboriginal term 'cariré' that, according to Sobrinho (1941), means fish ('cari') + different ('ré'). Fossil fishes found in the rocks are very different from the fishes found in the waters which they could eat! Thus, the 'carirés' may have, most probably, intrigued the 'Cariris', converting them as the first Brazilian paleontologists, while attempting to find an explanation for these curious occurrences.

For decades, the paleofauna of the Araripe has intrigued both geologists and paleontologists, Brazilians and foreigners. The three-dimensional form of fossilization, the phosphatized conservation of delicate antennas and legs of minute arthropods (ostracodes), the preservation of fine and coloured wings of dragonflies, muscles of pterosaurs, petals of the primitive flowers that blunted in terrestrial biota, everything is difficult to explain. Martill (1989) coined the term `Medusa effect' for a geologically instantaneous petrifaction responsible for the extraordinary preservation of the fishes in the Araripe concretions, similarly to what occurred to all who dared to look directly into the eyes of the Greek goddess Medusa. Only a paleoenvironment with large paleobiodiversity together with oxygen-free very calm waters and fast chemical dynamics could favour the preservation of this life that blossomed long before mankind. And these remains were kept almost intact by natural diagenic processes during more than 100 million years, allowing us to contemplate them… in the Araripe Geopark.

The fossils are mainly found in two levels of the stratigraphic Cretaceous unit denominated Santana Formation. The oldest are the minute fishes *Dastilbe crandalli* Jordan 1910, that occur in large quantities in limestone laminae, locally called 'pedra-cariri'. Other larger fossil fishes, reaching 1.8m in length, occur in the above marls, inside carbonate concretions, the ictioliths. Its paleobiodiversity include as many bony fishes (18 species) as cartilaginous fishes, namely the ray *Iansan beurleni* (Silva Santos 1968) and the shark *Tribodus limae* Brito & Ferreira 1989. Between the bony fishes, there are fossils of large coelacanths (*Mawsonia gigas* Woodward 1907 and *Axelrodichthys araripensis* Maisey 1986).

More than 20 different species of pterosaurs, some with a wing span of 5.5m (e.g. *Tropeognathus mesembrinus* Wellnhofer 1987), overflew the region at that time and were preserved in such a detail that reveal anatomical structures unknown to other recovered specimens around the world. Their variety is so large, that the region is internationally known as 'pterosaurs paradise'. The oldest sea turtle, *Santanachelys gaffneyi* Hirayama 1998, with the still mobile metacarpi, also occur in the Araripe Basin, as well as remains of small dinosaurs, diverse crocodiles and frogs.

The Cretaceous arthropods are found in the Santana Formation with an abundance, diversity and preservation never before observed in other known fossiliferous sites. So far about 280 species of insects were already recognized, belonging to the groups of the ensifera (crickets), ephemeroptera (ephemera), hemiptera (chinch-bugs), hymenoptera (wasps and ants), neuroptera (wing ants), blatoptera (cockroaches), isoptera (termites), dermaptera

(centipedes), coleoptera (beetles), lepidoptera (butterflies), tricoptera (small butterflies), celifera (grasshoppers) and diptera (flies and mosquitos). To this adds the occurrence of other invertebrates, as spiders, crabs, scorpions, shells and sea-urchins. Some fossils show a quality and richness of morphologic details not expected for forms that lived millions of years ago, such as the coloration of the wings and the ocular or the digestive system structure. And this paleobiota is available to visitation in the Araripe Geopark...

As in all ecological systems nature includes not only animals but also plants. These are also present in the Araripe Basin, from simple and delicate algae to vascular plants with their trunks, ramifications, leaves and fruits. Fragments of uncommon gymnosperms, conifers, primitive angiosperms and ferns are easily found in the laminated limestones of the Santana Formation. Some specimens show the complete plant, with their foliar tissues, roots, reproductive structures and pollen grains fossilized together. Delicate flowers of the oldest known angiosperms are preserved together with pollinator insects, as the hymenoptera and lepidoptera, suggesting that these organisms already interacted with plants since Cretaceous times. In older Jurassic sedimentary levels (Missão Velha Formation) occur silicified conifers trunks of the genus *Dadoxylon*, some with more than 2 m in length and 1,2 m in diameter.

3. ARARIPE GEOPARK AND ITS GEOTOPES

This exuberant Cretaceous paleobiota preserved in around 8000km^2 of the Brazilian northeast hinterland led UNESCO to consider important the creation of a Geopark on the region, allowing this paleontological wonder to be preserved and visited. It also offers the opportunity for the socio-economic development of the local population through research, educational and tourist activities, establishing connection between geological and paleontological natural history and the cultural history, as Weber (2008) pointed out.

For the creation of the Araripe Geopark, several locations of the south of the Ceará State were integrated. Of the nine geotopes that composes the Araripe Geopark, only three property show the above described paleobiota: the Missão Velha Geotope, the New Olinda Geotope and the Santana Geotope (Fig.1). In these three geotopes the visitor can observe the rocks and the fossils *in loco*, the local workers in their practices, either cultivating the soil or breaking rocks and cutting the limestones. Biologists and geographers from the Regional University of Cariri (URCA) guide the visitors to these geotopes, explaining the geologic history related to the sedimentary deposition and the occurrence of fossils.

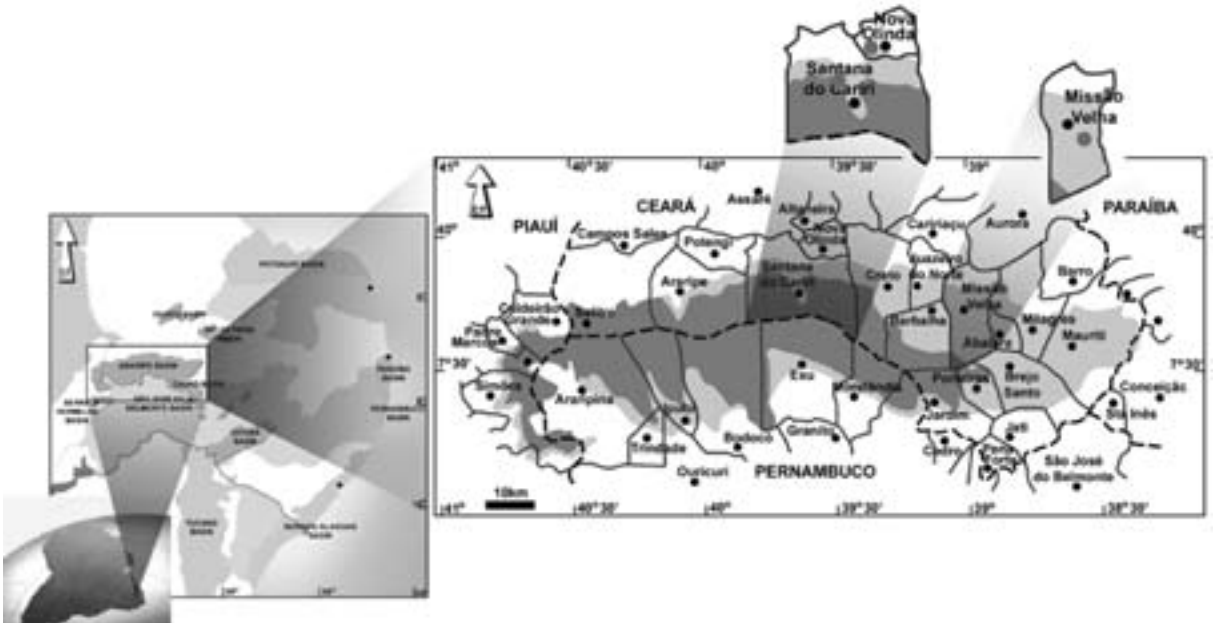

Figure 1: Localization of the Araripe Basin in the south of the Ceará State, Brazil, and of the three very fossiliferous geotopes (red points) of the Araripe Geopark.

The Missão Velha Geotope is an outcrop located at the margins of the streamlet Olho D'água Comprido, located in the area named Grota Funda, in the Missão Velha District. Between the red sandstones and conglomerates, many fragments of silicified woods of Jurassic gymnosperms occur, testemonies of a forest of high conifers intersected by rivers, that carried the fallen trunks to lower plains, where they were rapidly covered by sands, and thus fossilized.

The Nova Olinda Geotope is a small portion of the Pedra Branca mine, located to the left of the road between Nova Olinda and Santana do Cariri, in the Nova Olinda District. In the greyish-clear laminated limestones abundant remains of algae, small fishes, and varied arthropods can be preserved. Fossils of other vertebrates and vascular plants are less frequent. This geotope records the Cretaceous biota that lived in a shallow fresh water lagoon and in adjacent flood plains. These limestones locally called 'pedra cariri' are usually extracted by the population to build their houses.

Another Cretaceous geotope with abundant fossils is the Santana Geotope, located in the Cana Brava ranch, agricultural zone of the Santana do Cariri District. In the quarries, it can be observed sandstones, shales, and marls where abundant carbonate fossiliferous concretions occur. This sedimentary sequence and their fossilifereous content register the paleoenvironmental characteristics of ancient coastal lagoons, influenced by transgressive marine episodes. Located 3km from the city Santana do Cariri, the local Museum of Paleontology is close to the geotope and in it is possible to see all the rich and exuberant paleobiodiversity of the Araripe Basin.

The Museum of Paleontology of URCA in Santana do Cariri was created in 1985 by inspiration of the mayor of the city, the sociologist and professor Plácido Cidade Nuvens. With the effort of the local and regional communities and the support of diverse Brazilian paleontologists and entities, Dr. Plácido compiled a collection of almost 7000 specimens, which has continuously prospered with the contribution of the most diverse segments of the society. In 1988, this museum was donated to the Regional University of Cariri, becoming a reference point for visitation, not only by scientists and students, but by the general public, as well,

curious by the Ceará subsoil mysteries. The exhibition of rare fossils of the Araripe Basin and the local dinosaurs and pterosaurs reconstructions attracts about 20 000 scholars, students, researchers and tourists each year. Currently this museum is being modernized and enlarged.

4. Conclusions

The Araripe Geopark has the privilege to be located in a rich region with exceptional and quite diverse fossils, such as fishes, saurians and other vertebrates, as well as insects, other invertebrates and plants, from algae to angiosperms. Almost 400 different species were already recognized and innumerable anatomical structures rarely preserved on these fossils allows to better understand the evolution of these organisms and to better describe the Mesozoic geological history of our planet. Many of these specimens can be appreciated at the Museum of Paleontology of URCA in Santana do Cariri, associated with the Santana Geotope of the Araripe Geopark. The occurrence of these fossils can be observed *in loco* in outcrops or in quarries, through a visit to the Santana, Nova Olinda and Missão Velha geotopes, guided by Araripe Geopark monitors.

The region of the Ceará hinterland, where the Araripe Geopark is located, possesses a charming nature, clear skies and wonderful moonlight nights, with innumerable crystalline water sources feeding a forest of native fruitful trees, a caatinga oasis incrusted in the Brazilian northeast semiarid areas. The colonial gastronomic culture and the traditional popular festivities fill all those visiting the region with joy and color. The simple life of the farmers and miners take with optimism the sustainable development that the UNESCO Geopark will be able to generate.

The main concern of the Araripe Geopark will be the paleontological study of the outcrops, the main subject for geotourism in the region. Without a better knowledge on the regional geology to establish the sequence of past events, the fossil assemblages and the taphonomic processes they endured and without measures for their protection and conservation in the museums of the region, it is not possible to show the true exceptionality of the Araripe Geopark to the tourists, researchers and visitors. The formation of human resources in Paleontology is crucial to the popularization and decoding of the scientific data for students and the general people. The Araripe Geopark must also prioritize alphabetization of the farm and quarry workers in order to promote the socio-economic and cultural development of the region.

The Araripe Geopark cannot offer at its current stage of development sumptuousness and much comfort to its visitors, but it can offer truly exceptional records of the life that millions of years ago inhabited our planet and a gentile and cordial reception, by simple and warm people who has in their soul the daily hinterland wisdom!

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GEOPARK IDRIJA - THEMATIC TRAILS

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Idrija Municipality has extremely rich geological history, which we wish to present to broader public with the project Geopark. By attractive and popular presentation of the heritage, we will encourage naturalistic education of all generations and increase the interest for visiting the future Geopark. On the basis of the inventory of geological heritage in Idrija Municipality we organised some thematic and school trails on our well-known cyclist and tracking trails. Thematic trails include geological, morphological and hydrological as well as botanic, zoological, tree and other natural particularities. The trails are suitable for a wide range of visitors: school groups, families, mountaineers, cyclists and also as a field work for students of natural sciences.

The main thread of the Geopark is one of the oldest mercury mines in the world as the main factor in formation of Idrija town's history. Antony's main road, the oldest part of the mine, was renovated in 1994 and is now open for visitors. This 300 m long gallery, dug in 1500, was used as the main entrance for miners to the cave and back for almost half a century. The Idrija Municipal Museum offers a rich geological collection of minerals and fossils from Idrija and Cerkljansko region. The visitors have the opportunity to observe the story about the origin of the mercury ore deposit in the Mine Geological collection near the Francis's shaft, however there are numerous historical and technical monuments in the town, devoted to mining.

From geographical aspect, the area of Idrija is placed at the crossing of two gigantic mountain ranges: the Dinaric Mountain Range and the Alpine range. It is precisely this crossing, which enables exceptional natural phenomena – various minerals discovered in remarkable stratigraphic sections, different tectonic phenomena, mineral and fossil deposits. Water is also extremely important, since it contributes to the variety of the terrain with numerous sources, running waters and karst features. Due to the complexity of the terrain we organised several thematic units, represented in various thematic trails through the whole area of geopark. The total length of all thematic trails is approximately 70 km.

In the proximity of the town a visitor has the opportunity to observe all minerals forming the terrain of Idrija - from the oldest carbon slate-pits, formed almost 300 million years ago to the youngest Paleocene-Eocene flysch, being "only" 55 to 35 million years old. The terrain has a typical over - thrust structure, where minerals are thrusted one over another in such way that older minerals often cover younger ones. The trail concludes with a remarkable view on the famous Idrija fault, which is one of the most important faults in the Southern Alps, visible also on the satellite pictures.

The next thematic trail leads us to a stirred terrain of the Zgornja Idrijca Landscape Park. Besides the geological profiles the trail along the Idrijca and Belca River offers some marvellous gorges, water-falls and sources of excellent drinking water. Here the visitor can calm down, take a deep breath and admire the nature or observe numerous technical and historical monuments in the natural park, mostly related to mining.

Hikers, mountaineers and cyclists can find especially attractive thematic trails, connecting small villages and distant farms on tablelands. The karst tableland is covered with sinkholes, dry small valleys and various swallets, which give this region its typical appearance.

If we climb up to the mountain tops, the views on the Julian Alps in the North and Southwest to the Adriatic Sea will repay all our effort.

MAGMA GEOPARK: CULTURAL HIGHLIGHTS

Pål Thjømøe
Magma Geopark AS, www.magmageopark.com.

Magma Geopark is establishing 45 geopark locations in its area. Several of these locations combine a variety of themes including geology, landscape, nature and cultural heritage. Magma Geopark is using these locations to promote the themes and the geopark together with a variety of partners. It is also an important issue in the establishment of a sustainable economy for the company Magma Geopark AS.

Together with three partners, the geopark has established the company "Kulturopplevelser AS" = Cultural Highlights (CHL). CHL will develop packages involving courses and conferences for companies in the region, and packages for tourists that visit the geopark for a shorter time, typically 2-3 days. The partners that own CHL together with Magma Geopark are an event company (Dalane Opplevelser), a hotel (Grand Hotell, Egersund) and an old farmhouse (Pittergarden). Other partners that have businesses in the area, involving e.g. local food and transport, will also be involved. Establishment and development of CHL has been supported by a grant of 100.000 euros from Innovation Norway. Each of the four owner companies has contributed 5000 euros and many hours of work.

CHL has so far developed four packages and, together with local companies, is now testing them. CHL desires to make the special quality of the region better known, and to develop quality products. Traditions, storytelling, the environment and genuine adventures are important. To provide this, the packages combine cultural adventures, promote team-building, and include visits to geopark locations. The main contents of the four packages are:

Package No. 1: **Egersund and geology**. Day one; GeoBike to four geosites, course/conference and lunch at the hotel, treasure hunt in the old town of Egersund, wine tasting, dinner and overnight stay at the hotel. Day two; Team-building at a geopark location with rock climbing etc.

Package No 2: **Egersund and local traditions.** Day one; historic play at geopark location "Bakkebø", course at the hotel and making your own local food. Day two; course/conference, walk in the geopark location "the old town of Egersund", and visit the chocolate factory.

Package No 3: **Explore Lake Ørsdalen and the mining history of Ørsdalen.** Day one; course/conference at the hotel, dinner and line dance at Pittergarden, overnight stay at the hotel. Day two; boat trip on Lake Ørsdalen, historic play, visit the geopark location Ørsdalen old tungsten mine and climb to the top mine.

Package No 4: **Bjerkreim and the sheep.** Day one; course/conference and overnight stay at the hotel. Day two; local traditions; team-building, local food (including lamb; Bjerkreim is the municipality in Norway with the largest number of sheep), storytelling, wood nymph, dairymaid, music and line dance at Pittergarden.

PARTICIPATION OF ADOLESCENTS IN EUROPEAN GEOPARKS

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Adolescents are the future advocates, multiplicators, researchers and managers of geoparks. To involve and encourage them to participate in nature protection, regional development and related fields is essential to create our future according to our vision of a sustainable lifestyle. The way adults sometimes describe adolescents as superficial, lazy, consumption-oriented, and fixated only on their own benefit and optimization of pleasure is contrary to the high expectations to live up to that vision. Keupp (2000) shows that our vision of a civil society based on the voluntary and social involvement of our citizens does indeed suit our young citizens but that the structures of organizations complaining on a decline in civil engagement often do not.

Geoparks provide an ideal environment not only to experience environmental protection hands-on, but also to take an active part in regional development. While the need for participation of the local community in protected areas is widely being acknowledged and put into practice, adolescents are often not involved as stakeholders. If we want our future generations to further implement our vision of a sustainable development, we need to integrate them more into the discourse.

What role does participation play in European Geoparks? What possibilities do adolescents have to take an active part? What potential does the participation of adolescents in European Geoparks have? These questions are being answered during author's 'Diplomarbeit' (equates to master thesis): It combines secondary data on participatory approaches in protected areas – in general and in regard to adolescents – with surveys and interviews (primary data) on participation of adolescents in European Geoparks. Our interest lies in how far the public is being involved and what role the participation of adolescents' plays. Are they involved as stakeholders or participate in other ways? What experiences have been made?

Why Geoparks? Geoparks are areas that work to "conserve and valorise their geological heritage through the integrated and sustainable development of their territories" (www.europeangeoparks.org). Integrated and sustainable development can be supported in various ways: These include the involvement of the local communities to increase understanding for and acceptance of the Geoparks' concept (cf. Stoll-Kleemann & Welp, 2006). Megerle & Vogt (2006) argue that an important factor and foundation of geoparks is the human need for regional identity. This is supported by the high value of regional activities in the 'implementation' of sustainable development. Adolescents growing up in rural areas (which applies for most Geoparks) often lack a positive view on their area and long for the more adventurous life in the cities or have to focus on moving to the cities due to little possibilities of getting a job in the area. During the project "Meet your Geopark" (Fig.1) it could be observed, that adolescents realising an own project in cooperation with the geopark do not only get to know the area they live in better, but can also identify themselves more with it due to the wonders they have discovered in their backyard.

The involvement of the local communities is more and more being realised as an important factor of the work in protected areas. Adolescents are often not involved in this process. To strengthen participation of adolescents in Geoparks it is necessary to first evaluate the current participation. Berghöfer & Berghöfer (2006) propose four defining questions to

serve as axes: (1) Who participates?, (2) In what dimension?, (3) How does the process take place?, and (4) For what purpose? Furthermore factors in participation of adolescents in geoparks leading to a mutual benefit need to be identified to serve as a guideline for future projects. It is hoped that an increase in the participation of adolescents in geoparks leads to a higher interest in protected areas and Earth Sciences in general, as well as motivates more adolescents to participate in their local community and Geopark.

After presenting the current status of author's thesis we would like to present some ideas of how the EGN could involve adolescents. One project already being realised in some Geoparks is setting up Youth Groups. Another idea is a Voluntary Service, exchanging young volunteers between European Geoparks to combine the international experience with experiencing a different Geopark from the one they live in.

Figure 1: "Meet your Geopark" in Osnabrück in 2008 © Christian Hammermann

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RELATIONAL TOURISM IN ROCCA DI CERERE EUROPEAN GEOPARK

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The Rocca di Cerere Geopark European has recently developed a new strategy for tourism based on the finding that the territory of the park is crossed by a major influx of tourists in Sicily, with an average of 500,000/800,000 visitors a year, mainly directed to Villa Romana del Casale, World Heritage, and to Piazza Armerina.
The flow is considered completely detached from the remainder of the tour of the area and is characterized by a strong component of all visitors not informed in the same context.
Obviously the Geopark will consider not target the entire contingent of visitors, but an emphasis on those parts of the quota that may be interested in diversifying their way of living on the land and the relationship with it.
Precisely in this sense, the Geopark has funded 9 new B & B "quality standard", which already in the last year have been crucial in the stabilization of new tourism experiences capable of raising the residential and relational tourism.
In this first stage is bound to create a seal of quality "Flavors of Demeter" with exhibitors and specially designed packaging and a communication plan for major impact.
The area identified as Geopark is proposed as a place of human relations, scientific discovery, sport and entertainment (sports Structure of Lake Nicoletti).
The Geopark through the GAL Rocca di Cerere designs a new development plan to be implemented by 2013 with the following major aspects: STRATEGY Culture, tourism, environment and rural heritage in the Rocca di Cerere European Geopark: meeting, promotion and development system of the land for economic and social development integrated and harmonious.
The strategic aspect of the project expressed by the PSL GAL Rocca di Cerere is just putting a system of wealth of this land. This strategy is implemented through the following key issue: CENTRAL THEME systematization and integration of tourism and promotion of multi-enterprises for a renewed economic structure in rural Rocca di Cerere GAL.

This strategy has been presented during the last European Geopark week in Rocca di Cerere Geopark with new paths, events, activities and other (Fig. 1).

Figure1: Concert in Pupi Ballerini Geosite during last European Geopark WeeK

ADAMELLO BRENTA GEOPARK IN THE DOLOMITES WORLD HERITAGE SITE

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On the 26th June 2009 Dolomites has been inscribed on UNESCO's World Heritage List (Fig. 1). The World Heritage Committee's decision, holding its 33rd session in Siviglia, has been taken unanimously, recognizing the values' irreplaceable universal importance which they were candidate for: the extraordinary natural beauty and the outstanding representativeness for the Earth Sciences.

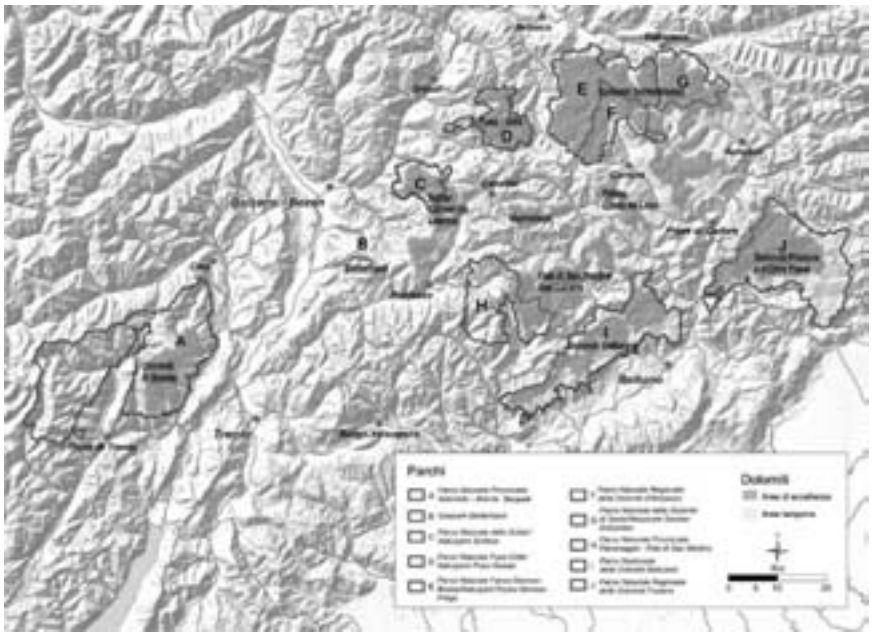

Figure 1. The Dolomites World Heritage sites (in orange) and the protected areas (in purple). (Map by C. Micheletti).

After the Dolomites' awarded as World Heritage, a rich and deep discussion has developed, which has been able to take back in the foreground (had the merit of bring back as first rate) the fundamental topics of landscape and environment in our culture and economy: this is an extraordinary change to think about the mountain, our territory's specificity and the possible different pattern's tourism. These subjects need to be faced with a new awareness and responsibility in order to guarantee for a long time all these values declared as universal.
However, in the debate has not pointed out to the role of Parks for the protection and valorisation of the extraordinary Dolomites territory. It is good to remember that, since a long time, a complex system of 10 protected areas is involved in the management of this territory, even if instituted and operating in different ways: for Bolzano Province the Nature Parks of Sciliar-Catinaccio, Puez-Odle, Fanes-Senes-Braies, Dolomiti di Sesto and the geologic Park Bletterbach di Redagno/Aldino; for Veneto the Dolomiti Bellunesi National Park and Dolomiti d'Ampezzo Park; for Friuli the Dolomiti Friulane Nature Park; finally, for Trento Province, the Paneveggio-Pale di San Martino Nature Park and Adamello Brenta Nature Park.
The awarded is also the demonstration of an overall correct past territory management: far-seeing choices has been taken and also the institution of protected areas played a role in the safeguard of the "Stone Giants".
In this context Parks' preconceptions need to fall down; sometimes Parks are considered as a limit and a threat for the development of people living in, or as "glass bell", according to an

idea now overcame by the history. On the contrary, is time to think of protected areas with different eyes, recognizing that numerous Parks, especially in Italy, are excellence places, engines for a sustainable development, where there is not only territory's protection, but the man is in the centre of a management strategy that aims to the life quality of people through an equilibrate and keeping with nature development.
To testify this, is useful to cite the result of a recent survey, committed by the Nature Conservation Service of the Trento Autonomous Province, from which it emerges that 90% of the Trento Mayors consider "well-balanced" the relation between protection and economic development in the management of protected areas.
This dynamic and vital Parks' presence played an important role also in the candidature of Dolomites as Unesco heritage, as additional security element for a responsible and respectful territorial management.
For example, IUCN (International Union for Conservation of Nature), that took care of technical investigation for the evaluation, considered really opportune the participation of Adamello Brenta Nature Park in the European and Global Network of Geoparks recognized by Unesco, that took place by the 26th June 2008, as occasion of intelligent valorisation of the landscape and geologic heritage, and therefore as a laboratory for good practices of tourist valorisation, useful for the Dolomites Heritage itself (Fig. 2).

Figure 2. Campanil Basso, in the core of the Brenta Dolomites (Photo by L. Herbert).

Without fears and with pride, therefore, protected areas may today propose themselves as additional value of the extraordinary reality of Dolomites, bring a dowry of its contribute of management and project assessment experience to the Foundation which will take care of the Heritage, providing also new instruments for the realization of new sustainable development.
Good examples could be the "European Charter of Sustainable Tourism", instrument of shared tourism planning, already applied from tens of European protected areas, and the Geopark Action Plan, for the valorisation of the geological heritage and the development of the so called "geotourism".
These instruments teach as nature, landscape, and also geology, may become factors of local development: this is demonstrated also by the several initiatives concluded by Adamello Brenta Nature Park in the 2009, that has been declared by ONU as "International Year of Planet Earth": the Brenta Dolomites Trek, a long loop crossing Brenta Dolomites, the Via GeoAlpina, the international trail promoted in Italy by ISPRA (Institute for Protection and Environmental Research), which connects the geologic treasures of Alps, from Marittime to Giulie Alps, crossing also Adamello and Brenta territory, and the Adamello Brenta Geopark Action Plan.

ACTION PLAN OF THE ADAMELLO BRENTA GEOPARK

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The Adamello Brenta Natural Park was recognized in 2008 as international "Geopark" included in the European Geoparks Network and the UNESCO Global Network of Geoparks, thanks to the peculiarities of its geological heritage, the policy of sustainable development implemented through the European Charter for Sustainable Tourism action programme, environmental education, training and scientific research activities aimed at promoting sustainable geotourism. To safeguard and to increase the value of a geological-environmental heritage represents an important challenge and a considerable commitment, which imply an adequate action planning.
For this reason the Park has worked out an Action Plan (Fig. 1) in order to develop a programme aimed to:

- support and encourage the admission and the identity of the Adamello Brenta Geopark during its start-up phase;
- improve its performances;
- grant the confirmation of the recognition at the end of the 4 years of validity.

As well as representing a sort of guideline for the implementation of a 4-year programme, the Action Plan define a global action programme which, if necessary, can include also the extraordinary projects which could be financed as part of the activities of the EGN (i.e. Interreg).

Figure 1: Special number of the Park's magazine dedicated to the Action Plan.

In particular the Action Plan will have to pursue the following goals:

- the balance among the different sectors (conservation, research and development);
- identification of the actions to undertake in the Geopark area and definition of the priorities;
- resources planning.

A multi-year, concrete, realistic and shared action plan is an instrument of primary importance in a complex organisation such as the one of the Park.

The Action Plan will necessarily have to fit in the different programme tools of the Park, becoming a sort of referee in order to assure the implementation of a strategy of valorisation of the Geopark over time.
It is not by chance, in fact, that the recent variant of the Park Plan has included the Action Plan as one of the projects of the Park Plan (art. 4.2.11 of the Provisions for Implementation).
Moreover, considering that the Adamello Brenta Geopark is part of the more general policy of sustainable tourism development defined by the European Charter for Sustainable Tourism, the Geopark Action Plan shall be considered integral part of the tourism strategy, too (Fig. 2).

Figure 2: Geotourists in front of an interpretative panel (Photo by G. Alberti).

Last but not least, the Action Plan will have to follow the main guidelines of the Plan of Environmental Interpretation. The proposals of this document are that of planning and organizing
the activities related to the promotion of the territory, the welcoming, the information and the environmental education (Fig. 3).
Thanks to the Action Plan, the Geopark is officially recognized as a strategic tool for the global planning of the Park; the main planned actions will be part of the Annual Programme of Management like the actions scheduled for the other sectors.

Figure 3: Children during the activity "Geolaboratory: from the Mother Earth" (Photo by V. Masè).

2. Geotourism and local development

TOWARDS A GEOTOURISM DESTINATION - THOUGHTS FROM THE NORTH PENNINES

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One of the most important aspects of Geoparks is that they should be a focus for nature and culture based tourism, with a strong emphasis on using our geodiversity to support sustainable development. Geoparks are at different stages of development - some are established tourism destinations and some are working towards this goal.

There seem to be many different approaches to tourism in Geoparks and aspirant Geoparks, and there is merit in exploring how people promote their areas, what they see as 'doing tourism', the role they think they should have in the tourism industry and how their interpretation, events and educational programmes contribute to the visitor economy. Using an example from the North Pennines, this contribution considers how far down the road this Geopark has got towards becoming a 'geotourism destination'. We'll also look at the role the Geopark team plays in marketing the area versus the role others might play, issues surrounding pre and post-arrival information, and how interpretation and education are parts of the visitor economy (but only when done well). Do you really 'do tourism' in your organisation?

Come along to this presentation ready to be challenged to go out and make memories for people, and to take the next (or maybe first) steps down the road to building an 'environment-based economy' in your Geopark.

GEOPRODUCTS IN GEOPARK NATURTEJO

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Geopark Naturtejo has a strong project centred in Geological Heritage with promotion and local economic development through geotourism. The European and Global Geopark networks to which Geopark Naturtejo belongs have common goals and exchange information and good practices developing common strategies. Geological Heritage must be protected and managed in sustainable ways and transnational networking of geoparks enables to enlarge the scale of the projects.
The Geological Heritage is a new socio-economic value that can and must be exploited by tourism. Geotourism is an emergent segment of tourism based on Geodiversity. Humans always travelled to see geological wonders, but only now there is a really chance in this sector. It is being created a new niche with new specificities and new contingencies that follow the general trends of tourism (like lodging and restaurants) but that also have its own trends.

To promote the local development through Geodiversity, Naturtejo Geopark encourages local companies to innovate, investing and contributing for the development of the local economy. These local companies that engage several sectors, such as restaurants, lodging or outdoor activities play a very important role developing the basis of each geotourist strategy. But a Geopark is a new concept of a special and privileged territory to remind the Earth, where we can combine Science and Development. Soon, in Naturtejo Geopark, some innovative products were born that are contributing actively for the growth of local economy and also to raise awareness for Geodiversity – the **Geoproducts**. These Geoproducts combine traditional products with new concepts and interpretations.
It is very important to understand that Geotourism is much more than Geodiversity. It is important to cover also biodiversity, history and culture, with the main propose of local development. The more high-quality offer diversity exists the more rich and appealing is the destination. Geoproducts must have an important role in geotourism projects. More than products they are strategies to raise awareness for Geodiversity, they are a different approach that provides new experiences to the geotourist at the same time that they promote the local development.

In Monsanto Village, "the most Portuguese village of Portugal", sorrowed by granite boulders, there is the first GeoRestaurant - "Petiscos & Granitos" (meaning Dainty & Granites) presenting Boulders Soup or Marble Cake with the very traditional "Burlhões", a sausage of goat and peppermint (Fig.1). This GeoRestaurant, a balcony for the landscape' vastness, takes place in a traditional granite building in the middle of gigantic granite boulders, holding a natural "cave", a perfect scenery to have a GeoDinner. Even in the bathroom you can find boulders in the wall and every wall are written with geological citations from famous Portuguese writers like José Saramago or Fernando Namora.

Foto de João Geraldes

Figure 1: GeoRestaurant "Petiscos & Granitos". **a -** Balcony over the Geopark landscape, **b** - terrace and "cave", **c -** Geo Bathroom, **d -** GeoRestaurant dishes.

Almost in the extreme of the Geopark there is Casa do Forno, a GeoBakery and guest house, perhaps the first in the world (Fig.2). The GeoBakery has a very busy traditional oven that cooks besides traditional bread, Trilobite and Granulite cookies. After seeing the fossils in their context in the Geopark trails, why not taste them? But to understand the geological history of the territory, Casa do Forno suggests "The Slices of Earth" (tectonic pizzas on the plate) and Orogenic toasts for all the Geopark episodes (Cadomian, Variscan and Alpine). Casa do Forno, the guest house, offers not only comfort and rest but also geotourist activities, such as water trails, mining routes and reconstitutions of the traditional episodes, such as the smugglers route made by the Portuguese for centuries by crossing the Erges River. Here it is possible to have a delicious GeoDinner where you can start with Salted Schist's and finish with egg cream Cliffs.

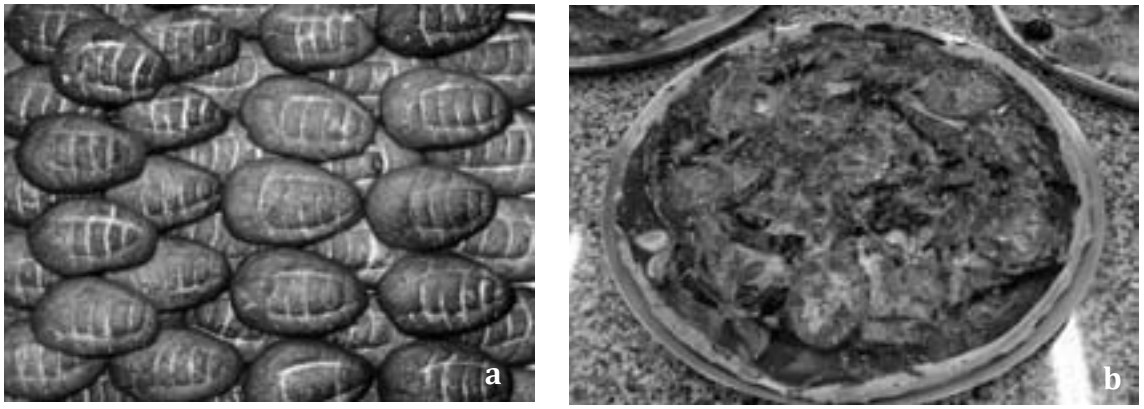

Figure 2: "Casa do Forno". a – Trilobite's cookies, b - Slices of Earth (tectonic pizzas), c - pedestrian trails, d - live reconstitutions.

Another revolutionary concept concerning GeoMarketing was the company Trilobite. Aventura (meaning Trilobite.Adventure) with outdoor activities, such as pedestrianism, slide, rappel, climbing, in the quartzite rocks with fossils from Penha Garcia. An innovative Geoproduct was the paintball championship – TriloPaint. This common outdoor activity was adopted and transformed in a typical product from the Geopark. Trilobite.Aventura also manages a bar located near the Fossils Trail, in a traditional quartzite building in the medieval core of Penha Garcia village. In February 2009 the company celebrated its first anniversary with a GeoCake illustrating the suggestive logo of Trilobite.Aventura. This trilobite-moving based on the outstanding trilobite trace fossils from the Ichnological park of Penha Garcia was transformed in logo and is always present in the trilobite team uniform (Fig. 3) and company's image.

Figure 3: a - Trilibite.Aventura anniversary cake, b - The Trilobites' uniform

Incentivos Outdoor (Fig. 4) company arrived at the Naturtejo territory in the beginning of the Geopark project and always worked in order to prepare GeoProducts to the tourists that visit this specific territory.

FIGURE 4: Incentivos Outdoor activities. a - GeoKayak, b - "There is gold at the Foz!" , c - Pedestrian Trails leaflet for GeoTrekking, d - boat trip in the Portas de Ródão Natural Monument.

It is an outdoor company which runs the boat trips to the Portas de Ródão Natural Monument and the Neolithic Tejo Rock Art. This visit along the quartzite crests and deeply-incised Tejo valley meets not only the Geodiversity but also the important avifauna, the historical and archaeological heritage. Besides these traditional boat trips Incentivos Outdoor also endorses GeoKayak in Portas de Ródão, in the Tejo River, but also in the Zêzere River meanders. In Foz do Cobrão Schist Village the company promotes a panning for gold activity with the local community. This activity called "There is gold at the Foz!" recreates the gold mining activity coming from Roman times until the the 1^{st} half of the 20^{th} century. The visitors are invited to take off the shoes, enter in the river and look for gold nuggets. In this village, the company runs a restaurant, in a traditional schist building with tasty traditional food and local products. Incentivos Outdoor presents also GeoTrekking and GeoCircuitos (GeoTrails) Programmes.

There are also traditional products produced since a long time ago directly related with Geodiversity, such as the Ródão products that use the Portas de Ródão geomonument as a brand (Fig. 5).

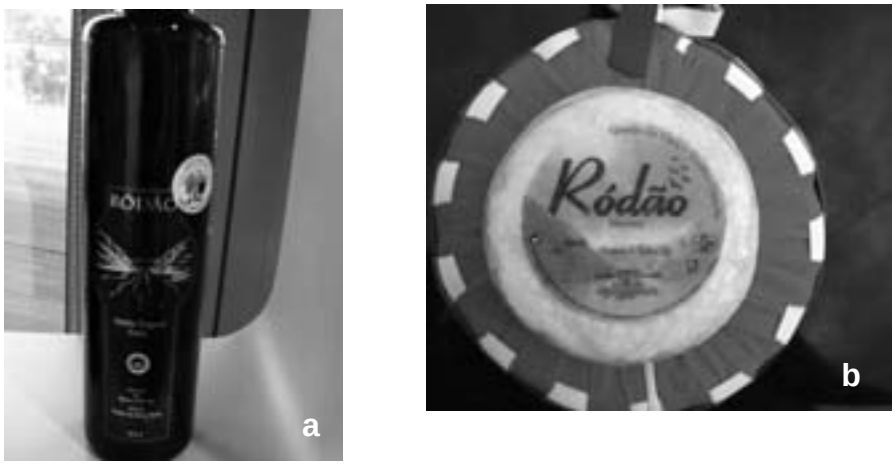

FIGURE 5: Ródão traditional products using the geomonument as brand. **a** – olive oil, **b** – cheese.

Every year Geopark Naturtejo promotes a calendar of GeoProgrammes, such as the GeoDinners or the GeoTrails, which has the acme during the European Geoparks Week (Fig. 6), all with Geodiversity as scenery and taking many public (social) and private (economic) institutions to get involved.

The sustainable local economy involves the creation of tourism backup infrastructures, namely lodging, restaurants, cultural animation, museums, exomuseums and interpretive centers and infopoints, outdoor activities and shops. It is important a good geotourism strategy with intervenients from different sectors of society. Geoparks need a strong commitment of the local community through local administration, local NGOs and local companies.

Naturtejo encourages new projects in the territory and promote them in its activities. This is as long-term project and very innovative because the geological features that have been always present in the region for the local people now can be economically exploited through new opportunities for business and sustainable explored for the benefit of people .

FIGURE 6: GeoTrails created for the BOOM Festival 2008.

GEOTOURISM AND LOCAL DEVELOPMENT – POTENTIALITIES AND RISKS

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Geotourism, at the same time that offers the visitor a deepening of the environment origins, based in geologic information and knowledge, also constitutes an essential element to include people in the context of discussions and reflexions which deal with the conflicting relationship between man and the planet where he lives (MINEROPAR, 2008).

In this sense, the potential development of Geotourism from Geoparks implantation needs special attention, considering it involves material and immaterial components, which articulate themselves under reflex of an incorporated history and the perspective of new models for the development of certain regions and spaces.

In this field emerge, beyond landscapes which geodiversity shape and makes beautiful, social environmental and economical problems, mixing several and sometimes antagonic interests.

Developmental practices based in extrativist models, despite the evolution of environmental sciences and increasing understanding of the interdependence between the different systems in which the planetary matter organizes itself (Capra 2004; Williams 2000) remain active and widely spread, underlying the base of human settlement on the planet.

The exploration of the geotourist potential of a given region when based and fostered by the economic component, even when justified by the social aspect, can be predatory to the environment, putting under threat the geological heritage, the local geodiversity and the community itself which longs for a development which can enable life quality improvement.

It matters considering that a Geopark is a territory with management based in the existence of an admirable geological heritage, support of a set of initiatives which enable the improvement of the life quality of its inhabitants, under a sustainable development perspective (Pereira et al. 2008).

It is essential therefore, that prior to creating a Geopark, there are comprehensive and deep discussions involving the community, researchers and the government searching for an only language, which promotes the understanding of Geosciences concepts, the preservation of the natural and cultural heritage, the search for the regional identity, and last, but not least, the development of geotourism.

Pereira et al (2008) point out that special attention should be given to this kind of tourism, so that it does not become a mass tourism, under risk of losing its sustained character.

The sustainability of the very geotourist enterprise depends on and demands protection actions to both the material and immaterial heritage of the region. The protection to the local culture and traditions, to the different ethnics and regional groups, to geosites and landscapes, associated with educational policies able to motivate development based on ethic and democratic basis, are a must to the implementation of fostering strategies to Geotourism.

Without observing such measures, aiming at promoting the harmonization of interests and fostering practices of environmental management which match development with the communities´ desires, the risks of Geotourism failure are high and it loses its potential value to geoconservation and to development.

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GEOTOURISM AS AN OPPORTUNITY FOR LOCAL COMMUNITIES' PARTICIPATION IN GEOPARKS

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In recent decade "geotourism" has emerged as a much talked about topic that is frequently linked to the term "sustainable tourism". Moreover geopark as an innovation for the protection of natural and geological heritages has an important role in geotourism development. By attracting increasing numbers of visitors, a geopark stimulates local socio-economic development through the promotion of a quality label linked to the local natural heritage. It encourages the creation of local enterprises and cottage industries involved in geotourism and geoproducts. This paper discusses the vital role of indigenous people in geoparks through analyzing three geoparks strategies and innovations in two countries of Europe and Iran.

At present, UNESCO declaration about geopark as a new form of protected area has been highly evolved the strategy of local communities' participation in protected areas. Geopark states that indigenous people should not be removed from the lands where they live, since the locals' knowledge and traditional style of their life play a vital role in environmental management. Geopark encourages the local communities to follow cultural interchange and identity preservation. It also motivates the local people to effectively participate in achieving sustainable development and sustainable tourism. Moreover geopark leads to stimulate the local economy through geotourism and conservation activities. Managers of geopark try to improve welfare of indigenous communities through innovative activities and consulting with local businessmen, local tour operators, private sectors, local accommodation facilities, local restaurants and producers. Besides, they involve locals in conservation and educational activities and imparting the indigenous knowledge.

Concerning the present situation and potentials in every geopark, the managers have taken some positive measures toward stimulating local's participation. For instance, Qeshm Geopark creates seasonal and part time jobs for locals through conservation activities and geotourism. Besides Naturtejo Geopark plays a vital role in consulting with locals and suggesting innovative ideas to them - geobakery and family house, georestaurant - with the goal of economy improvement in geopark territory. It also has close cooperation with schools, outdoor companies and family houses. Subsequently, Réserve Géologique de Haute-Provence Geopark attempts to develop network, local nature guides and innovative activities - G*eorium* and products based on the geological elements- in geopark.

Thus geoparks, pursuant to accomplishing their targets – geotourism, conservation and education- try to involve local people in geopark activities. For locals' involvement not only improves the local economy but develops utilization of indigenous knowledge.

GEOTOURISM DEVELOPMENT IN THE LESVOS PETRIFIED FOREST GEOPARK

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1. Lesvos Geopark

The island of Lesvos, situated in the northeast Aegean Sea, is the third largest island in Greece at 1630 km^2. On its western side one can find the Lesvos Petrified Forest Geopark, the very first Greek geopark, comprised of large accumulations of exposed fossilised tree trunks. A protected natural monument (Presidential Decree 433/1985), the Lesvos Petrified Forest consists of four major terrestrial and marine fossil sites lying on an area of 15.000 hectares. The area of the Petrified Forest also belongs to the NATURA 2000 network due to its exceptional natural characteristics (fossils, flora and fauna).

The Lesvos Petrified Forest Geopark includes a core zone (15,000 hectares of the Petrified Forest protected area) and a broad buffer zone (more than 20,000 hectares of the central volcanic terrain).

The Natural History Museum of the Lesvos Petrified Forest was founded in 1994 to protect and efficiently manage the Petrified Forest. It is a non-profit organisation that defines the management structure of the Lesvos Petrified Forest Geopark. Its seven-member board encompasses representatives of the central government (Ministries of Culture and Forestry), the local authorities (Municipality of Eressos-Antissa (Sigri), universities (Universities of Athens and the Aegean) and the local community. Its scientific, technical and administrative staff includes 9 permanent and 25 temporary employees. Systematic scientific research and excavations have been carried out over the last decade by the Natural History Museum in order to gain a better understanding of the geological evolution of the island and the origin of the Petrified Forest.

The main components of the operation of the Lesvos Geopark include scientific research, creation of the geosite inventory, protection, interpretation and promotion of geosites, conservation of fossils, creation of visiting parks, establishment of a network of walking trails linking sites of interest with ecotourism infrastructures, development of environmental educational programmes on geosites, organisation of scientific and cultural events, and promotion of monumental geosites.

The Geopark's management plan is the main tool for the operation of the Lesvos Geopark. The management plan, linking geoconservation and promotion of geosites, natural and cultural heritage with the development of geotourism, includes nine components:

- Geosite identification and assessment,
- Enhancing the natural and cultural heritage,
- Geosite protection and geoconservation,
- Geopark infrastructure and land management,
- Geotourist and promotional activities,
- Educational activities and tools,
- Supporting local business,
- Implementation, monitoring and review,
- International cooperation and EU funding.

During the last seven years the Lesvos Geopark has been following the provisions of its management plan and has implemented a range of activities aimed at the further improvement of its infrastructure, services, activities and promotion. The results of the implementation

of the management plan have been a significant increase in the number of visitors, the enrichment of its offer and services to visitors, and improvement of its operations.

2. Geotourism infrastructure

The Lesvos Petrified Forest Geopark has developed a range of tourist infrastructures to serve its visitors. The Natural History Museum of the Lesvos Petrified Forest in Sigri village is at the core of these infrastructures. This state-of-the-art museum has become a key factor in attracting visitors to this part of the island.

Museum exhibitions present the evolution of plant life on Earth, the flora of the Petrified Forest with fossil remains of over 40 different species found and identified in the broader area of western Lesvos, as well as the volcanic activity related to the formation of the Petrified Forest and the evolution of the Aegean area.

Within the Petrified Forest's protected area, the main fossil sites are fenced and safeguarded, and five visiting parks have been established, attracting thousands of visitors each year. These include the Petrified Forest Park, the Sigri Park, the Plaka Park, the Nisiopi Park and the Skamiouda Park. Several other areas will become visiting parks during the next years, as the Museum has already begun the necessary procedures.

Another main infrastructure is the "Lava Paths" that lead visitors down the ancient paths of the pyroclastic flows from the main volcanoes to the Petrified Forest. Equipped with information panels that explain the various geosites, these footpaths link the existing visiting parks, wetlands, sites of natural beauty and ecological value, as well as cultural monuments (the Sigri castle, the Ypsilou monastery, the Eressos acropolis), picturesque villages and other sites of interest throughout the Geopark. Along the main roads crossing the Lesvos Geopark area, informative panels and road signs direct visitors towards the Petrified Forest and demarcate the borders of the protected area. Walking trails start from different points along the main road.

The Geopark has also established two information centres to inform visitors about the geotourist and educational activities in Lesvos. The first centre in Mytilene, the capital of the island, includes a small exhibition centre. The second information centre operates in the village of Eressos during the summer.

There is also an information point in the Odysseas Elytis Airport of Mytilene.

3. Geotourism activities

A broad range of activities accomplish the task of attracting and informing visitors.

Lectures and multimedia presentations at the Museum are used to familiarise visitors with the geological processes related to the origin of the Petrified Forest, the diversity of fossil plants, and the geological evolution and natural heritage of the Aegean.

Guided tours in the Petrified Forest parks, thematic guided walks, guided trekking and various recreation activities in the vicinity of geosites help raise public awareness about the values of geosites.

Furthermore, a series of scientific and cultural events is organized and hosted every year in the Petrified Forest to attract the attention of the broader public to this unique natural monument. The range of events includes scientific lectures, slide projections, documentary films, natural science oriented temporary exhibitions, book presentations, painting – sculpture – photo and video-art exhibitions, music and dance events, theatrical plays and happenings. Through these events the Geopark draws large audiences of people who may have low or no interest in natural heritage, thus creating new opportunities for sensitisation.

The Geopark also organizes several thematic events to celebrate special events or international days (i.e. Museums International Day, Day of Monuments, Day of the Earth, Day of the Environment, European Heritage days, European Geoparks Week, Earth Fest - summer festival).

Temporary exhibitions on the Lesvos Petrified Forest circulating through the larger cities and museums in Greece and abroad contribute significantly to the promotional work of the Lesvos Petrified Forest Geopark.
International and national scientific conferences and meetings are also hosted in the Museum's conference centre. Such events bring scientists from all over the world to the Geopark, helping to raise the Petrified Forest's profile in the academic community and to promote the use of its existing infrastructure for the hosting of other academic and educational activities (i.e. research groups, educational visits, student field work). As a result, several universities have started to organize student visits and field work in the Geopark.
The promotion of the Petrified Forest occurs through print and television media. New excavation findings have attracted the attention of local and national media to this exceptional natural monument. A number of articles in national newspapers and magazines as well as radio and TV programmes have referred to the Petrified Forest, the new excavation findings and the importance of the monument. Research results have been presented in numerous scientific meetings in Greece and abroad, and several multimedia presentations on the Lesvos Petrified Forest have been organized in Athens, Thessaloniki, Crete and in the main towns of Lesvos.
The Geopark has also produced a series of informative scientific and popular publications for visitors such as coffee-table books, field guides, magazines, conference proceedings, brochures, leaflets, posters etc.

4. Geotourism and local economy

The Geopark has created links with local tourist enterprises, restaurants and small hotels in order to provide the necessary infrastructure to meet the needs of the increasing number of park visitors. The majority of visits to the Geopark occur during the summer period (July – September), but the aim is to extend the visiting period to the spring and autumn seasons.
In the village of Sigri, the number of "Bed and Breakfast" accommodations has doubled over the last few years in order to meet the increasing demand. More importantly, visitors have increased the duration of their visit to the Geopark area. As a result the majority of the new enterprises established in western Lesvos are connected with the activities of the Lesvos Geopark.
The Geopark also supports the making of local handicrafts such as the production of fossil casts and souvenirs by local enterprises. These items are on sale in the Museum shop along with a variety of other locally made products. Lesvos has a long tradition in pottery and wood carving and the Geopark promotes these products to its visitors.
The Lesvos Geopark also collaborates closely with women's agrotourist cooperatives and local organic food producers to offer its visitors the opportunity to taste and buy local food products (pasta, organic olive oil, wine, ouzo, liquors, traditional sweets and marmalades etc). The catering for all Geopark events (conferences, meetings etc.) is supplied by the women's cooperatives using the local traditional recipes. Their products are also sold in the Museum snack-bar.
Every summer the Geopark organizes an Agrotourist festival (attended by 28000 visitors in 2007), which promotes quality local products, food and drinks prepared by the women's cooperatives. The Agrotourist festival includes a variety of presentations, events and happenings as well as an exhibition fair of local products. The event brings local producers and potential customers together. In this way Geopark visitors experience not only the rich natural heritage of the area and sites of high ecological and aesthetic value, but also the culture, tradition, and local production of the region. The Women's agrotourist cooperative found that this festival provided them with an excellent opportunity to promote their products and their success lead to the creation of similar cooperatives in other villages.
The Lesvos Geopark contributes significantly to territorial development by directly and indirectly creating new jobs. Since 1995 people have been finding employment within its activities, such as the 25 seasonal positions (8 months per year) and 8 permanent positions. This has to be added to the 5 existing positions in the Petrified Forest Park. But what is

even more important for the employment in the area is the number of other employment opportunities which have been created in tourist enterprises, small hotels, guest houses, restaurants and other activities connected with the increase of tourist flow in the Geopark area. Several other local artisans, such as makers of handicrafts and ceramic fossil casts, carpenters, and blacksmiths, are permanent collaborators with the Geopark.
Geoparks address the strong need for effective management of important geosites and sustainable development of rural areas through the development of geotourism which enhances the value of the Earth heritage, its landscapes and geological formations, key witnesses to the history of life. The Geoparks initiative adds a new dimension to the 1972 Convention concerning the Protection of the World Cultural and Natural Heritage by highlighting the potential for interaction between socio-economic and cultural development and conservation of the natural environment.

5. Conclusions

The Lesvos Petrified Forest Geopark integrates the range of resources found in its broader region, including the existing geological tourist attractions (the Petrified Forest Park, the museum, the Sigri Park and the Plaka Park), the various interpreted geosites, unique landscapes, wetlands, sites of natural beauty and ecological value, as well as cultural monuments, picturesque villages, traditional gastronomy and local products.
A broad range of activities combine the main components for the operation of the Lesvos Geopark, including scientific research, the creation of the geosite inventory and map, the protection, interpretation and promotion of geosites, the conservation of fossils, the creation of visiting parks, the establishment of a network of walking trails linking geosites to ecotourism infrastructures, the development of environmental education programmes on geosites, the organisation of scientific and cultural events, and the promotion of monumental geosites.
The results of its operation prove the potential of Geoparks to become powerful new tools for sustainable rural development through geotourism.
The positive results of Lesvos Geopark operation on geotourism development have been already recognized. Lesvos Geopark won the SKAL International Ecotourism Award 2008 in the category “general countryside”. SKAL International is the largest organization of travel and tourism professionals in the world.
In 2009 Lesvos island was declared as the first Greek Tourism Destination by the Greek Ministry of Tourism Development. The award was given in the frame of the European Campaign EDEN: European Destinations of Excellence. The theme of 2009 campaign was ‘Tourism and Protected areas”. The award was given to Lesvos due to the operation and activities of the Lesvos Petrified Forest Geopark.

GEOPARK: THE RIGHT PATH TO TERRITORIAL COMPETITIVENESS THROUGH NATURE TOURISM

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The birth of a Geopark allows a territory to belong to a network of Geoparks around the world, with a vast accumulated knowledge in management of geological heritage, in a tourist and scientific perspective, and, at the same time, be supported on a strong, solid, believable brand such as UNESCO.

Frequent Asked Questions

- What is the right way to take advantage of opportunities brought by a Geopark creation?
- How should the population be involved in such a powerful and demanding process?
- What's the role of the political entities?
- How does economical growth, through Nature Tourism, can be taken as a raise of development levels to local population?

Points to be followed

Strategy

- To push and manage all the different actors, either belonging to public or private sector, that perform or that in a more or less deep way are connected to the Environmental/Geological, historic and cultural heritage to give their active contribution in the implementation and development and consolidation of a sustainable strategy based on the heritage valorization.
- Ensure the productive capacity, respecting the heritage qualification principles, allowing the diversification of touristic products, aiming in particular to the innovation in supply through the incorporation of new methods, ensuring tan attractiveness raise and, therefore, a more competitive territory.

Definition of Development Goals

- To protect and promote the natural and cultural-historical heritage through sustainable models of management;
- Focus on innovative products, market niches, certification and research on the framing of a Sustainable Tourism.
- To promote the articulation and harmony between National Touristic Strategic Plans and a balanced development in the context of the European Funds and policies.

A Nature Tourism Icon

- Nature Tourism concept has its basis in the premise that projects and activities should give its share to local and regional sustainable development. Having these guidelines in mind it is easy to conclude that planning and touristic development should embrace, in harmony, the following 4 levels of interest:

• Receiving population (hosts);
• Tourists (guests);
• Tourism;
• Natural environment;
• Developed and implemented tools in the management of visitors:
• Agreements with tour operators over the number and size of ups to bring;
• Application of systematic environmental, social and cultural act assessment on all proposed development. This is also concerned with details of what is offered to visitors, such as the choice of products to them (for example avoiding artifacts with a sacred significance) or use of inappropriate sources of fuel;
- Codes of conducts for visitors;
- Zoning both within and outside protected areas. This should cover both the sitting of facilities and the degree of access allowed. In some locations, village communities have identified specific zones for ecotourism, both with respect to facility provision and wildlife.
- Conservation measures. A common approach is to locate tourist lodges some distance away from community villages.

INVOLVEMENT OF LOCAL COMMUNITY IN SETTING UP A GEOPARK

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A process of establishing a geopark can be a very difficult undertaking if simply forced upon a local community with no previous groundwork. Based on our five-years experience with the project Geopark - Island of Rab, we conclude that a local community in the area aspiring to become a geopark can be divided into several segments, all of which need to be given attention separately, thoroughly and continuously:

1. administration (e.g. of a city, county)
The administration needs to know both short-term and long-term results expected to come out of the geopark project, what the benefits (consequences) of having a geopark are in the terms of finances and legal status. The project idea has to be adjusted to the local needs and realistic abilities. Frequent meetings between geopark project executives and the local administration are necessary to pre-empt any possible problems that may arise.

2. tourist board and tourist workers
Close cooperation with the tourist board of the area is needed and desired while creating and distributing geopark promotional materials. Also, the geopark website, coordination with local folklore (heritage) clubs and similar, and geopark promotional events may be more easily managed with the help of the tourist board. Tourist workers (e.g. hotel and pansions owners) should be informed about the geopark project from the beginning through presentations, workshops and similar, and consulted if needed.

3. businesses, shops, restaurants, etc.
For the local businesses it is important to know what the geopark will mean in the terms of income, customers, new business options. This can be accomplished through public presentations, lectures, printed publications, etc.

4. mountaineering club, nature-oriented NGOs, etc.
Cooperation with any organization whose main activity is in one way or another connected to nature can be of great help during the initial phase of establishing a geopark, and later once the geopark starts "living" on its own. Their members can offer valuable hands-on help, experience, ideas, and knowledge of the area, all of which can be used to improve the process of geopark's development.

5. children, teens, schools/school teachers
Children are the most perceptive age-group, and they tend to pass on the knowledge they gathered to their parents and friends. That is why organizing popular-scientific lectures, workshops and field trips for schoolchildren and their teachers is an excellent way to inform a significant part of the local community about the geopark, what it means, how it works and what the scientific basis is.

6. media (local radio station, TV station, newspaper/magazine)
Local media should be informed (and kept informed) from the beginning about a geopark project, any new developments and significant events.

7. local experts/scientists (geology, history/archaeology, biology, etc.)
Every community has a number of qualified experts in various scientific fields. Geoscientists, biologists, archaeologists and others who were not the part of the initial geopark idea, should be included into the process of its establishment and development, adding their expertise and especially the knowledge of the local natural and cultural heritage.

8. others
Other members of the local community who do not fit into any of these above categories, can be informed about a geopark development and its scientific basis through public lectures and exhibitions, through the media (newspaper, magazines, radio) and geopark publications.

GEOPARK ON SITE - LOCAL AMBASSADORS FOR A GLOBAL NETWORK
RESIDENTS' COMMITMENT IN GEOPARK DEVELOPMENT

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The Geopark Bergstrasse-Odenwald is located in the south of Germany between the two European Metropolitan Areas Frankfurt Rhein-Main and Rhein- Neckar. The territory offers a broad variety of locations of geological and cultural importance, highlighted by three UNESCO World Heritage Sites. Since 2002, the Geopark is a member of the European Geoparks Network, since 2004 part of the Network of Global Geoparks of UNESCO.

As an active member of the GGN and EGN, the Geopark is committed to implement the message and underlying concept of these networks by the communication of geological and cultural heritage to the general public and the provision of contributions to sustainable regional development.

The size of the territory (3,500 km^2) and the high number of residents (about 1 million) has been one of the biggest challenges within the implementation of the regional Geopark concept - in the physical landscape as well as in the perception of the general public.

With its "Geopark-on-Site "- Programme, the Geopark Bergstrasse-Odenwald has developed a targeted approach in order to enhance a regional network of committed local stakeholders and to communicate authentically the territory's geological and cultural identity to the public. The "Geopark-on-Site" concept addresses residents who are interested in the presentation of their direct local environment to visitors. Local groups are invited to join the Geopark-on-Site network and to participate in a training offered by the Geopark administration. Currently, more than 150 active Geopark-on-Site guides as part of the Geopark's visitor service provide a substantial contribution to the public profile of the Geopark. Visitors are attracted by the special combination of scientific information with on-Site authenticity and local knowledge. At the same time, hidden knowledge and passive expertise of the region is being reactivated and hereby preserved for future generations – a sustainable contribution to the reinforcement of regional identity. "Geopark-on-Site" is promoting regional economy and typical products by linking tour offers with visits of regional enterprises (restaurants, farms, handcrafts). The dissemination of the message of GGN/EGN is an obligatory part of the presentations of the on-Site guides.

On the organisational level all Geopark-on-Site groups are closely linked to the Geopark administration: e.g. by vocational training offers, by a regular newsletter, by exchange meetings and by provision of program leaflet layouts in the Geopark CI. Of course the on-Site groups are presented on the Geopark homepage.

The Geopark–on-Site concept integrates local stakeholders as ambassadors of the GGN/EGN message and is linking local commitment and local knowledge directly to the development and promotion of the Geopark. This approach is likely to work out worldwide: in each region you would find local traditions, customs and products as well as residents who would be proud and happy to present these values. Existing examples from different Global Geoparks are proving this statement.

GEOTOURISM AND INTERPRETATION FACILITIES IN BEIGUA GEOPARK (ITALY): THE VISITOR CENTRES AND INFORMATION POINTS NETWORK

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During the last five years Beigua Geopark has developed several projects and has acted to raise public awareness about nature conservation and to enhance the geological heritage at a local, national and international level.
Thanks to effective partnership and operative collaboration with geoscientists, local authorities and tourism organizations Beigua Geopark set up around the territory a structured network of interpretation facilities to support geotourism activities. The network consists of:
1. "Palazzo Gervino" Visitor Centre (Sassello Municipality) – it is entirely dedicated to the theme of Geology and Geomorphology (Fig.1). Thanks to the latest multimedia equipment, the Visitor Centre can supply information regarding features of the Beigua Geopark, as well as the international Geopark network (The European Geopark Network and the Global Geopark Network, supported by UNESCO). There is a particularly interesting fossil exhibition here, such as finds of *Antracotherium*, an Artiodactyl mammal widespread in Europe, Asia, and probably Africa between the Eocene and Oligocene periods (50-23 million years ago). There are also paleontological exhibits regarding two specific sites: Ponte Prina (Sassello) and Santa Giustina (Stella). These show evidence of the geological evolution which took place in the Park territory during the Oligocene period, around 28-30 million years ago. The historical mansion of Palazzo Gervino also houses an Information and Tourist Office.

2. "Villa Bagnara" Visitor Centre (Masone Municipality) – the priority theme of the Centre is related to the traditional local trades and typical farming products within the Park area, but a "Geopark Corner" and information boards with multimedia links to all sites of major geological interest in Beigua's territory is available.

3. "Vaccà" Ornithological and Educational Centre (Arenzano Municipality) – located in the Lerone Regional Forest and mostly dedicated to ornithology, the Centre offers a geological laboratory with learning kits which explain the geological and geomorphological processes within the surrounding area.

4. "Bruno Bacoccoli" Information Point (Cogoleto Municipality) – it is situated in the heart of the Park, at an altitude of 1,100 m above sea level, supplies tourist information and displays a lithology exhibition related to the Park, exhibiting a variety of outcropping rocks to be found in the Beigua Geopark. An outdoor "Stones garden" shows different pattern of rocks belonging to the ophiolite area in Beigua Geopark.

5. "Banilla" Information Point (Tiglieto Municipality) – the information point hosts a variety of local activities and offers information regarding tourist facilities and attractions within the Geopark.

6. "Alpicella" Museum (Varazze Municipality) – it presents a permanent geo-archaeological exhibition referring Geopark territory.

TOURISM "TECTONICS" AND GEO-BAKERY

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Casa do Forno, an ancient community oven that was almost down to ruins two years ago… "Saved" by a couple of geologists and their family, it was turned it into cosy accommodation and a Geo-Bakery.

After abandon our "normal" mining jobs in the Gobi desert we started a new project in a completely different business: tourism. We really like our B&B and traditional bakery, but a collection of rocks and minerals in the corridor wasn't enough for us, geologists. So, we started to change a few details, and to be inside Naturtejo Geopark was the perfect excuse!

The "schists" were our first geoproduct just by changing the original name, because they already existed and looked like schist. Then we transformed the shape of little cakes and call them "Trilobites" (Fig.1).

Figure 1: "Trilobite" cakes.

Our planet is our source of inspiration and geodynamics can be just amazing. The Earth crust is broken in several pieces, tectonic plates… like "Slices of the Earth"… (Fig. 2) like slices of pizza! The flavour of our Slices of the Earth change depending on the actual location of a determinate plate

Figure 2: Variscan and Alpine Toasts

Orogeny, collision, stress. Picture two continents colliding like two slices of bread, and the sediments of the sea that are in the middle like slices of cheese and smoked ham…What are you going to have at the end of this Wilson's cycle? Correct! Orogenic toasts (Fig. 3)!!!
All this is fun and great, but it is a big challenge as well. It is not easy to put people asking for a Pizza Nazca or a Cadomian Toast.

FIGURE 3: "Slices of the Earth"

But Casa do Forno is not just a Geo-Bakery alone (Fig. 4)…
"*In "Casa do Forno" you'll wake up in the morning with the flavour of fresh baked bread. You'll go down to the breakfast room and there it is, tempting us, with homemade jams joining it. In here you can enjoy a familiar environment of calm and relaxation, enjoy the garden and the pool, or just sit to enjoy a cup of coffee or tea while reading a book. The wide balcony opens up for privileged view! First, the cosy garden with fluffy grass where the Salvaterra's granite emerges, and in the background the wavy scenery molded by the rivers on the schist substract...The surrounding have plenty of areas yet to explore which makes Salvaterra do Extremo an exciting destination... Abandoned mines, roman gold mines, fossils, hills and valleys that tell us stories from 600 million years, narrow and deep river canyons, vultures, deers, foxes, landscapes impregnated with stories of smuggling shepherds and an exuberant flora during the spring...*"
Casa do Forno organizes some outdoor activities where we show people the Geodiversity of Salvaterra do Extremo surroundings. These are the perfect opportunity for use our geo-products on a small meal (Fig. 5).
That is how we create a complete geotourist experience.

FIGURE 4: Geo-bakery brochure. Geological section from the Geological Map 1:50000 of Salvaterra do Extremo, sheet 25 B, published by Instituto Geológico e Mineiro.

Geo-Menu

Casa do Forno, an ancient communitary oven that was almost down to ruins two years ago... Saved by a couple of geologists and their family, it was turned it into a cosy accomodation and a Geo-Bakery!

In Salvaterra do Extremo surroundings you can find the most ancient rocks of the Geopark-Naturtejo and at the same time, the oldest fossils knowned in Iberian Peninsula.

Lets taste some geodiversity...

Gaspacho (cold tomato soup)

To fight the heat so tipycal of this region in the summer,people take this fresh soup that can be made from several vegetables and fruit...

Salted Schists

Delicious "schist like" pastry stuffed with cod fish paté.

Olive Bread

Olives are a symbol of mediterranean culture. In Casa do Forno, we put them in bread, obviously!

Orogenic toasts

Made have the rocks been "suffering" during the last 600My in this Geopark! Cadomian, Variscan and Alpine, diferent ways of putting two slices of bread under stress to a point where its nucleous almost melts.

Slices of the Earth

The crust of the Earth is broken into a mosaic of separate plates. All around the world we found inspiration to give flavour to each one!

Migas de Poejo com peixe frito (mashed bread with fried fish)

Poejo is a herb that grows wild close to water lines. Its fresh flavour gives a wonderful taste to this very tipycal dish.

Cliffs

Meringe with egg cream falling from the cliffs.

FIGURE 5: Geo-Menu. Extract from the Geological Map 1:50000 of Salvaterra do Extremo, sheet 25 B, published by Instituto Geológico e Mineiro.

GEOPARK AND GEOTOURISM IN CHAPADA DIAMANTINA (NORTH-EASTERN BRAZIL): STRATEGIES AND PERSPECTIVES

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1. Geological settings

The Chapada Diamantina region comprises a group of mountains, plateaus and karst reliefs located in the center of Bahia State, north-eastern Brazil, occupying an area of around 65.000 km^2, in the middle of the São Francisco craton (Fig. 1). This region is constituted by low-grade metamorphosed volcanic and sedimentary siliciclastic and carbonate rocks from the Proterozoic Eon.

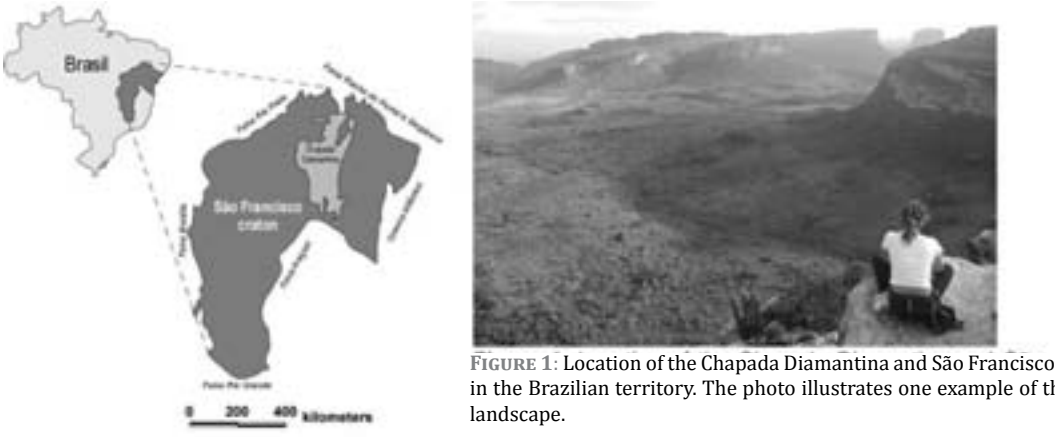

Figure 1: Location of the Chapada Diamantina and São Francisco Craton in the Brazilian territory. The photo illustrates one example of the local landscape.

These rocks are stratigraphically divided into four groups as follows: Rio dos Remedios Group (Paleoproterozoic), Paraguaçu and Chapada Diamantina Groups (Mesoproterozoic) and the Una Group (Neoproterozoic). The Rio dos Remédios and Paraguaçu groups were deposited inside an aborted rift valley and the Chapada Diamantina Group, as a sag basin. The set is shaped as a "bovine head" basin and exhibits nowadays an average thickness of more than 1.000 m. According to Dominguez (1993) the deposition of these rocks started 1,7 Ga. ago and lasted for around 700 million years (Pedreira, 1997).

The region has high hydrological and hydrogeological relevance, as the main rivers of the Bahia State start on these mountains and plateaus, which drives it to be considered as a natural reservoir. This situation reinforces its importance for conservation practices as we could say that the protection of that landscape and its geological heritage is also the protection of the water resources that feeds the main cities of the Bahia State, which includes around 13 million people.

2. Geoconservation in Chapada Diamantina: present situation and future perspectives

The Geological Survey of Brazil is proposing the creation of four geoparks in the region of Chapada Diamantina, which are supposed to integrate the UNESCO´s Global Geopark Network. Presently, 33 geosites were identified under the scope of an ongoing PhD's thesis project, carried out by the first author of this resume, which will contribute to support the creation of these geoparks. This inventory is evaluating the interests associated to each geosite, their potential uses, influence and the situation in respect to the nature conservation and protected areas.

Nowadays, there is already a network of 12 protected areas in the region, focused on the conservation of the biodiversity, but also considering some aspects or elements of geodiversity in their creation acts. Most of these protected areas are not fully operational and they cannot ensure the conservation of the geosites included inside their borders. There are also some private initiatives to protect localities that are object of intensive visitation (more than 10.000 visitors per year), which most of the time, can guarantee the protection of some geosites.

Preliminary considerations show that the set of protected areas occupies around 4000 km^2 of Chapada Diamantina´s territory, which corresponds to 6% of the total area estimated for the region. It was also detected that 50% of the inventoried places are located inside protected areas and around 10% of the inventoried geosites are protected and used by private initiatives, namely local population that owns the land and control the visitors' access to geosites.

The creation of geoparks in Chapada Diamantina would be a good strategy to protect geosites, to establish geotourism initiatives in the region and to publicize Earth Sciences in the country. Nevertheless, an important debate concerning the management structure of these geoparks, facing the huge geographical dimension of the area and difficulties related with municipality management, must be taken into account. The creation of an association of existing NGO´s and administrative institutions could be a good starting point to manage these geoparks.

3. Evaluation of the local geological heritage, geosites and geotourism

During the 18th and 19th centuries, the mining of gold and diamonds was the main economic activity at Chapada Diamantina. With the depletion of reserves, most of the population migrated away. Nowadays, tourism and an intensive farming raised the local economy, converting the region in one of the major nature tourism destinations of South America. Although the main tourist attractions are represented by geosites (waterfalls, caves and canyons), most of the tourists do not have the perception of their scientific or didactic relevance, as Earth Sciences are not a very popular topic in Brazil.

Considering that the geological heritage is already the main touristic attractiveness of Chapada Diamantina, which brings most of the tourists to the region, one could say that the present tourism activity in the region could be considered as geotourism. Nevertheless, there is a lack of interpretative information available to visitors and no coordination to ensure geosites management. The strategy to implement and handle the geotourism at Chapada Diamantina should integrate the guidelines to protect the geological heritage and the production of interpretative materials about the geosites, aiming to raise the visitors' awareness about the evolution of the regional landscape and Earth history.

Preliminary results of the ongoing inventory shows that the main interests related with geosites are geomorphological, tectonic and hydrological ones. Tourism is their main potential use, followed by the scientific use. In terms of its influence, field observations shows that 3 geosites are considered of international relevance and 4 of them are considered of national interest; the remaining geosites are considered of regional or local relevance.

The ensemble of geosites inventoried until now is representative of the regional geodiversity. Geosites are related with rocks that crop out in the region, their geomorphological features and with the ancient mining activity from the 19th century. These geosites reinforce the didactic value of Chapada Diamantina associated with sedimentary paleoenvironments, including marine, fluvio-deltaic, glacial and desert deposition and also geomorphological processes related with the landscape evolution, including karstic systems. Furthermore, the Chapada Diamantina's geological heritage is related with the mining history from the Brazilian colonial period, including the mining of gold and diamonds.

Many of the geosites are already used by the ongoing touristic activity, due to their aesthetical appeal and some of them, that are located at the eastern border of Chapada Diamantina, are visited by more than 10.000 persons per year, based on the information collected in the field. As an example, Fig. 2 presents a scheme of the Cachoeira da Fumaça waterfall that is 400 m high and located inside the Chapada Diamantina National Park being one of its main touristic attractions, visited by 16.000 people in the year of 2008, from different parts of the world, according to the local guides association that controls the access to the geosite.

Taking into account that tourism is already an important economical activity in the region, the production of interpretative material of the local geological heritage, followed by the creation of geotouristic routes and the reinforcement of the ancient local mining culture would drive the geotourism as an economical alternative to some cities of Chapada Diamantina, turning this activity as the basis for the sustainable development of the region.

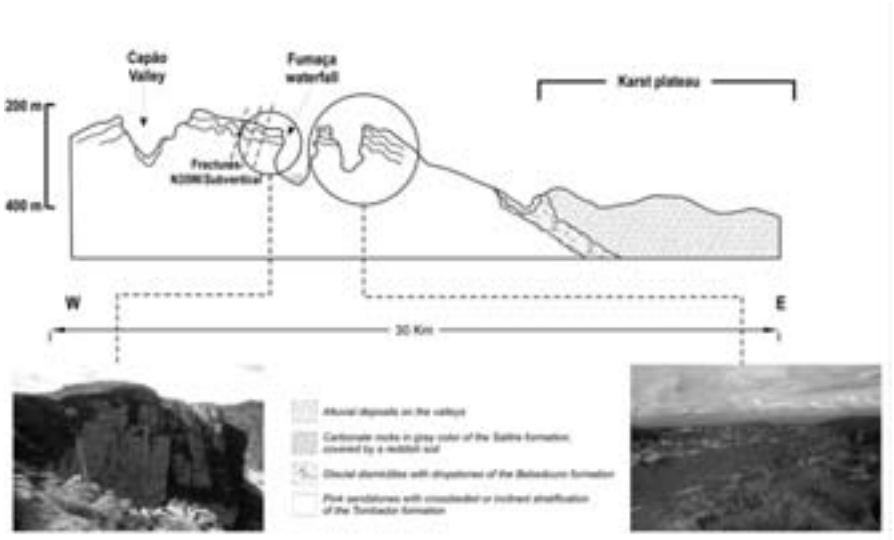

Figure 2: Scheme of Cachoeira da Fumaça waterfall and its geological context. The geosite is located within the Chapada Diamantina National Park and is one of its main touristic attractions.

4. Geoconservation and geotourism in Chapada Diamantina: strategies and perspectives

According to the UNESCO´s definition (UNESCO, 2009), a Geopark is a territory containing a number of geoheritage sites of particular importance, rarity or aesthetic appeal. These sites are part of an integrated concept of protection, education and sustainable development through geotourism. A geoconservation plan for Chapada Diamantina must ensure the conservation of its geological heritage and the definition of the main geosites that can be interpreted and publicized. It is necessary to define routes and sets of geosites that would be elucidative of the region's geological and geomorphlogical evolution and also interesting to illustrate the Earth history and the geological evolution of the São Francisco craton.

The geoconservation plan must also define the boundaries of the potential geoparks and submit them to UNESCO´s Global Geopark Network, considering its basic strategies of conservation, education and geotourism, Facing this situation, the main strategies that are in course of action to reach these goals are described below:

- **Inventory of geosites**: the systematic inventory of geosites adopted the methodology of reconnaissance inventories (Sharples, 2002) and the selection of superlative sites (Wimbledon, 1999). In this first stage, geologists from the Geological Survey of Brazil, who worked on the geological mapping of the region, helped in the selection of the geosites. These geosites include places that are already subjected to touristic visitation and also the ones that gather scientific interest to explain the regional geological evolution.
- **Quantitative geosites assessment**: a specific quantitative methodology for the area is being developed. This will help to prioritize the geoconservation actions for the inventoried geosites, considering the information available and the protection and vulnerability of each place.
- **Propose geotouristic routes**: some geotourist thematic routes will be proposed and interpretative and educational material will be prepared for each one of them.
- **Delimitation of geoparks**: UNESCO´s Geoparks will be proposed, following the project of the Geological Survey of Brazil. Due to the wide area of Chapada Diamantina, the present discussions about the creation of geoparks in this region are related with the number of geoparks to be created and their management structure.

Considering the aesthetic appeal of the area, its geological heritage and the ongoing nature tourism demand, the perspectives for the region is that geotourism can be a very good alternative to foster the sustainable development in Chapada Diamantina. The creation of the Geoparks can also bring to the visitors and local population some knowledge about Earth history and the awareness that the natural resources must be exploited respecting natural limits and facing the social demands.

It must be considered that, in spite of the splendored mining history of the region, nowadays it presents some of the worse social index of the Bahia state, which means that this exploitation did not bring the expected development to the region. Even the ongoing tourism did not bring yet the expected benefits for the local population.

Acknowledgments

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VALONGO PALAEOZOIC PARK – A GEOTOURISM RESOURCE

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1. Introduction

The Valongo Palaeozoic Park, resulting from the partnership between the Municipality of Valongo and the Faculty of Sciences of the University of Porto, constitutes from 1998 an educative and environmental resource, where the geology advertising and awareness to natural environment next to schools and to general public promote geotourism.

This work aims at protecting, promote and valuing a great Geological Heritage which occurs in Valongo area, within the scope of a sustainable development. The project started in 1995 and was financed by a European Community LIFE Programme. Since 2000 through a protocol of cooperation between the City Council of Valongo and the Faculty of Sciences of University of Porto, the Geology Centre provides assistance and scientific support in the Valongo Palaeozoic Park. Among the geodiversity of the Palaeozoic Park, the internationally recognized Ordovician fossil-rich beds and the gold mineralization (exploited since Roman times) must be emphasised. Among the proposals of the Portuguese Group of ProGEO for the Definition of Portuguese Geological Categories of International Relevance to be integrated into the European Geological Heritage, the Palaeontological Heritage of the Valongo region – "Ordovician fossils from Valongo Anticline" – was one of the frameworks proposed (Brilha et al. 2005). The geological heritage of Valongo Palaeozoic Park includes significant values that have also deserved the attention of scientists and authorities that carried out initiatives of preservation, divulgation and raising awareness of this heritage which led the Portuguese Group of ProGEO to assign to the Municipality of Valongo the Geoconservation Award 2005. The 2nd prize of "Eurosite Green Days Award" was also received by this Municipality for the campaigns towards raising awareness, preserving and promoting projects in natural areas classified as Natura 2000 Network.

The Palaeozoic Park is located south the city of Valongo, about 15km from the city of Porto and covers "Serra de Santa Justa" and part of "Serra de Pias", enclosing part of the Ferreira valley located between the two mountains. It can be accessed through one of the three entrances of the Park.

2. Geodiversity

Concerning geodiversity, we emphasize the palaeontological values among many others. Scientific interest of Ordovician fossils occurring in the region is internationally recognised. The Palaeozoic of the area is represented by Precambrian(?) and/or Cambrian to Carboniferous metassediments, showing variations in sedimentary environments (changing from seas to lakes or rivers) and climate changes (glacial climate and equatorial climate). Particularly Ordovician shows different and interesting values (Romano & Diggens 1974; Couto et al. 2003; Couto & Borges 2005) (figs. 1-4). Traces of significant mining activities for gold and antimony show the mining wealth of the region already known by the Romans in the 1st century (Ferreira et al. 1971; Couto, 1993, 2002). The slate, an important geological resource is still exploited.

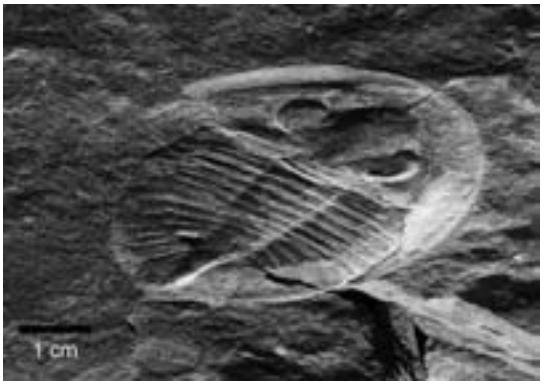

Figure 1: *Nobiliasaphus* - trilobite of the Middle Ordovician.

Figure 2: Folds in the Lower Ordovician: alternations of phyllites and quartzites in the inverse limb of Valongo Anticline.

Figure 3: - Lower Ordovician quartzite ridges in the inverse limb of Valongo Anticline (Fragas do Diabo).

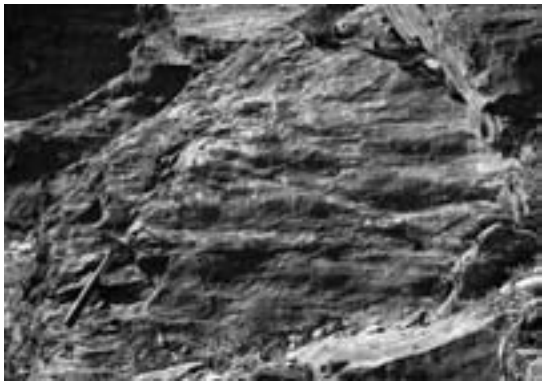

Figure 4: Ripple-marks in the Lower Ordovician quartzites indicating shallow marine environments.

The significant geological structure known as "Valongo Anticline" shows interesting evidences of tectonic action (Ribeiro et al. 1987) and remarkable features related with geomorphology (Rebelo 1975).

Besides the geological values the Park also presents important aspects concerning the landscape, biology and cultural values.

Figure 5: Couce, a small rural village in the heart of the Valongo Palaeozoic Park.

In our activities an effort is made to involve the local community that becomes more and more interested in their own heritage.

3. Infrastructures and visits

An interpretative circuit with three geo-trails (green, red and yellow trails) was established showing different aspects of the natural heritage and, in particular, of the geological heritage (Couto, 2005; Couto & Lourenço, 2005). In the last year the Municipality of Valongo established an "ecological corridor" profiting the green geo-trail of Palaeozoic Park and linking the urban area to the field.
In the Interpretative Environmental Centre (Fig. 6) a small library is provided with scientific and didactic papers related to the geology of the region, topographic and geological maps, leaflets, CD-ROMs and videos. Other didactic materials are available namely advertising posters (Fig. 7), a three-dimensional representation of the present day geology and geomorphology of the region and its evolution throughout the times and a binocular magnifying lens that allows the observation of fossils and minerals with identification cards.

A permanent exhibition of Palaeozoic fossils and ores of the region with summary information also exists (Fig. 7).

Figure 6: Environmental Interpretative Centre.

Figure 7: Guided visit: thematic posters and fossils exhibitions can be observed.

In the aim of environmental education, visits to trails or to mines are guided by elements of Department or Centre of Geology of the University of Porto promoting the geological heritage as an integrate part of natural heritage. The visits begin in the Interpretative Environmental Centre where the most relevant aspects of geological history of Valongo are taught using the didactic materials.

The visits are flexible in character, depending on the interests expressed by visitors and on the level of their knowledge. Information about the evolution of life on Earth, about internal and external geodynamics, about the Theory of Plate Tectonics and its close relationship with the formation of oceans and mountains, relevant episodes of the geological history, including the fact that this region was covered by sea, since for at least about 540 M.a. until about 350 M.a., the existence of submarine volcanism related with the gold (Couto et al., 2003), the existence of a great paleobiodiversity particularly represented by marine invertebrates different from present forms, like trilobites and graptolites (Delgado, 1908;

Couto et al., 1987; Couto & Lourenço, 2008), the existence of icebergs in the seas of Valongo 440 M.a. ago (Couto, 1993), the existence of quartz auriferous veins exploited by the Romans in the I, II and III century A.D. are transmitted to the visitor (figs. 8-9).

It is also transmitted to the people the evolution of scientific knowledge, stressing that knowledge is, as Planet Earth, a dynamic process with a strong historical component.

Figure 8: "Fojo das Pombas", a Roman dismounting of an auriferous quartz vein.

Figure 9: Roman gallery accessing to "Fojo das Pombas".

Guided visits for schools arise on Wednesdays and to the general public on the first Sunday of each month. Apart from regular guided visits, training for teachers, scientific excursions within formation courses for teachers and national and international scientific meetings have been realized in the Valongo Palaeozoic Park. Since 1998 under the "Geology in the Summer" an initiative of "Ciência Viva" and more recently, since 2005, in the aim of "Universidade Júnior" of the University of Porto, a diversity of initiatives have been undertaken not only to advertise the geological and palaeontological heritage but also to divulgate the geomining heritage of the region.

Palaeozoic Park has an internet page (www.paleozoicovalongo.com).

Conclusions

With the work developed in the Valongo Palaeozoic Park we intend to make geology more accessible to everyone and to promote the environmental education and geotourism in the region.

In addition to the items already available to the visitors, three books geared to different kind of public (children, students and public in general) are in press, in the scope of a "Ciência Viva" Project, aiming that scientific information can be easily understood by everyone.

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GEOTOURIST DEVELOPMENT OF THE EDGE UPATA – KM. 88, BOLÍVAR STATE, VENEZUELA

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The edge Upata – Km 88 is a long and straight road through 330 km in the south of Venezuela. It is part of the normal way to get to Canaima National Park, a World Heritage Natural Site, chosen because of its geological and ecological features. The world's famous highest waterfalls Kerekupai Vená (Angel Falls) are inside the park, and it is the second tourist destiny in Venezuela, after Margarita Island. The edge Upata – Km. 88 has a constant flux of tourists the whole year, and it is also the main road that connects Venezuela and the Federative Republic of Brazil.

The area is composed of different communities adjacent to the edge (Upata, Guasipati, El Callao, Tumeremo, Km. 88, etc.) They are low-density communities suffering economical depression. The geotourism in this area can help to the valorisation of the local geoheritage and cultural heritage, and to develop and strength the communal organization through the figure of community councils, a new way of popular power supported by the government.

In this presentation, a resume of the management driven by the Fundación Geoparques de Venezuela in the "Geotourist Development of the Edge Upata – Km. 88", will be shown. Strategies, designs, projections and goals of this project will be discussed. This Project is supported by the Main Gold-Mining Venezuelan Company CVG-Minerven.

GEOTURISM AND LOCAL DEVELOPMENT: THE IMPORTANCE OF BECOMING A PARTNER.

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The Gal Appennino Bolognese, from Bologna, Italy, represents one of the five associations selected by the Emilia Romagna Region (Fig. 1) within the European Programme called: Leader and Leader Plus. The Program was finalized to the development of rural areas into "Asse 4". From 1996 until now, the Association has been organized to direct a lot of interesting activities addressed to the increase of economic and cultural tourism, like the development of the paleontological site of Sasso Marconi, the reconstruction of the whale's fossil found in Pianoro some years ago and the web-site called Geoagritur dedicated to the geological farm holidays.

Figure 1: Emilia Romagna region with Bologna's provincial area (detailed on the right).

Gal Appennino Bolognese cooperated from 1996 with other Italian public and private Institutions for the achievement of the specific target explained in Action Number 3 and 7 of the PAL (Local Action Plan). The Action number 3 wants to create a coherent political system in the area (Fig. 2) for the improvement of tourist attractions and the development of facilities.

Figure 2: Gal Appennino Bolognese's AREA, on detail.

The specific aim of the creation of the Appennino Bolognese Geopark is directly connected to the specific plan of Action 7: "The creation of one demonstration Program for the geological, natural, and cultural interesting Site Valuation of the Appennino Bolognese.

On the project we are introducing the Gal Appennino Bolognese association as the leader of synergy among institutions working in the area to achieve a standard target for the creation of a common developing system.

We believe that our Group as to behave as the manager of European administrator of the geological natural and historical heritage for the local authorities, which have been supported by the Gal over the last few years. To obtain membership of the Unesco Global Geopark Network is becoming an absolute priority, aware as we are of the need to enter into a Global Geo Tourism System, the real engine of territorial development. The chance to enter in the most prestigious Geoparks Network presenting the geological features as a groundbreaking interpretation of the area would enable us to reach a sustainable development which the European Institutions recommend as the only one possible. Below we list the partners of the project, the actions in connection with their future political plans and their determination to work together to create and manage the future Geopark.

• **Emilia Romagna Region** was the first Italian region to have passed the law valorizing the geological diversity of the local heritage. This law was created in 1996, identifying the public interest in safeguarding the management and the increase of specific geological regional qualities as secretary an aid to promoting scientific environmental, tourist and cultural values. The main aims since 2006 have been identified in the development of knowledge of the geological heritage and its promotion with the development of information provision for the public of the sites paying attention to the area's improvement on tourism.
Through the POR (Regional Operating Plan), the Region outlined the main guide lines to the 2007-2012 Program, showing the development of geological tourism as a key point closely correlated with the development of local government. The Region put the management's to the area's assets into the hands of Gal Appennino Bolognese. The important role assigned by the Region to its invaluable Geological heritage is clearly evident.

• **Seismic and Soil Survey of Emilia Romagna** is working on the area through its scientific activities, focused on limitation of risk and the development of information to the public for the protection and promotion of the regional geological heritage. In the area of Gal Appennino Bolognese's competence, it had found specific geosites with on deep interest. Among them are the ones registered in Fig. 3.
All these geosites denote a great natural wealth able for tourist attractions and opportunities for the diffusion of information, in some cases already introduced into a Natural Park protected by local environmental laws. The survey has also developed other important scientific collaboration with foreign and Italian universities. Some months ago, in cooperation with the Geology Department of Urbino University, some paleontological educational pathways were created directly connected with local actions of the Gal Appennino Bolognese in the same area.

• **The environmental department of Bologna's provincial local authority** has shown full collaboration for the environment and the parks of its competence which make the area very interesting. It envisages important economic results and local improvement in the quality of life.

• **University of Bologna** through the Geological Museum "G. Capellini" numbered among Italy's best ones has expressed a wish to collaborate on the project. This standard of excellence is already active in the area with other university involvement in the Archeological Museums in Bologna, Marzabotto and Monterenzio.

Figure 3: Some already identified geosites in the area (from left to right, from up to the bottom): Contrafforte's Pliocene; Calanchi dell'Abbadessa; Emiliana gypsum outcrop; sandstones from Vidiciatico al Corno alle Scale.

ABANDONED QUARRIES AS A GEOTOURIST OBJECTS IN MUNICIPAL AREAS – EXAMPLE FROM THE KIELCE TOWN (HOLY CROSS MOUNTAINS, POLAND)

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The area of the Kielce town has a specific geographical location with regard to the primary geological structure of Europe. The town area is situated in the western part of the Holy Cross Mountains, in the margin part of the Caledonian-Variscan Orogenic Massif, within the border zone with the Precambrian East European Platform (Dadlez, 2001). The tectonic position and geological history of this area expressed in great variety the sedimentary rock representing almost all periods from stratigraphic chart (without Jurassic and Cretaceous). Numerous natural resources and abandoned quarries at which they have been worked are an important aspect of geodiversity and geotourist potential of this area. An impact of open pit mining activity on the city landscape is especially noticeable within ranges and elevations build of Middle and Upper Devonian carbonate rocks, ex. Kadzielniańskie Range. The Devonian massive limestones and dolomites have been quarried on a large scale in the several localizations: Wietrznia, Kadzielnia, Grabina (Czarnów Quarry) and Ślichowice (two quarries on Ślichowica Hill). Most of these outcrops, after the end of exploitation in the quarries were taken into protection as nature reserves: Wietrznia Nature Reserve of Z. Rubinowski Memory, Kadzielnia Nature Reserve, Skalny (Ślichowice) Nature Reserve of. J. Czarnocki Memory and Biesak-Białogon Nature Reserve (Urban, Wróblewski, 1999). There is also one nature (landscape) reserve with numerous remnants of the lead ore mining situated on Karczówka Hill. Four of these localizations (Wietrznia, Kadzielnia, Ślichowice, Biesak-Białogon) were proposed as a representative geosites to European Network of Geosites (Urban, Gągol, 2008; Alexandrowicz, 2006).

The principal problems with protection of geodiversity and on the other hand adaptation the geosites to public access are entered to the field of interest different organizations, at the national and local level. At the local level, promotion and management the inanimate nature reserves within the Kielce town is the main aim of Geopark Kielce – institution funded by local government in 2003. Since that moment several initiatives, such an arrangement the touristic paths and observation points (Kadzielnia, Ślichowice) or provision interpretative panels and publishing leaflets, have been realized. Nowadays, opening post-mining, protect areas up for the geotourism are being realized in a few ways. One of the examples is a creation the geo-educational centre in Wietrznia which will be connected by educational trials with other geological and archeological sites in the Kielce town and the Holy Cross Region (it's a part of large project The Holly Cross Archeo-Geological Trail). Other initiative is preparation the combined caves in the Kadzielnia quarry for public access. From the local development point of view, the important aim of the Kielce Geopark and other institutions or local scientific organizations, is the foundation of the Świętokrzyski (Holy Cross Mountains) Geopark and its adoption to the European Geoparks Network. Situated the Kielce agglomeration within the area of the projected Geopark giving the chance to increase the educational and protective ability the quarries as a geotourist attractions and geosites function in regional thematic network.

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FOSTERING GEOTOURISM ON CENTRAL BALTIC ISLANDS

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The major islands in the Central Baltic area are Gotland on the Swedish side, Åland islands, belonging to Finland, and the Estonian islands of Saaremaa and Hiiumaa. Although the islands in the area have a common geological as well as historical background, very little attention has been paid to develop and promote geotourism activities on these islands.
The joint collaborative project "Fostering geotourism on Central Baltic islands", funded by ERDF through Central Baltic INTERREG IV A Programme 2007-2013 and implemented by the Department of Earth Sciences at Uppsala University and NGO Geoguide Baltoscandia, aims at preparing a solid foundation for nature tourism development on major Central Baltic islands. Within the three year project period we intend to produce well-illustrated, full-colour travel guides and educational video films on six topics. These geotourism topics describe both the common features of Central Baltic islands as well as bring up uniqueness of natural and cultural heritage on some islands. Additionally we would like to carry out a survey on nature tourism marketing experiences in Nordic countries in order to identify areas of interest, hold a training seminar and field trip as well as hold conclusive exhibitions in Estonia and Sweden to introduce the project and Central Baltic geotourism destinations to a wider audience in both countries. The material produced during the project will be distributed free of charge to the local authorities, tourism experts/agencies and educational leaders in order to create and further manage both site-specific and cross-border nature tourism activities. On that ground, new cross-border geotourism routes on exploring meteorite craters, fossils and sedimentary rocks, and diverse coastal landscapes of the Baltic Sea can be developed by local tourism experts. The travel guides will be published in English to maximise the impact of the promoting material produced. All this should attract tourists to visit promoted areas and to explore new geotourism routes.
The goal of the project is to collect and analyse nature tourism practises from different countries in the Baltic Sea region and to provide local people with information on the wonders of nature in their area and give ideas about how they can develop this tourism sector on Central Baltic islands.

AUDIO-VIDEO GEOGUIDE IN THE ADAMELLO BRENTA GEOPARK

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Flying over the Adamello Brenta Geopark like an eagle, passing through valleys and glaciers, winging waterfalls and very high peaks and then diving in enchanted alpine lakes, approaching the magmatic rocks of the Adamello-Presanella massif for then flying to the sedimentary ones of the Brenta Dolomites. This is possible with the new software which allows the three-dimensional navigation and visualization: Geobrowser 3D developed by the "Fondazione Graphitech" (Povo – TN). It is also possible to activate and deactivate many geographical information layers like the boundary of the Park, the geosites, the paths, the Sites of Community Interest (pSCI) and the Special Protection Zones (SPZ), the aerial photos and the trekking map Tabacco (1:50.000). Free download of the software Geobrowser 3D is possible in the website of the Park www.pnab.it.
In order to get people know and appreciate the territory of the Geopark, a film has been realized by means of the software 3D Real Time Exploration (Fig. 1). This simulate a virtual flight over the protected area and the "visitor" will be taken nearby the most relevant Geosites of the Geopark, and will have the possibility to increase its knowledge thanks to contents which pop up while stopping in the interested spot. In this way he or she can visit all the territory flying over the two main mountain groups: the Adamello-Presanella and the Brenta Dolomites.

Figure 1: The 3D video over the Adamello Brenta Geopark.

Besides, the "virtual hiker" can experience a guided tour in one of the most beautiful valleys of the Park: an MP3 audio and video guide lasting 40 minutes will describe the beauty of the Genova Valley, 40 "treasures" of nature, history, geology, culture and art (Fig. 2). Those who want to visit the "Versailles of Italy" (so was defined the alpine valley by the English explorer Douglas William Freshfield) will be able to download for free the audio files of the guide and the map with the 40 spots. These are then transferable on an mp3 player or on a mobile phone.

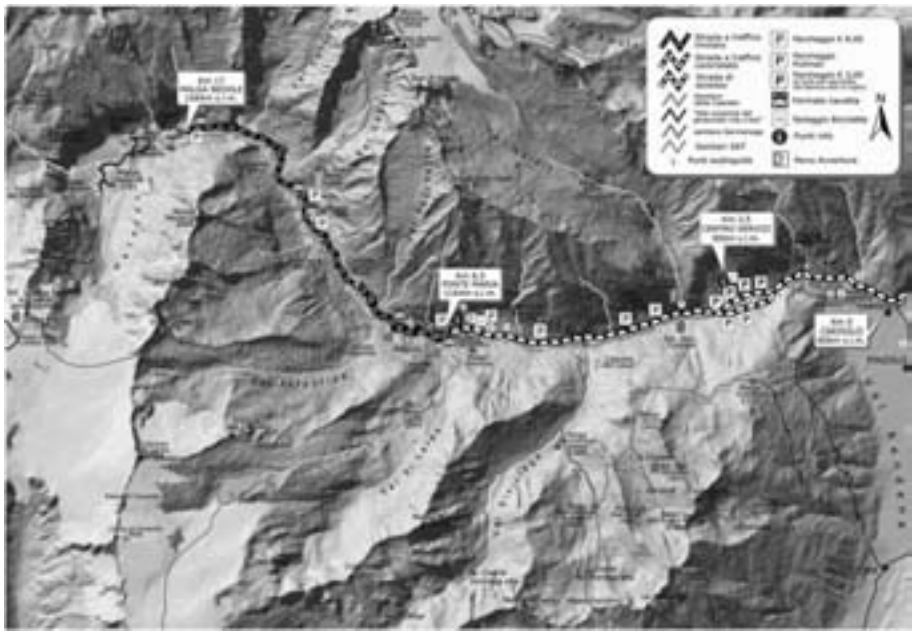

Figure 2: The map with the 40 treasures of Genova Valley downloaded from www.pnab.it.

The Adamello Brenta Geopark territory will be visited at any time and condition and from every place of the world. In this way many visitors will be attracted by the great beauty of the Park, they will get to know it better and will also have the possibility of planning some excursions in order to discover its mountains, its territory and its people.

VIA GEOALPINA IN THE ADAMELLO BRENTA GEOPARK

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The Via GeoAlpina is a project that involves six countries of the Alpine Chain: Austria, France, Germany, Italy, Slovenia and Switzerland. It is an initiative that has the purpose of spreading the geological culture through some of routes and also other cross-national connections.
In particular guidebooks will be done and printed, in order to illustrate by an easy and accessible - but strictly scientific – language, geological features of some of the most suggestive Alps' landscape. Everything will be available and downloadable (from) by a specific web site, or it will be possible to request all the information to Tourism Offices, Parks and other Organizations that have supported to the initiative. The Via GeoAlpina's route crossing the heart of Adamello Brenta Nature Geopark goes from Tonale Pass to Tovel Lake (Fig. 1). It is about an itinerary split up in four stages crossing granite and carbonate massifs, in the presence of the largest plateau glacier of Italian Alps, trough unmistakable glacier tracks and wonderful karst landscapes.
The Via GeoAlpina in the Adamello Brenta Geopark is so divided:

- First stage: from Tonale Pass to Mandrone refuge, through Maroccaro Pass;
- Second stage: from Mandrone refuge to Carisolo village along Genova Valley;
- Third stage: from Carisolo village to Grostè Pass, following the most of the trail called "Dolomiti Brenta Trek";
- Fourth stage: from Grostè Pass to Terres village, crossing the Tovel Lake.

Figure 1: Map of the Via GeoAlpina in the Adamello Brenta Geopark.

The trail is particular interesting in both a geological and geomorphological points of view, because it allows noticing rocks of extremely different nature and spectacular types of actual and old periglacial and glacial landscapes. It is possible also to see the Adamello Glacier, the largest plateau Glacier of the Italian Alps.

Figure 2: Along the Via GeoAlpina guided by a geologist during the EGN week organized in the Adamello Brenta Geopark.

Along this trail is particularly evident the geodiversity phenomenon. The suggested routes develop in two distinct areas, with different geological features: the Brenta one, characterized by sedimentary carbonate and dolomite rocks, and the Adamello one, where crystalline rocks emerge. The two environments, even if close to each other and subjecting to the same past and present climatic conditions, show extremely different landscapes. The strictly karst landscape's shape, which characterizes the Brenta massif, carved by spires, towers, and almost devoid of superficial hydrography, is contrasted with the severe and sometimes monotonous glacial environment of Adamello, furrowed by several streams, canyons and waterfalls. The geodiversity key-reading of this itinerary's landscapes has also a strict connection with the biodiversity, which rules the natural development of endemism and typical vegetal associations.

Throughout the entire trail, there are also specifically structures established to disseminate the knowledge about mountain environment and, particularly, on its geology. Strictly closed to geoconservation purposes are the aims of "Adamello study centre – Julius Payer", located between the first and the second stage. It can be found on the Tovel Lake, towards to the end of the itinerary, the limnological station of the Natural Science Trento Museum, a similar station centre to the one before, but focused on Geological and Biological Sciences.

In this place it is the end of the Via GeoAlpina's route crossing the whole Adamello Brenta area, full of testimonies and ideas that are well fitted with the purposes of the Via GeoAlpina.

3. Geoparks and Science

GEODIVERSITY AS A BASIS FOR GEOCONSERVATION, GEOTOURISM AND GEOPARKS

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The developing international paradigm of "geodiversity" is often loosely applied yet it has a specific meaning, viz. the diversity of abiotic nature (Gray, 2004). Several countries, including UK, Ireland, USA, Italy, Spain, Portugal have used, or are using, this principle in selecting geoconservation sites, i.e. the aim is to conserve representative examples of the country's geodiversity. UNESCO/IUCN are also increasingly applying the geodiversity principle in developing the World Heritage List of geoscience sites. Geodiversity is also a fundamental basis for geotourism and many leisure/sporting activities. Most geoparks are also promoting the variety of geological and geomorphological features within their areas in order to attract visitor numbers. Thus geodiversity is an important basis for geoconservation, geotourism and geoparks, and this presentation will explore these issues.

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COMMUNICATING THE STORY OF CLIMATE AND MAN

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From the beginning the story of humans and their primate ancestors was closely related with global climate change. The earliest primates, including lemurs, tarsiers and monkeys appeared and evolved in the warm, wet and forested world which existed between 65 and 10 million years ago.

The marked cooling and drying of the Earth's climate from approximately 9 million years coincided with the near-synchronous expansion of savannah grasslands (Fig. 1) in different geographical locations (Osborne & Beerling, 2005). The progressive expansion of Africa's grasslands favoured the evolution of hominids leading to the emergence of the genus *Homo* at approximately 1.99 million years ago.

Figure 1. Typical savannah vegetation in the Masai Mara Game Park, Kenya. Photo Steven Ramsay.

With the onset of significant global cooling 2.6 million years ago, the African savannah expanded and contracted inversely with repeated glacial and interglacial cycles (Osborne & Beerling, 2005). The emergence of new, more successful human species appears to coincide with glacial intervals.

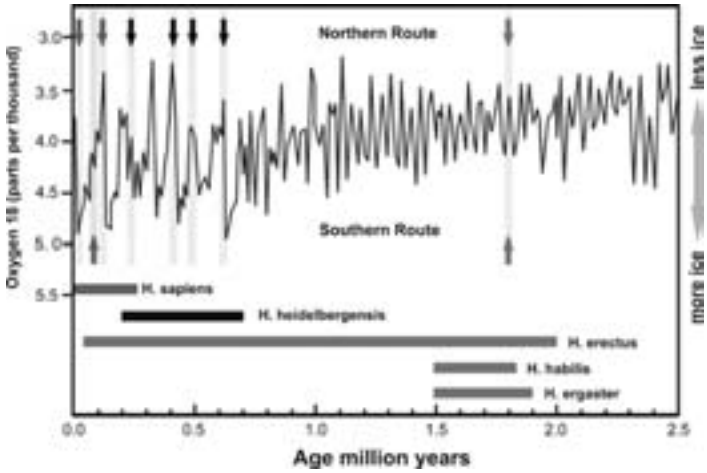

Figure 2. Ranges of species assigned to the genus *Homo* (Sarmiento et al., 2007) and suggested times for their migration out of Africa (Oppenheimer, 2003) compared with a composite marine record for Oxygen 18 (0 -2.5 million years) derived by averaging data from the Ocean Drilling Project (Corfield, 2003). The Oxygen 18 record is a proxy for global ice volume changes.

Downward trends in the curve reflect increasing ice volumes on land, the yellow shading highlights interglacial warm periods, the blue shading indicates a glacial period. Proposed times of species migrations are represented by colour coded arrows *Homo erectus* (green), *Homo heidelbergensis* (black) and *Homo sapiens* (red).

The migration routes taken out of Africa by *Homo heidelbergensis* and *H. sapiens* were determined by glacial – interglacial cycles. The availability of a northern route across the Sahara through the Levant and into Eurasia coincided with the expansion of grasslands during warm interglacial periods. This route was used successfully by groups of *H. heidelbergensis,* but an out of Africa migration by *H. sapiens* at 120, 000 years ago terminated in the Levant due to the onset of a glaciation in which descendants of the migrants died out (Oppenheimer, 2003). During ice ages, humans crossed at the Gate of Grief at the southern end of the Red Sea and followed a southern route into Asia. Genetic evidence indicates that our species, *Homo sapiens*, pursued the southern route during a glacial interval approximately 80, 000 years ago arriving in Australia at about 70, 000 years ago. Europe, Eurasia and Central Asia were colonized during a warm interval between 46, 000 - 50, 000 years ago by a group which migrated northward out of Kurdistan (Oppenheimer, 2003). Thus warming of the global climate coincided with expansion into new territories, the spread of new technologies, e.g. Lower Middle and Upper Palaeolithic, and the peopling of the world (Fig. 3).

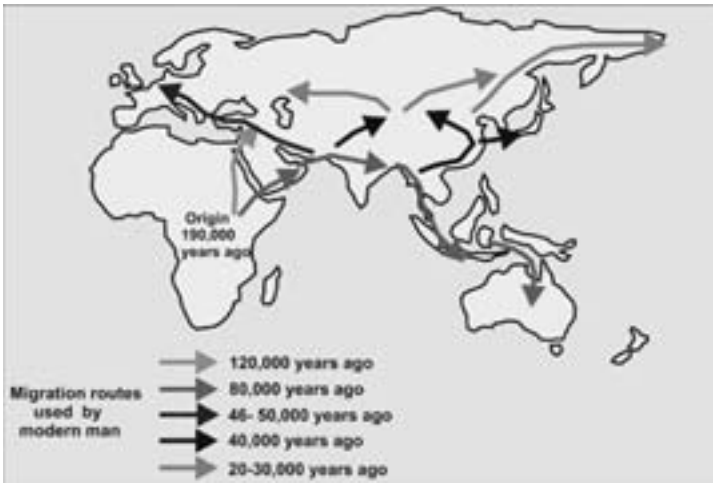

Figure 3. Migration routes used by our species *H. sapiens* based on mutation patterns in maternally transmitted mitochondrial DNA (Oppenheimer, 2003).

The ever increasing size of the global population, the development of a complex global economy and the rising demand for energy derived from burning hydrocarbons has led to significant changes in the chemistry of the atmosphere and ocean and to anthropogenic related global warming. A palaeoclimate record based on ice core data from Antarctica shows that the greenhouse gases, carbon dioxide and methane, co-varied with Antarctic temperatures during glacial-interglacial cycles over a period of approximately 650, 000 years (Fig. 4). The level of these gases is now higher than at any time during the past 650, 000 years (Fig. 5). Global climate projections indicate that rising levels of greenhouse gases will profoundly affect surface temperature, rainfall and sea level by the end of the 21st Century (Meehl & Stocker, 2007).

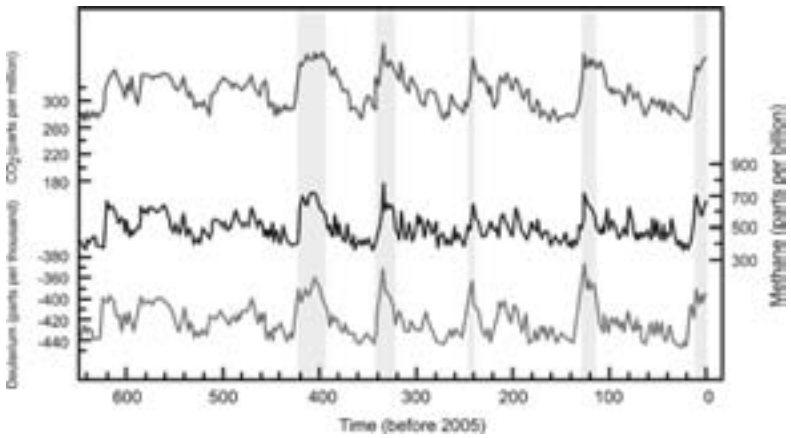

FIGURE 4. Variations in concentrations of Deuterium (green) and the greenhouse gases carbon dioxide (red) and methane (orange) from air trapped in Antarctic ice cores (Eystein & Overpeck, 2007). Deuterium is used as a proxy for local temperature. The last 5 interglacial periods are shaded yellow.

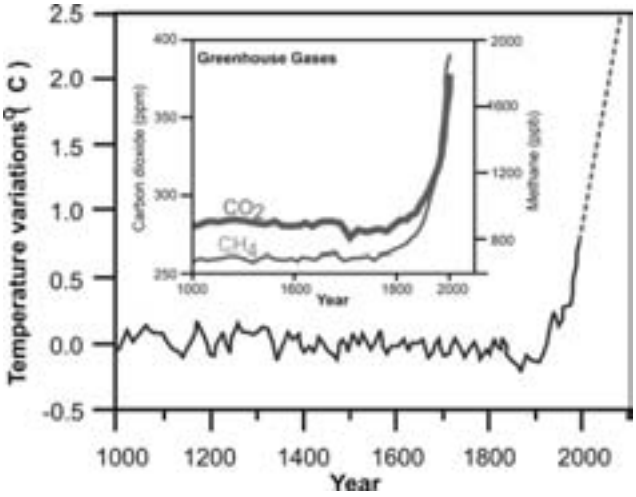

FIGURE 5. Atmospheric concentrations of the greenhouse gases carbon dioxide and methane compared with the temperature record for the last 1000 years. The figure combines greenhouse gas data from Fig. 1 (Forster and Ramaswamy, 2007) with the record of Northern Hemisphere temperature variations during the last 1, 000 years from Fig. 6.10 (Eystein & Overpeck, 2007).

In 2007 scientists involved in the Intergovernmental Panel on Climate Change warned of an increasing risk of species extinctions as a consequence of continued global warming. It is suggested that 20-30% of plant and animal species assessed so far are at greater risk of extinction with increases in global average temperatures above 1.5 to 2.5˚ compared to 1980-1999 levels. The acidification and reduced levels of dissolved oxygen in the ocean, both the result of global warming, will probably lead to a fall in marine biodiversity. Thus the rapid rate of man made global warming in response to rising concentrations of greenhouse gases could potentially result in an extinction event similar to the extinction or mass extinction events in the geological record (Fig. 6). Figure 6 shows that the end Ordovician, mid Carboniferous and end Eocene extinctions were associated with glaciation, and that the end Devonian, end Permian and end Triassic extinctions were associated with reduced levels of atmospheric oxygen. Thus warming of the global climate, which once played a major role in our peopling the world, now poses a potential threat to our political stability and to sustaining a growing population.

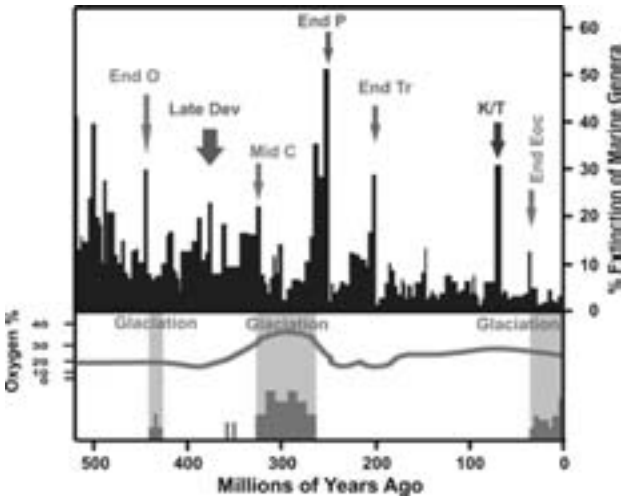

Figure 6. Mass extinction events, continental glaciations (grey shading), occurrence of ice rafted debris and variations in atmospheric oxygen (yellow shading). Data derived from Wikipedia (the free encyclopedia), Figure 6.1 of Eystein & Overpeck (2007) and Berner (1999). The 5 major extinctions include the Cretaceous/Tertiary (K/T), end Triassic (End T), end Permian (End P), Late Devonian (Late D) and end Ordovician (End O). The end Eocene (End Eoc) and middle Carboniferous (Mid C) are also shown.

It is now, more than ever, imperative that the story of mankind, our cultural development and the significance of the impact of our achievements on the climate and biodiversity of the Earth should be told and understood. Geoparks can play a significant role in communicating the story of how changes in global climate made it possible for our species to migrate out of an "African Eden'' to populate the Earth, to become the last humans, and how as a result of this amazing success story we are now profoundly affecting global climate and biodiversity. Geoparks are ideally suited to raise awareness of our need to manage and love the Earth.

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IMPLEMENTATION OF THE INTERNATIONAL YEAR OF PLANET EARTH (2007-2009) IN PORTUGAL, IN THE FRAMEWORK OF THE UNITED NATIONS DECADE OF EDUCATION FOR SUSTAINABLE DEVELOPMENT

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In the framework of the United Nations Decade of Education for Sustainable Development (2005-2014), the Portuguese National Commission for UNESCO decided to implement the aims and objectives of the International Year of Planet Earth - IYPE (2007-2009) at the national level.

In doing so, the Portuguese National Commission for UNESCO tried to highlight the role of Earth Scientists as key players in building a sustainable world and also to show to society at large how Earth Sciences can help future generations meet the challenge of ensuring a safer and more prosperous world, since they can promote a wise sustainable use of Earth materials and encourage better planning and management to reduce risks for the world's inhabitants.

The Portuguese Committee for the International Year of Planet Earth was thus created by the Portuguese National Commission for UNESCO, in April 2007, with a view to promote the Scientific and Outreach Programmes of the IYPE.

The Scientific Programme consists of 10 relevant, multidisciplinary themes: Health and Earth; Climate Change; Groundwater; Ocean; Soils; Deep Earth; Megacities; Hazards; Resources; and Life and Earth. These 10 themes provide the operational framework for the Year's Scientific Programme.

Due to the importance of the 12 brochures produced for each theme by the Corporation IUGS-UNESCO, the full set of these brochures, available only in English, was translated into Portuguese by the Portuguese National Committee for the IYPE.

The Portuguese brochures were officially presented at the Launch Event of the IYPE in Portugal, jointly organised by the Portuguese National Commission for UNESCO and the Portuguese Committee for the IYPE, in Lisbon (at the *Knowledge Pavilion*), on 10 November 2007, on the occasion of the World Science Day for Peace and Development, with the participation of around 3000 people.

A website was specially created and developed by the Portuguese IYPE Committee (www.anoplanetaterra.org) for the triennium and all brochures can be downloaded from there.

The translation and publication of the brochures (5000 brochures) in Portuguese meant a major effort from the Portuguese National Commission for UNESCO and from the Portuguese IYPE Committee since a significant amount was required. In fact, it was only possible because it was sponsored by five Portuguese companies and one from Brazil. The goal was to reach all sectors of the Portuguese society and also to reach the African Portuguese-Speaking Countries, Brazil and East Timor, a community of 230 million people.

For the implementation of the Outreach Programme, further to the referred Portuguese website (a very useful platform), leaflets were also produced, containing general information

about the IYPE, as well as an itinerary exhibition about the themes of the IYPE (which has been presented all over the country, starting at the Portuguese Parliament and then from schools to museums, city halls, geoparks, etc.); posters, DVDs and books were also produced (for example, two books were published especially for children, entitled "Tales by Ms. Earth" and "Big mess among the rubbish", with also a Braille version) and other materials, such as special stamps and special Port Wine with the IYPE label; IYPE has also been presented in TV and Radio programmes, and articles in local and national newspapers; outreach also included the promotion of international student contests, the organisation of Conferences, workshops, the launch of the Springer Journal "Geoheritage", the participation of artists and ballet dancers in a special ballet dedicated to the IYPE, etc.

The Portuguese Committee for the IYPE, created with the aim to disseminate the IYPE objectives at the national level, works under the high patronage of the President of the Portuguese Republic, and it is composed by a Committee of Honour, an Executive Committee and a Committee of Representatives.

The Committee of Honour comprises all major governmental representatives, such as the Prime-Minister, several Ministers and Secretaries of State, the President of the UNESCO-related Group of Members of Parliament, and Presidents of the Calouste Gulbenkian Foundation and Mário Soares Foundation.

The Executive Committee is composed by five representatives of Portuguese Universities located throughout Portugal; the President of the Portuguese Geological Society and three members of the Portuguese National Commission for UNESCO (the President, the Executive Secretary and the Programme Specialist – Science), as well as of four observers from the Ministries of Environment, Education and Science and also an observer from the public Television (RTP).

National Geographic – Portugal and the Public television channel (RTP) are media partners of the Portuguese Committee for the IYPE.

The Portuguese sponsors of the Committee are: CARRIS, BAYER – Portugal, Águas de Portugal, EDM, and EDP- Portugal. PETROBRAS is the international sponsor (Brazil).

The Committee of Representatives is composed by 370 members belonging to different sectors, namely universities (public and private universities), research centres, schools, foundations, institutes, municipalities, national committees of UNESCO Programmes (IHP, MAB, IOC), private sector, a ballet company, NGOs, associations, museums, the Portuguese Geopark Naturtejo and Geopark Arouca, agencies, Academy of Science and other Academies, *Ciência Viva* – Science Alive and Science Alive Centres, UNESCO clubs, individuals, etc. This number is still growing everyday and all these members join in on a voluntary basis. The Portuguese Committee is thus open to all who want to develop the aims and themes of the IYPE and special attention is paid to civil society, as highlighted by the subtitle of the IYPE: *Earth Sciences for Society*.

All members of the Portuguese IYPE Committee insert directly in the IYPE Portuguese website the list of events/activities that they are organising on one or more themes of the IYPE. It is therefore possible to know who is doing what, when and where, in Portugal.

This kind of membership has allowed for useful synergies and interesting partnerships to be created and has stimulated an increasing number of events, based on a multiplying factor of best practices and shared experiences.

The Portuguese National Commission for UNESCO considers that all these partnerships are very positive since they allow the dissemination of the aims and goals of the IYPE through all levels of society and it strongly believes that all actors involved in the promotion of the IYPE themes should be encouraged to join the referred platform.

The major achievement in this project is the sharing of experiences and good practices between all members and the networking between them.

Since its creation, in April 2007, the Portuguese Committee for IYPE has carried out around 478 events, 86% of which under the Outreach Programme, mainly implemented by public organisations (76%).

In some cases, the Portuguese National Commission for UNESCO participates directly in the organisation of IYPE events/activities or gives its institutional support to major events, including their promotion at its own website (www.unesco.pt) and the dissemination of documentation.

At the international level, the Portuguese IYPE Committee has participated in the Global Launch in Paris, February 2008; cooperation with the other 4 National Committees for IYPE of the Community of Portuguese-Speaking Countries (Angola, Brazil, Mozambique and Cape Verde) has been strongly supported due to the above-mentioned edition in Portuguese of the 12 IYPE Brochures, available online, and to the organisation of the First International Conference on the Development of Geosciences in the Community of Portuguese-Speaking Countries, held in Coimbra, Portugal, in October 2008, where the *Coimbra Declaration* was approved.

A mission to Cape Verde was also organised, to participate in the official launch of the Cape Verde National Committee for the IYPE (October, 2008) and to promote an educational project in Fogo Island, in the framework of the UN Decade of Education for Sustainable Development and the IYPE.

The Portuguese National Commission for UNESCO has also supported the creation of the National IYPE Committees of Angola and Cape Verde.

Although we have registered many activities and events, it is not easy to evaluate whether we have contributed to the change of behaviour of all actors involved in this project and if we have changed their point of view regarding the role of geosciences, especially among students, teachers and decision-makers, but a public fact should be highlighted: all vacancies in public universities in the field of geosciences were occupied this year, and this is a very important figure compared with last year's performance. There is seemingly an increasing number of students interested in geosciences. Also, young Portuguese geoscientists are being looked for by many companies, especially from Brazil and Africa.

When evaluating the increasingly number of members who have joined the Portuguese Committee for the IYPE and the events that have been promoted at the national level, one can say that the IYPE has been a great success in Portugal. The creation of the referred platform made it possible to reach many different actors (including media), to involve them in the IYPE themes and to promote the role of geoscientists.
As regards evaluating the increasingly number of articles in local newspapers, TV and radio programmes dedicated to the IYPE themes, the effort done by teachers and municipalities to work together in this field, the number of books published by many Portuguese scientists, and of companies publicly vouching their social responsibility, it appears that gradually the IYPE issues are being included in the environmental, social and economic agenda.

With the promotion of the IYPE, the Portuguese Commission for UNESCO was able to reach politicians, local authorities, civil society, the private sector, the media and geoscientists and to make them talk about IYPE issues.

Seminars, conferences, workshops were also promoted and supported, with the main objective to reach civil society and where geoscientists could explain in a very simple way how they can help with their knowledge, highlighting the urgency of changing our behaviour in order to have a more sustainable future.

In terms of obstacles, it is still difficult to reach the media at a national level and to get them involved in this process. The same obstacles apply to decision-makers, but efforts continue to be done to try to work closer with them.

The Portuguese National Commission for UNESCO has cooperated in this filed with other NatComs, especially those from the Portuguese-Speaking African Countries, mainly by sending documentation about these issues in Portuguese. The above-mentioned itinerary exhibition will also be shown in those countries by the end of this year.

The Portuguese NatCom has also worked very closely with the two Portuguese Geoparks belonging to the UNESCO Global Geoparks Network on these issues and a very positive partnership was developed. Geoparks are a privileged place where the IYPE issues can be promoted and where education for sustainable development can be implemented.

Once more it is important to highlight the work done by local newspapers and local radio programmes which have been greatly involved in this project and have been very active covering all major activities, as well as the links that have been created by other institutions to our website, that have multiplied the information available on the IYPE.

Our project can be an example of a good practice because the partnerships and synergies created during these three years (2007-2009) allowed us to largely promote at the national and international levels the aims of the United Nations Decade of Education for Sustainable Development and those of the International Year of Planet Earth.

There are still other potential partners who want to participate in the Portuguese Committee for IYPE and others who have contacted us to encourage us to continue this work beyond 2009.

We know who is doing what, where and when is taking place, and in this sense we have created a useful tool with this database.

With the celebration of the IYPE we have also promoted the UNESCO Networks, such as the Biosphere Reserves and Geoparks. We have likewise contributed for the multiplication of many activities under the framework of the UNDESD and the IYPE. We have furthermore inspired other National Committees for IYPE which have being doing similar activities.

Due to our success and dynamics we have been invited by the UNESCO-IUGS Corporation to organise and host the International Event of the IYPE, which will take place in Lisbon, from 20 to 22 November 2009.
In this event, especial attention will be paid to members, sponsors, partners, and networks that have been created throughout these three years.

One thing is for sure: the Portuguese Commission for UNESCO will continue with this work and give growing visibility to the UNDESD and IYPE issues in the forthcoming years.

PSYCHEDELIC EXPERIENCES WITH GEOLOGY: GEOLOGICAL VIDEO ART AT BOOM FESTIVAL

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1. BOOM Festival: not just Trance Music

The Boom Festival is a biennial festival which takes place in Idanha-a-Nova (Portugal), at the core of the UNESCO Geopark Naturtejo Meseta Meridional. The first Boom Festival happened in 1997 as an electronic music festival, but the present-day Boom is a multidisciplinary event (Silva, 2008). Bringing together the latest inspirations in psychedelic audio and visuals, Boom Festival features music, paint, sculpture, video art, theatre and various kinds of workshops (Fig. 1).

Geopark Naturtejo started to develop a series of projects in order to promote geological heritage in the Boom Festival 2008. Among these projects, Andrea Baucon authored a Video Art installation named *Geodelia*, linking Geology, Art and psychedelic culture.

Figure 1:Images of the Boom Festival 2008, taken from www.boomfestival.org. Courtesy of Jorge Fialho. a. the dancefloor. b. Theatrical performance. c. Night snapshot of "The Sacred Fire", a thematical area of the festival. d. People of the Boom Festival.

2. The concept of *geodelia*: the exuberance of the mind meets geology

Geodelia is based on moving pictures and comprises video and audio data, but it does not rely on the conventions that define theatrical cinema. It does not employ the use of actors, it contains no dialogue, it has no discernible plot, and it does not adhere to the most of the other conventions that define motion pictures as entertainment.

Geodelia derives its name from the term "psychedelia", which derives from the Greek words for "soul," ψυχή (psyche), and "manifest," δήλος (delos). The term was coined by the

psychiatrist Humphry Osmond (1957) and defines the perception of aspects of one's mind previously unknown, or by the creative exuberance of the mind.
Therefore *Geodelia* invokes Geology as a mechanism for obtaining aesthetic inspiration. The animated compositions of *Geodelia* are an expression of geological objects but they may exist with a degree of independence from visual references in the world. Indeed *Geodelia* features the element of surprise, unexpected juxtapositions and *non-sense*. There is no didascalic purpose in *Geodelia*, the focus is only on the beauty of geological shapes.

3. *Geodelia*: an hypnotic travel trough Geology

Geodelia is also known as "*Geodelica Trilogy*" because it is constituted by three groups of visuals, furtherly explained trough selected examples.

3.1. Aesthetics of Geology

The first section of *Geodelia* introduces the visitor to the aesthetics of Geology. The visual "You Can't Eat a Trilobite" (Fig. 2) pertains to this section and represents a grotesque and surreal exploration of palaeontology. People were asked to say the word "trilobite" in front of a video-camera (Fig. 2a, b); their reactions built the central core of this complex, colourful, and harmoniously patterned visual. It is a cross-pollination of texts, paleontological engravings from the 19th century, fossils and the mentioned real-life videos.

Figure 2: Snapshots from the visual "You can't eat a trilobite". a. Real-life videos (a grasshopper) are blended with paleontological texts from the 19th century. b. People were approached and asked to say "trilobite". c. "You can't eat a trilobite!" d. "You Can't Eat a Trilobite" featured a fossil trilobite into a steel cage.

Another interesting visual from this section is "You Were Snow, You Were Sea, You Were Trilobite". In this video, the hydrological cycle meets philosophy and metaphysics. Water moves continually through a cycle of evaporation, evapotranspiration, precipitation, and runoff, usually reaching the sea. Before being in a human individual, a water molecule was already river, snow, rain, cloud, lake. And it was already in other organisms too. The author presented this work with the following words: << A molecule of water from your body: what were its adventures? Yesterday you were a river. Last month you were a cloud. 130,000 years ago

you were a glacier during Ice Age. 500,000,000 years ago you were a trilobite. Much of the Universe's water may be produced as a by-product of star formation, because its components, hydrogen and oxygen, are among the most abundant elements in the universe. You were a star. >>
Is this a sort of "material reincarnation"? Does life begin or is it a continuous process? Probably this video does not answer to these questions, but it highlights the intimate relationship between the geological and the biological realms.

3.2 The psychedelic colours of Geology

The second section of *Geodelia* deals with the psychedelic colours of Geology. An important part of this section is represented by a new concept to Video Art: petrographic thin sectioning (Fig. 3). This technique – largely known by geologists – consists of cutting a thin sliver of rock with a diamond saw or a laser. The sliver is mounted on a glass slide and then smoothed using progressively finer abrasive grit until the sample is only 0.03 mm thick. The thin section is ready to be examined under the light of polarizing microscope. Thin sections are prepared by geologists in order to investigate the minerals constituting the rocks; as different minerals have different optical properties, most rock forming minerals can be identified by their colour. For instance, quartz is white under plane polarized light, and smoky under crossed polarizers. Clinopyroxene is tan to green under plane polarized light, and it is a vibrant blue, pink, or green when viewed under crossed polarizers. Until now, this technique has been domain of geologists, but this installation brings thin sections to a new dimension: aesthetics. This is the first appearance of "petrographic thin sectioning" in Video Art – ever.

Figure 3: A consistent part of Geodelica is realized with a technique directly brought from Geology: petrographic thin sectioning. a. "Dance of the Plagioclases": title intro. b. Bright-coloured geological texts comment the vibrant colours of thin sections. c. Rotating thin section. d. The lettering of "There Were Not Only Pyroxenes" was inspired from the 8-bit era of videogaming.

Another intriguing visual of the second section is "Hypnotic Dreams of Miss Trilobite" (Fig. 4). It creates kaleidoscopic visions inspired by one of the first sophisticated visual systems: the eyes of trilobites. Some

of the "Psychedelic Dreams of Miss Trilobite" are created with fractal geometries, geometric shapes that can be split into parts, each of which is (at least approximately) a reduced-size copy of the whole (Fig. 4b, c). Fractals are too irregular to be easily described in traditional Euclidean geometric language. Many approximate fractals can be found in nature (clouds, snowflakes, trees, ferns, broccoli...), with special regard to geological landscapes (crystals, mountain ranges, river networks, coastlines...). "Hypnotic dreams of miss trilobite" shows the important role of digital media in production of the *Geodelia.* In fact *Geodelia* features many fractal patterns designed by computer graphics, while real-life videos are integrating digital technologies. Digital Art has allowed for an even greater and more profuse expression of psychedelic vision, blending it harmonically with geological features.

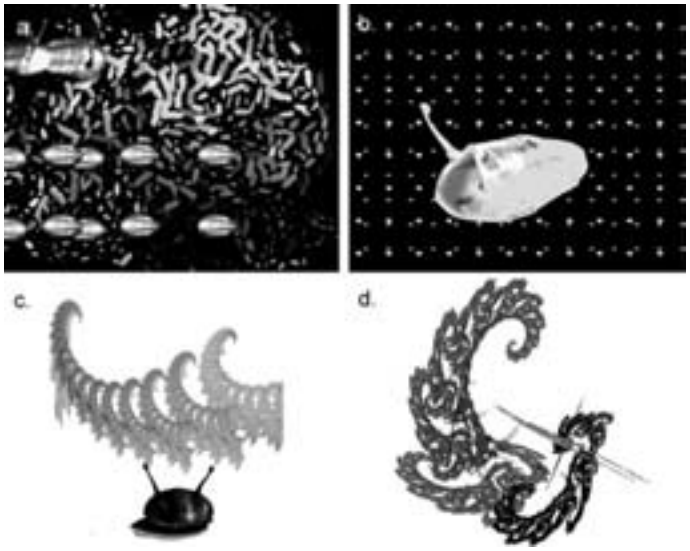

Figure 4: Hypnotic Dreams of Miss Trilobite. a. Kaleidoscopic trilobites. b. An oniric trilobite floating. c. Miss Trilobite staring at fractal patterns. d. Fractal patterns.

3.3 Geological landscapes and humankind

The third section of *Geodelia* is dedicated to the relationship between humankind and geological landscapes. This relationship is often contrasting and dramatic, as expressed by "Destiny*Yesterday". In this visual, the screen is divided in two parts. The left side shows the beauty of geological landscapes, gradually disappearing under the growing pressure of human pollution (right side). The limited availability of resources is took into account also by "Prometheus' Kitchen" by using the metaphor of a kitchen.

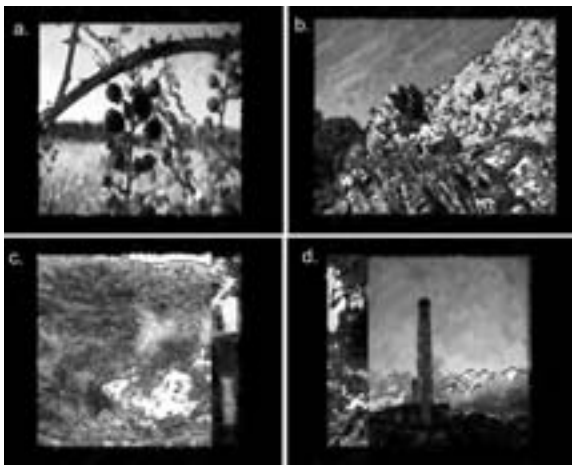

Figure 5: Destiny*Yesterday. a. Biological landscape. b. Geological landscape, inspired by a geosite of Geopark Naturtejo (Penha Garcia) c. Geothermal phenomena (Azores), symbolically invaded by the effects of pollution. d. Pollution progressively invades the natural and geological landscape.
Humankind is constantly consuming resources causing instability, disorder, harm and discomfort to the physical and biological systems of our planet.

4. Discussion

One of the key-concepts of *Geodelica* is the lack of perceptive narratives. Geological features evolve on the screen, and shapes and colours seethe and morph hypnotically with hallucinogenic flowing colors. As geologic patterns materialize on the screen, the colors undulate, in a harmonic array of mind-blowing morphologies.

A question might arise: Why choosing dazzling geological patterns and not a traditional educational video? Is it useful to embrace a non-didascalic approach to Earth Sciences?

The essential factor in both cases is the public. Boomers – the participants to the psychedelic event – demonstrated an encouraging attitude towards *Geodelia* and supported the expressive power of Video Art (Fig. 6). For this reason, *Geodelia* is educational even without a didascalic intention. *Geodelia* acknowledges the emotional power of Geology and demonstrates the charm and the beauty of geological shapes by a variety of mesmerising geological patterns.

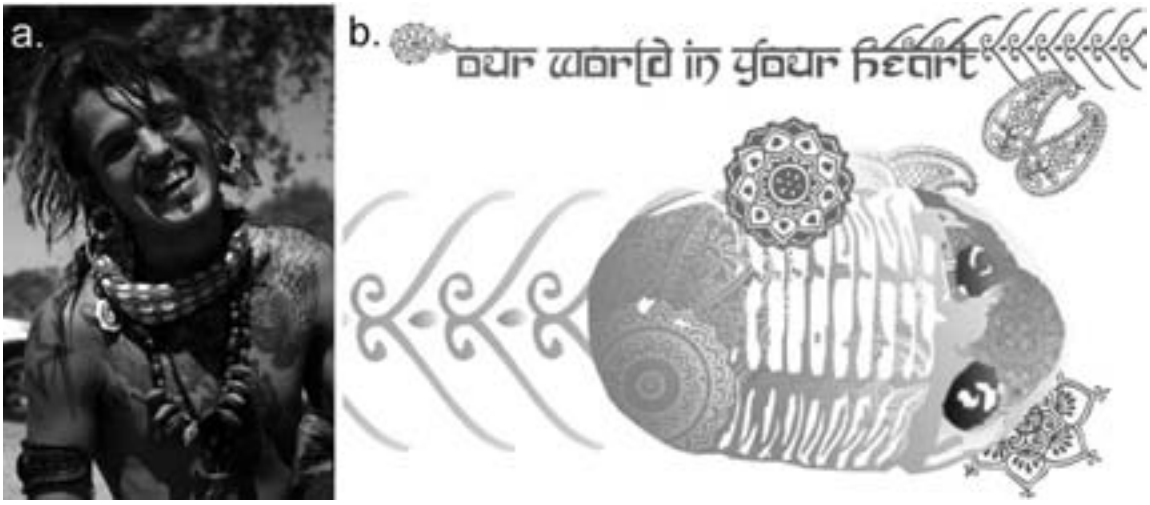

Figure 6: Geodelica: psychedelia meets Geology. a. The participants of the demonstrated interest and awe for *Geodelica*. Courtesy of Jorge Fialho. b. The author of *Geodelica* designed a vinyl sculpture to physically introduce his Video Art. The sculpture is inspired by an asaphid trilobite and its associated trace fossil, *Cruziana*.

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ORDOVICIAN ICHNOFOSSILS: A NEW SCIENTIFIC AND EDUCATIONAL RESOURCE FOR THE AROUCA GEOPARK

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In the area of Arouca Geopark 41 geosites were identified, mainly related with Pre-Variscan and Variscan geological occurrences (Sá *et al*., 2008). One of the most impressive geopark' geosites is the "Valério's Quarry", where samples of the the biggest trilobite fossils have been recovered during the latest years (Gutiérrez-Marco *et al*., 2009). Regarding Variscan occurrences, geosites are mostly associated with plutonic rocks and with gold and wolfram mineralisation (Sá *et al*., 2008). From a paleontological point of view, Middle Ordovician and Lower Silurian invertebrate remains (Gutiérrez-Marco & Sá, 2006, 2008), as well as some trace fossils from the "Armorican Quartzite" (Gutiérrez-Marco & Sá, 2006; Sá *et al*., 2006, 2007; Aceñolaza *et al*., 2008) constitutes the most important fossil record of the Arouca Geopark.

Inside the European Geoparks Network, Paleozoic trace fossils have also particular scientific, educational importance in the Naturtejo Geopark (Ordovician, Portugal) and in the English Riviera Geopark (Permian, UK). Regarding the Arouca Geopark, previous and recent research shows that the Ordovician trace fossils have high scientific and educational value because they supply important data about the behaviour of organisms that lived more than 465 million years ago. In the Arouca Geopark seven geosites with trace fossils have been identified so far, six of them in Lower Ordovician rocks (Meitriz, Mourinha, Cabanas Longas, Vilarinho, Gralheira d'Água and Vila Cova) and one in Middle Ordovician rocks (Valério's Quarry).

The Floian (Lower Ordovician) icnofossils occur in the Santa Justa Formation (a local equivalent of the Armorican Quartzite) developed within the *Skolithos* and *Cruziana* ichnofacies. This formation was deposited in coastal marine environments with shallow waters during a transgressive event. The ichnological record corresponds to diverse ichnogenera interpreted as locomotion, feeding, dwelling and resting traces, such as *Arenicolites*, *Bergaueria*, *Cruziana*, *Daedalus*, *Didymaulichnus*, *Diplocraterion*, *Monocraterion*, *Monomorphichnus*, *Palaeophycus*, *Planolites*, *Rosselia*, *Rusophycus* and *Skolithos.* Amongst these traces, the ones with particular interest are *Cruziana imbricata*, a rare age-diagnostic Floian form, and *Rosselia socialis* because it represents the second Portuguese record of the ichnospecies. Some of these occurrences were identified in vertical strata forming hypichnial surfaces of several square meters, which allow the visitors to understand the intense biological activity on the old marine bottom.

The rocks of the Valongo Formation (Darriwilian, Middle Ordovician) are represented by massive shales and slates formed in neritic, disaerobic environments, that gradually changed to more oxygen-rich conditions. The trace fossils recorded in

the slates are concentric pascichnia traces (*Rotundusichnium*), complex branched burrows (*Chondrites*, *Cladichnus*?, *Phycodes*), single burrows sometimes with meniscate infill (*Taenidium*) and aggregates of fecal pellets (*Tomaculum*). In more oxygenated sediments the trace fossils assemblage changed into single, burrows (*Palaeophycus*, *Sericichnus*?), irregular burrows coloured by iron oxides (*Trichichnus*), and intricate

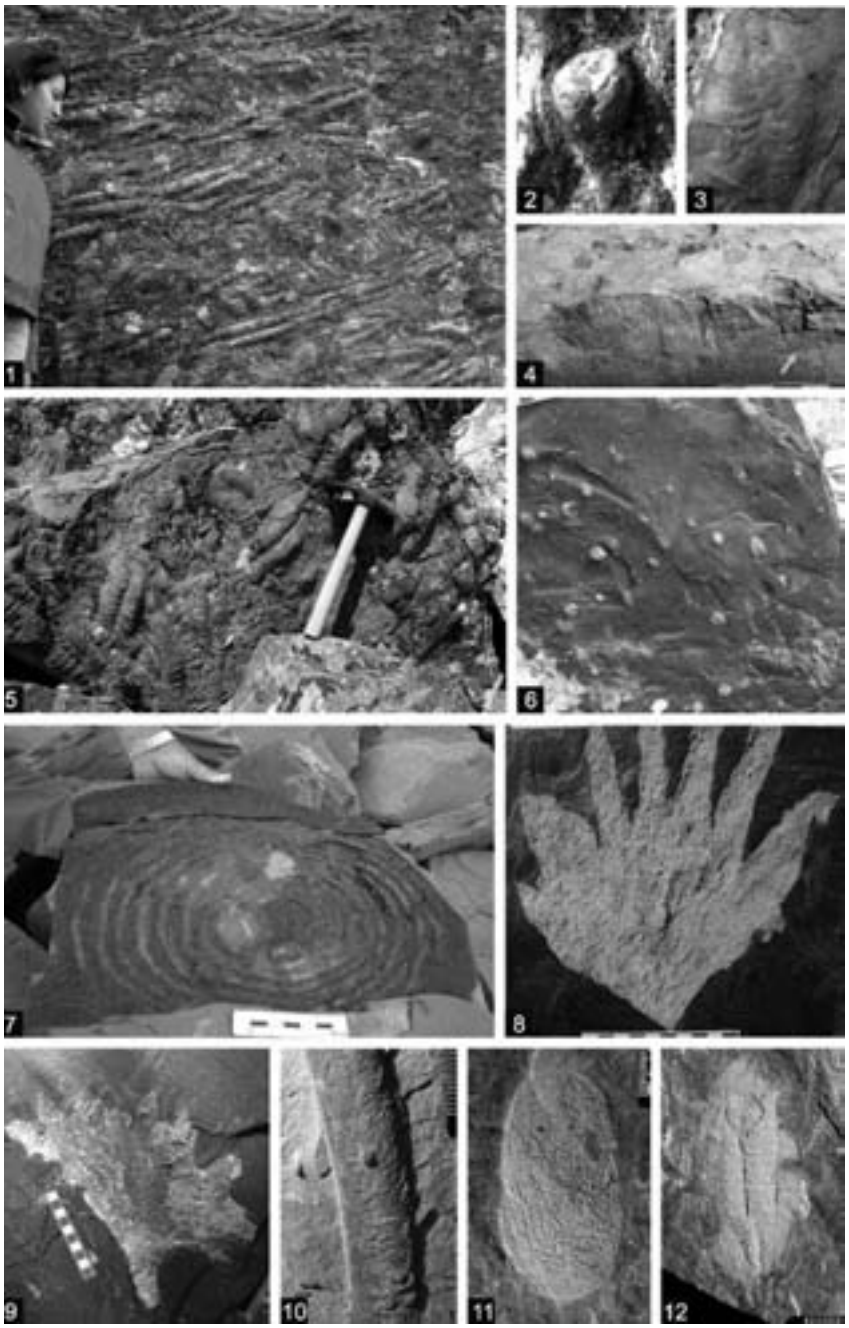

Figure 1: Ordovician ichnofossils of the Arouca Geopark. **1 -** Vertical hypicnial surface covered by *Cruziana* ispp.; **2 -** *Bergaueria radiata* Alpert, 1973 (x 0,6); **3 -** *Rusophycus carleyi* (James, 1885) (x 0,4); **4 -** *Rosselia socialis* Dahmer, 1937 (x 0,5); **5 -** *Cruziana rugosa* d'Orbigny, 1842 (x 0,1); **6 -** *Skolithos linearis* Haldeman, 1840 (x 0,2); **7 -** *Rutundusichnium* isp. (x 0,3); **8** and **9 -** *Phycodes noha* Mikulás, 1992 (8, x 25; 9, x 0,2); **10 -** *Taenidium* cf. *planicostatum* (Ksiazkiewicz, 1977) (x 0,8); **11 -** *Arachnostega gastrochaenae* Bertling, 1992 (x 0,5); **12 -** Praedichnion indet. (x 0,8).

galleries (*Arachnostega*), the last ones excavated in the infilling of mollusc shells and trilobites. There are also some evidences of bioerosion, represented by triangular bite marks on trilobites and mollusc remains, probably made by large predators like the orthoconic nautiloids. Among the mid-Darriwilian ichnofossils two ichnotaxa deserve special interest. The first one represents the oldest record for *Rotundusichnium*, a trace fossil previously known in deep sediments from Upper Cretaceous to Eocene. Thus, the Arouca record precludes in about 400 million years the normal record of the ichnogenus. The second remarkable trace fossil is *Phycodes noha*, an ichnospecies being so far recorded in the Klabava Formation (Floian – early Darriwilian) of Bohemia (Czech Republic). The Arouca specimens of *P. noha* are partially infilled by *Tomaculum problematicum*, which represents a novelty regarding the Bohemian specimens.

The richness and diversity of the Ordovician trace fossils (Fig.1) has a particular importance for science and for the new educational programs that will be implemented in the near future in the Arouca Geopark. The possibility for students and general public to act like "geodetectives" discovering not only the fossil organisms but also their behaviour throughout the study of its characteristic living traces, constitutes a major attraction that will be used to enhance the educational and touristic programs at the Arouca Geopark.

Acknowledgments

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SIRENIAN FINDINGS FROM THE PSILORITIS GEOPARK, CRETE, GREECE

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In the last decade 21 localities with Sirenian remains have been found in Neogene sediments all around Crete Island, rendering the island as one of the most important areas of Europe Sirenian research. Six of these localities are situated within the boundaries of the Psiloritis Geopark. These are the sites: Panassos, Panassos 2, Ampelouzos, Kefala, Psalidha and Apomarma. The localities of Psalidha and Apomarma were the first ones to be found in the area of the geopark (Markus Reuter, personal communication). The most important findings, however, are the two post cranial skeletons found in the localities of Panassos and Panassos 2 near the village of Panassos, Rouvas municipality. The most recent findings not thoroughly studied yet, are situated in two fossiliferous sites near Zaros village (Ampelouzos and Kefala). The preliminary morphological and metrical study of the remains from Panassos, and their comparison with other findings from Crete, as well as with Sirenian material from other European localities (like in Haute Provence Geopark, France), has shown that all studied individuals belong to the species *Metaxytherium* cf. *medium* (Desmarest 1822). The age of the studied Cretan Sirenian material has been determined as Late Miocene (Tortonian) and the presence of Sirenia in Crete indicates the prevalence of shallow and warm marine environments in coastal areas, rich in sea weeds.

VILA VELHA DE RÓDÃO VARISCAN COMPLEX SYNCLINE: STRATIGRAPHY AND STRUCTURE (CENTRAL-IBERIAN ZONE, PORTUGAL)

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The complex syncline of Vila Velha de Ródão is located in the Central-Iberian Zone (CIZ), SW sector. The studied lithostratigraphic succession is situated above the unconformity that separates the Beiras Group (BG) shale and greywacke complex from the Armorican Quartzite Fm (AQF). This study shows the geological relationship between the Ordovician-Silurian lithostratigraphic succession and the Variscan structure, which is based on new data that the review of geological mapping on the 1/25000 scale allowed to establish.

The revision of Vila Velha de Ródão geological mapping emphasizes the presence of a lithostratigraphic succession with Lower to Middle Paleozoic age, already recognized in the Amêndoa-Carvoeiro synform (Romão, 2000, 2001, 2006).The stratigraphic series is represented from the basis to the top, by: Beiras Group, BG (Ediacaran to Cambrian) - the shale and greywacke complex contacting with Lower Paleozoic through angular unconformity and faulting surface. Ordovician-Silurian succession - Armorican Quartzite Fm, AQF (80m) - massive coarse-grained sandstones with conglomerates and fine laminated quartzites with *Skolithos* and *Cruziana*; Brejo Fundeiro Fm, BFF (120m) - pelites and siltstones with *Didymograptus* and trilobites (Ribeiro *et al*., 1965, 1967; Teixeira, 1981); Monte de Sombadeira Fm, MSF (15m) - impure quartzites with storm characteristics; Fonte da Horta Fm, FHF (15m) and Ribeira do Casalinho Fm, RCF (10m) - pelites and quartz-sandstones; Cabeço do Peão Fm, CPF (25m) - bioturbated pelites and sandstones; Ribeira de Laje Fm, RLF (5m) - micaceous impure sandstones and arkoses; Casal Carvalhal Fm, CCF (50m) - pelite-siltitic sediments with glaciogenic genesis; Vale da Ursa Fm, VUF (20m) - gray massive quartzites with aggregates of pyrite; Aboboreira Fm, AF (10m) - dark laminated graphitic pelites with *Monograptus* (Romão, 2000, 2001, 2006).

The main syncline structure ends in SSE with a monocline (Campos & Pereira, 1991) in the Serra de São Miguel. The NNW final part of this macrostructure culminates in a triangular zone (Foz do Cobrão), limited to SW by a forethrust and to NE by a backthrust, with opposite facings. Their SW limb is imbricated by the Vinagra-Foz do Cobrão forethrust, which is characterized by a duplex geometry (Ramsay & Huber, 1987) and it is caused the displacement of the BG metasediments above the AQF quartzites. The forethrust and backthrust terms are related with the dominant regional facing of the thrust-fold system; where their interference originates a triangular zone and it suggests that there may exists a *décollement* in depth of thin-skinned type (Butler, 1982).

The macrostructure of the Vila Velha de Ródão syncline was affected by a progressive superposition of Variscan deformation events. The Variscan D_{1a} event induces early overthrusts with NE facing, coeval of the primary folds with a penetrative axial planar S_1 foliation, giving rise to a L_1 intersection lineation, sub-parallel to the fold

axis. The Variscan D_{1b} event retakes the early D_{1a} overthrusts and generates larger forethrusts (Fig.1): Vinagra-Foz do Cobrão; Portas do Ródão-Perdigão, Vale do Cobrão forethrusts, with duplex geometries. All of them show NE facing and induce displacements in the Beiras Group and in the Ordovician-Silurian succession. The Variscan D_{1c} event generates backfolds and backthrusts with SW facing: Chão das Servas-Carregais backthrust, induced by the superposition of the Beiras Group above the quartzites of the AQF on the NE board. The forethrusts and backthrusts system form the Foz do Cobrão triangular structure and induces a *décollement* in depth of thin-skinned type.

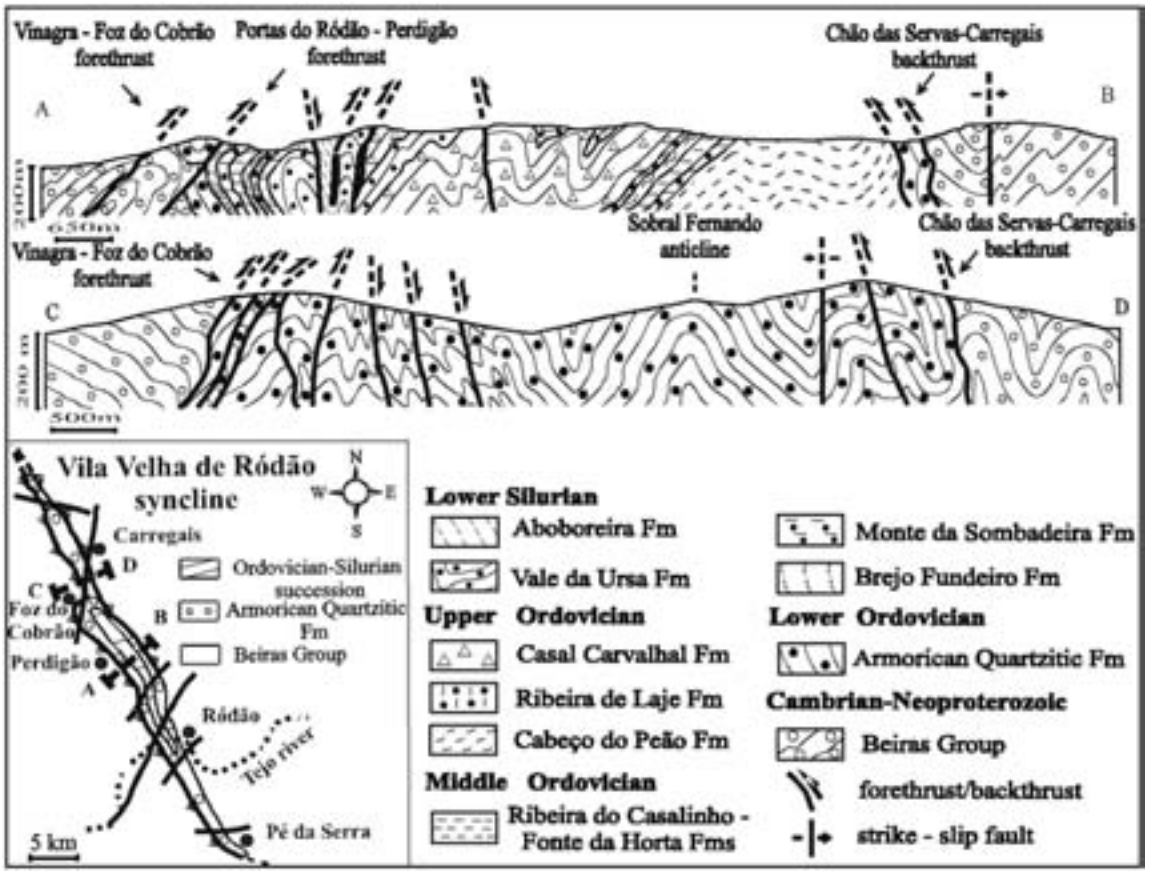

FIGURE 1: Schematic framework and geological cross sections of the Vila Velha de Ródão complex syncline.

The Vila Velha de Ródão complex syncline is affected by two generations of late-Variscan faults: the first with a NNE-SSW orientation could be interpreted as domino structures. Among them stands out the Ponsul fault (Ribeiro, 1943; Dias & Cabral, 1989), which was reactivated as a reverse fault during the Alpine movements and is responsible for the overlapping of the Variscan substrate upon the continental Tertiary deposits. The second, probably later with a WNW-ESE orientation is a dextral strike-slip system, cutting the entire Variscan structure.

The Ordovician-Silurian succession of the Vila Velha de Ródão syncline was deposited during a major sedimentary cycle with duration of within 50Ma (Romão & Oliveira, 1997; Romão, 2000, 2006): transgression - from Arenigian to Dobrotivian; condensation - near the basis of Caradocian and regression - from Lower/Middle Caradocian to Lower Silurian. The fold's geometry and attitude, as well as the S_1

foliation are compatible with a maximum NE-SW compression during the D_1 phase. The sub-vertical stretching (sub-parallel to the kinematic **a** axis) indicates a vertical escape of material (Ribeiro *et al*., 1990; Romão, 2000); the stress field is thus characterized by horizontal shortening and vertical stretching. The studied thrust-fold system indicates that the deformation gradually continues during the D_1 later events, induced by a similar stress field, but with one slight rotation of the compression towards ENE-WSW due to the progressive deformation of the Iberian-Armorican Arc (Ribeiro *et al*., 2007).

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ENGLISH RIVIERA EUROPEAN AND GLOBAL GEOPARK - HOPES NOSE PROJECT

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The English Riviera Geopark, situated in Torbay, South Devon, UK, joined the European and Global Geopark network in September 2007 and is active and dynamic in all areas of its work. The status has helped raise the profile of the geological importance of the area and as a result the Geopark is now actively engaged in the successful facilitation of an exciting partnership research, rescue and interpretation project with the Natural History Museum, London, renowned for its unrivalled collections and internationally important research programmes and Natural England the key national body responsible for conserving and enhancing the natural environment in England.

Native gold was discovered in narrow carbonate veins which cut through Middle Devonian limestone's of Hope's Nose by Gordon *in* 1922 whilst undertaking a student geological field excursion. Subsequent collecting visits by Sir Arthur Russell *in* 1929 revealed the gold to be of the form of dramatic fern-like aggregates and distinct crystals. Research in the early 1990's revealed the deposit to also contain a unique assemblage of base metal and selenide minerals, unique to the British Isles. Since the 1970's the deposit has attracted the unwelcome attention of opportunistic illegal collectors.

It is fortuitous that in our time, this deposit is accessible, the current erosion level revealing the associated mineralogy. The mineralised horizons are deemed to be small in a vertical plane and ultimately the natural processes of weathering will erode them completely.

Using a variety of cutting edge techniques over the summer months, the project partners have worked together to assess the unique geology of the site to further scientific understanding of the mineralization and associated geology, and assist the future management of the site.

The development of educational opportunities and future interpretation in the public domain is fundamental to this project with an active communications and profile building campaign being developed through a variety of media outlets.

USING ACTIVE FAULTS FOR RAISING PUBLIC AWARENESS AND SENSITISATION ON SEISMIC HAZARD: A CASE STUDY FROM LESVOS GEOPARK, NE AEGEAN SEA, GREECE

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The North Aegean region is a geotectonically complex area, because its geodynamic status is directly affected by the North Anatolian Fault Zone (NAFZ), its westward continuation in the Aegean Sea, known as the North Aegean Trough (NAT) and the West Anatolia Graben System (WAGS) in Asia Minor with significant historical seismicity (Papazachos & Papazachou, 1989; Kiratzi & Louvari, 2003; Papazachos & Kiratzi, 1996). As a result of the interaction between those tectonic systems, there is a strong diversity in fault trending and character (Koukouvelas & Aydin, 2002; Kreemer *et al*., 2004; Papanikolaou *et al*., 2006). These faults are located on islands as well as offshore, where they define seafloor morphology. Furthermore, the faults on the Turkish coast should not be ignored in a seismic hazard analysis of the area, as they are situated in short distance from residential areas and are possible seismic sources.

According to the Greek National Statistic Agency (2001 consensus), the population of North Aegean Prefecture is 204,108 residents while the population of Turkish coast cities and towns is several million. The definition of active faults and their seismic potential is therefore of paramount importance for seismic hazard assessment and civil protection (Pavlides *et al.* 2009). The risks that earthquakes pose to society of the NE Aegean, including death, injury, and economic loss, can be greatly reduced by better planning, construction, and mitigation practices before earthquakes happen, and providing critical and timely information to improve response after they occur. Further more social awareness and education on natural hazards is a crucial factor leading to enhance public safety and to reduce losses.

The research project "Use of modern research tools in geosciences in seismic hazard management with emphasis on the urban areas in NE Aegean islands" which was financed by the Greek General Secretary of Research and Technology and curried out in the frame of the North Aegean Region Operation Programme 2000-2006, included an important session on public awareness activities on seismic hazard which took place in the main NE islands, including thematic exhibitions, seminars and educational programs for schools.

1. Active faults

North Aegean faults are variable in strike and character. A large percentage of them are affected by the local shear stress field, showing predominantly horizontal displacement, as derived from the focal mechanism of shallow earthquakes in the area. However, there are also many normal faults, while the majority of all faults are either normal with left-lateral component or right-lateral component.

In this complex tectonic environment, the determination of the fault activity and the fault classification in active or possibly active faults is based on the following criteria (Fig. 1):

Fault geometry: the relation between the fault strike and the local stress field is very important for possible future reactivations. *Geological age:* the age of the last reactivation of the fault is the one of the most recent deformed material. Faults that deform Upper Pleistocene – Holocene sediments are *a priori* active.

The morphologic impact on relief: the identification of past earthquake ground ruptures, easily affected by exogenic procedures, is valuable indicator of recent fault activity;
its weathering degree is directly dependant to the elapsed time since the last reactivation. Morphotectonic signatures may also be various other structures, such as sharp fault scarps, the differential and intense deep erosion at the upper part of a fault scarp, an observed linear arrangement of recent geomorphic features, etc. Analysis and evaluation of the morphologic impact requires careful study of geomorphic features and their association (or not) to faults.

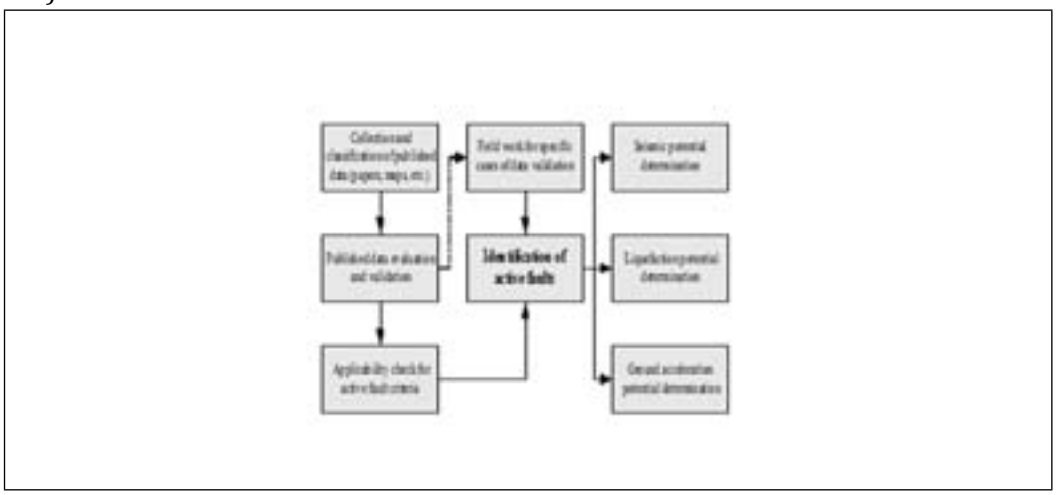

FIGURE 1: Procedure flow diagram for the characterization of active faults (Pavlides *et al*. 2009).

The seismotectonic characteristics: some faults are associated to historic or instrumental seismicity; in this case they are classified as active. In cases they produced surface ruptures during an event, it is easy to correlate them with specific tectonic structures. The determination of seismic faults that have not produced surface effects is based on the association of focal mechanisms with already mapped faults. *The morphotectonic indices:* the morphotectonic indices are strong proof for the activity level of a fault zone. This kind of indices can be fault scarp sinuosity, drainage basin asymmetry, valley width/height ratio, etc. There are many indices that can be used for drawing conclusions in tectonically active regions, but in all cases they must be used in combination with geologic and tectonic data (Pavlides, 2003).

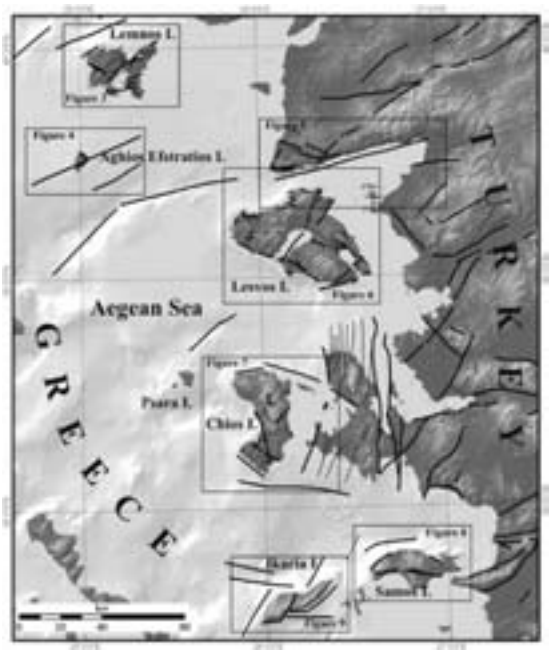

FIGURE: 2: Overview map of NE Aegean and its main faults. Thick lines indicate active or possibly active faults, while thin lines indicate the remaining mapped faults of the area. (Pavlides et al. 2009).

After applying the above mentioned criteria to individual faults, together with field confirmation, they can be characterized as active, possibly active or inactive. This classification refers to fault zones and not individual fault planes (Pavlides *et al*. 2009).
All active faults in the study area are presented in (Fig. 2), as well as in more detailed maps for each island. In each island's map, expected magnitude and displacement are also presented. They were estimated using Pavlides and Caputo (2004) relationships. It is important to note that the faults depicted in the maps should rather be considered as fault zones, instead of individual faults. Their exact trace has been identified by comparing various published data with field results. Faults located at Turkey were mainly extracted from Şaroğlu *et al*. (1992).

2. Active faults on Lesvos island

Lesvos island is the most populated island in the NE Aegean sea and is the capital of the N. Aegean Region and Lesvos Prefecture, so its seismic potential has special social-economic meaning not only regionally but also broadly.
Lesvos, the third largest Greek island, is dominated by Neogene volcanic rocks which form its characteristic landforms and landscapes. On its western side an entire Miocene fossilized forest has been unearthed, the well-known "Petrified Forest of Lesvos", a protected natural monument covering an area of 15.000 hectares.
On Lesvos island the most significant faults – potential seismic sources (Fig. 3) are the following (Soulakellis *et al*., 2006):

- The right-lateral Aghia Paraskevi fault (Fytikas *et a*l., 1999) was the one activated when the 1867 earthquake (magnitude 6.8) occurred. It cuts off the central part of the island from N to S, while its visible length onshore has earthquake potential 6.7. This means that it continues to the sea, to the Kalloni gulf possibly, as it arises from the microseismic epicenters distribution;
- The NW-SE trending faults on the southern shore of the island play an important role in shaping the coastal morphology. According to the length, the maximum earthquake potential is 6.6-6.8. Their SW dip direction, however, reduces the seismic risk for the island's settlements;

• The faults in the Gulf of Gera comprise a zone that has particular importance because of the short distance from the town of Mytilene. The earthquake potential reaches the value of 6.5.

FIGURE 3: Lesvos Island fault map. Numbers indicate the expected earthquake magnitude and displacement (m, in parenthesis) in case of potential activation of specific faults.

3. Seismic hazard awareness in Lesvos Geopark

Aiming at the Lesvos Petrified Forest protection and efficient management, the Natural History Museum of the Lesvos Petrified Forest, founded in 1994, is the management body of the Lesvos Petrified Forest Geopark. The Lesvos Geopark, the very first Greek Geopark, already counts one decade of successful operation.

Educational activities lie at the core of the Lesvos Geopark's operation. Environmental education programmes organized for elementary and high school students cover a broad range of activities aiming at raising the awareness of the local inhabitants diffusing of geoscientific knowledge at large on various issues such us: understanding of natural processes, geoforms and landscapes, the importance of the environmental protection and management, the conservation of the Earth's heritage and natural hazards (Fig. 4).

Thematic exhibitions accompanied by educational programmes introduce young students to the "secrets" of geo-scientific research and geoconservation through a variety of activities accompanied by educational tools and publications.


FIGURE 4: Students participating in educational program on earthquakes (from left to right): students getting information sitting on the seismic table modified as a classroom;. during the simulation of a strong earthquake protect themselves under the tables.

The educational activity "Earthquakes: natural processes and hazards on planet Earth – Living on an earthquake island" aims to familiarize students and citizens living on the Aegean islands with earthquakes, active faults and seismic hazard.

The activity was organized by the Natural History Museum of the Lesvos Petrified Forest and uses the scientific results of the research project.

This educational activity includes six main stages:

a. a multimedia presentation on earthquakes and active faults,;
b. an exhibition on active seismicity in the Aegean, including activities for the familiarisation of the participants with educational seismograph and the observation of the Seismological Station of Sigri which is connected at a telemetric network of the Seismological Station of the Aristotle University of Thessaloniki consisting of 14 permanent regional stations, covering the entire region of northern Greece;
c. a thematic exhibition on seismic hazard on the Aegean islands presenting data from the seismic history of the area, the active faults, the results of the historical earthquakes, and the new active fault and seismic hazard maps of the North Aegean islands;
d. field observation of active faults, their morphological characteristics, geometry and appearance;
e. simulation of several recent strong earthquakes in Greece and abroad by using the Museums seismic table;
f. educational activities of the participants.

The results of this educational activity which was carried out during 2009 was surprising positive. More than 3000 students participate, gaining new experiences thus contributing in better understanding earthquakes and Earth's natural processes.

Acknowledgements

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THE GEOSITE MAPS: AN INSTRUMENT OF KNOWLEDGE AND PLANNING, A FEASIBLE COMMON INSTRUMENT FOR THE GEOPARK

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A field study with the aim of knowing the many Geosites spread in the vast territory of the park has been conducted in the Geopark "Parco Culturale Rocca di Cerere", since last spring. The study, which starts from the file cards prepared for the classification of the Geosites within the "Geosites" project, has improved the classification and investigation methods of the planning skill. This has resulted in the detection of other fields of knowledge and then the connection between geological heritage and natural, cultural and landscape heritage in general. That has suggested the work group to define a complex and complete reading chart of the single site. The expected result will not only concern the deep and scientific knowledge, thus opening new research perspectives for the interested Universities, but also and above all the definition of the procedures in protecting and enhancing the listed Geosites. The next step to be taken would be that of discussing each time the conservation measures, the improvement strategies, and the limitations and proposals to "geotourism" aims.

The research work has been equipped with an original database programme, suitable with systems different from Microsoft and based on the freedom of research typical of LINUX. This choice makes the database translatable in every possible language with the simple processing of file fields. Geopark "Parco Culturale Rocca di Cerere", together with the "Centro di Educazione Ambientale Alexander von Humboldt", responsible for the research, make this instrument available to the Geoparks on the net.

A MEDIA-BOX BRINGING GEOPARK-KNOWLEDGE INTO SCHOOLS

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In the frame of a diploma thesis, written by Melanie Schnieders, landscape engineer in Osnabrück, a media-box was developed, that aims to transport main aspects of Earth History, Sedimentology, Tectonics and Glacial processes into Geography school lessons. The TERRA.vita Geopark is taken as an example to explain how layers of rock form, why they contain so much information about former periods and how orogenesis and erosion can expose old sediments to the surface again. The media box aims to help teachers, explaining geological processes using the surrounding landscape as an example, instead of talking about distant and exotic places, that are out of reach for most of the pupils.

A prototype of the box was already built as a part of the thesis and contains several useful things to explain the geological processes: a little collection of rocks shows the varying sediments of different ages, that can be found in the region, a puzzle explains continental movement, while another puzzle builds up to show today's position of the rock layers in TERRA.vita. Several mechanical models reconstruct the Africa-Europe collision leading to the rise of the alps and also the TERRA.vita-mountain-ridges in a distance as well as the uplift of the Teutoburger Wald with old layers becoming visible at the surface again.

The set is completed by a detailed guidebook, that is handed out to the pupils. A guideline for teachers and a short introduction film helps getting started with the box.

In spring 2009 the environmental foundation of the Osnabrück county decided to finance the construction of ten boxes and the print of 1000 guidebooks. Starting in spring 2010, schools can lend out the boxes to integrate them into the Geography lessons. TERRA.vita volunteers will accompany the teachers when they use the box the first time.

GEOTECA: LEARNING SCIENCE THROUGH THE AROUCA GEOPARK

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The Arouca Geopark was recently integrated in the European and Global Geoparks Network and it is recognized for his exceptional geological heritage and for its efforts on the local socio-economical-educational development.

During the school year of 2008/2009, the Arouca Geopark developed with the Primary Schools of the territory a pioneer project called "Geoteca". This project, initially developed by the school libraries, has as the most important aim the creation of a resources centre of Geology in these libraries in the context of the Arouca Geopark.

The main goals of "Geoteca – geological resources centre of the Arouca Geopark" are: *i*) improve the knowledge of students and teachers about the Arouca Geopark; *ii*) aware the student population of the need to protect the heritage of the Arouca Geopark; *iii*) encourage students to study the heritage values of Geopark; *iv*) promote the execution of activities with the Arouca Geopark; and *v*) bring the school community to the Geopark.

The "Geoteca" Project has started in the beginning of the school year of 2008/2009 with a "Thematic Session" given by the technicians of the Arouca Geopark to the students of Primary schools of the area which have school libraries: School E.B.1/JI of *Boavista* (Fig. 1a) and School E.B.1/JI of *Alvarenga* (Fig. 1b). This session entitled "Discover your Geopark!" has involved 220 students and 18 teachers. Besides the introduction of the project and the awareness of the students and teachers to the aims and importance of the preservation of the Arouca Geopark, this lecture also incited the knowledge of geosciences in the context of the Geopark.

After the first lecture, the students of both schools (Boavista and Alvarenga) created a box/suitcase allusive to Arouca Geopark and entitled "Animaleta do Geoparque Arouca". The box/suitcase was made by the students and decorated with the most relevant Geopark motifs such as Trilobites, Rocks delivering stones, Paiva River and Pedestrian Trails. Inside the box/suitcase, it was filled with books and resources related to the geology of Arouca and its values (Fig. 1c). This was achieved during the length of the school year, starting with a bibliographic research to books of geology, biology and culture and then to books on the touristic interests of the Arouca Geopark territory (Fig. 1d).

During the scholar year, there were more lectures/thematic sessions about key areas of the Arouca Geopark, which have contributed for the increase in knowledge of students and teachers. For example, subjects such as "Adventure Sports" in Paiva River (Fig. 1e) and "Pedestrian Trails" in the Geopark territory (Fig. 1f) were approached. In order to do that, several specialised speakers were invited to give those lectures. These sessions were of great importance for both students and teachers to understand that the Arouca Geopark incorporates far more than just its geological heritage. Parallel to those sessions, it was created and organized files and materials aimed to support the curriculum of the students based on the concepts developed by the project. These files which were filled in by the students were then incorporated in the "Animaleta do Geoparque Arouca" box/suitcase that was mentioned before.

Another activity organized by this project and with great impact, was the field trips to the most important geosites of the Geopark. The participants of this activity had the opportunity to made contact and learn about the fossils of Canelas, specially the Trilobites and also the rock delivering stones of Castanheira.

a


b

c


d


e


f


g


h

FIGURE 1: Developed activities during the "Geoteca" Project. **a,** Thematic Session "Discover your Geopark!" in Library Primary School of *Boavista*; **b,** Thematic Session "Discover your Geopark!" in Library Primary School of *Alvarenga*; **c,** First resource of "Geoteca" – the box/suitcase; **d,** Children found books about Geology; **e,** Thematic Session of Adventure Sports in Library Primary School of *Boavista*; **f**, Thematic Session of Pedestrian Trails in Library Primary School of *Alvarenga*; **g,** Workshop "Make your own Trilobite!" in Primary School of *Vila Cova*; **h,** Workshop "Make your own Trilobite!" in Primary School of *Ponte de Telhe*.

After visiting the "Geological Interpretative Centre of Canelas", it was also created the workshop "Make your own Trilobite!" in the school context, in which the students made their own trilobites based on mould of Trilobites (Fig 1). Once finished, they could paint the trilobites and bring them home. This workshop has reinforced the knowledge of the students about Trilobites. They learnt mostly about the morphology of the Trilobite body, but also their way of living. They made comparison between the Trilobites and the animals of today.


a


b


c


d


e


f


g

Figure 2: Carnival 2009. Children dressed up as: a-b, Hikings; c-d, Raft-boats; e-f, Trilobites; g, Arouca Geopark custom.

Some of these activities were extended to other schools of the area of Geopark that specifically have asked for that.

The peak of this activity occurred during the Carnival 2009, when several students of the primary schools of Arouca disguised with themes allusive to the activities generated by the "Geoteca" Project (Fig. 2).

The "Geoteca" project had a strong commitment of the educational community of Arouca, even though had originally started in only two schools that have school libraries. At the end of the present school year, the materials generated by this project were exhibited in Arouca and also outside Arouca in the following events:

- Cultural week of Arouca , Arouca, 27 May- 7 June, 2009,
- Conference "in the school with science", EuroParque, Feira, 28-29 June 2009.

In January 2009, the "Geoteca" Project was submitted to the "Merit Prize" of the Portuguese School Libraries Network. This project was distinguished, among a great number of submitted projects, by the level of involvement with the local values and communities. This prize in the value of 3.500€ will be dedicated to the acquisition of material to improve the "Geoteca" project.

RESEARCH IN CABO DE GATA-NIJAR GEOPARK

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During the last 22 years, since the designation in 1987 of this exceptional territory as a Nature Park, the area has been the subject of more than 250 research studies as well as projects concerning biological and geological diversity.

During the early years the majority of these studies were dedicated to investigating bird ecosystems and steppe habitats. Subsequent studies focussed on plant communities, marine habitats, and geological resources and processes. All these investigations resulted in a number of publications.

These research activities resulted in the international recognition of different aspects of the Cabo de Gata-Nijar Natural Park. In 1989 Cabo de Gata-Nijar was declared as a Special Protected Area for Birds (SPA), The salt pans (salinas) within the coastal depression at the southwestern slopes of the Sierra de Gata mountains were included in the RAMSAR Convention (The Convention on Wetlands of International Importance) in 1990, and in 1997 Cabo de Gata-Nijar became a member of UNESCO's World Network of Biosphere Reserves. During 2001 Cabo de Gata-Nijar was included in the SPAMI (Specially Protected Areas of Mediterranean Importance) List. From 2006 this territory has been a member of the Natura 2000 Network, a Europe-wide network of sites dedicated to the protection of the natural heritage, and of the European and Global Geoparks Networks. Finally in 2008 the Sustainable Tourism European Charter was awarded to the Cabo de Gata-Nijar Geopark.

The extensive research activity during the last 22 years resulting in international recognition was authorized by the environmental administration.. In addition other research initiatives have been concerned with the environmental and cultural aspects of this unique area.

These initiatives resulted in specialized publications, such as the exceptional literary or photographic works of Juan Goytisolo, Jose Angel Valente, Jeanne Chevalier, Manuel Falces, Perez Siquier, etc. Nevertheless, the results of the scientific research form the the major component of the publications on the Cabo de Gata-Nijar .
All the research work provides updated information on the territory and has helped to supply Cabo de Gata-Nijar with useful environmental data. Approximately 12 new research projects are authorized annually.

Finally it is important to emphasize that, after three years of collaboration with Almeria University, an Evaluation and Monitoring Center for Global Change has been established in the Geopark, and over the next years a crucial project "Evaluation and Monitoring Project for the Global Change effects in arid and littoral areas, GLOCHARIDS" will be developed

THE "PONTA DA FERRARIA" LAVA DELTA GEOSITE: SCIENTIFIC, EDUCATIONAL, ENVIRONMENTAL, HISTORICAL AND ECONOMIC (GEOTOURIST) VALUE

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1. Introduction: General Setting

Ponta da Ferraria is located at the westernmost end of S. Miguel Island and was formed at the base of the Sete Cidades Volcano western sea cliffs. It is located at about 25 km from the island's main, town Ponta Delgada.

Sete Cidades Volcano is one of the four silicic polygenetic volcanoes with caldera of the S. Miguel Island. With a 14 km average base diameter, an area of about 122 km^2, a 40 km^3 volume and maximum high of 2,700 m above the surrounding seafloor, Sete Cidades Volcano is a 800 ka inferred age stratovolcano, with a 5.3 km average diameter and 620 m maximum depth summit caldera (Nunes *et al.*, 2004). The erupted products includes basaltic s.l. lava flows and pyroclasts (e.g. its basement), trachytic s.l. lava flows, domes and pumice fall deposits, and pyroclastic flow deposits such as ignimbrites, surges and lahar deposits. The latest eruptions include 13 intra-caldera traquitic and explosive events, some of hydromagmatic nature in relation with lakes inside the caldera (e.g. Lagoa Verde-Lagoa Azul volcanic lake).

2. Geological Synopsis of Ponta da Ferraria Geosite

Ponta da Ferraria is a basaltic s.s. lava delta, with a typical triangular shape, a finger-like shoreline contour, an area of about 0.1 km^2 and altitude of about 15 m in its central part (Fig. 1). The lava delta shoreline is characterized by vertical, plunging sea cliffs in most of its contour.

Figure 1: Aerial view of Ponta da Ferraria – Pico das Camarinhas geosite. Courtesy of "Direcção de Serviços de Cartografia e Informação Geográfica" (Azores Government). **Cam-** Pico das Camarinhas scoria cone; **C-** craters; **D-** trachyte lava dome; **L-** littoral cone; **S-** natural thermal swimming pool; **T-** thermal building; **V-** Várzea scoria cone (mantled by pumice). Dashed line indicates the general boundary of the Ponta da Ferraria lava delta.

The lava flow that build that flatten coastal area (named "fajã" in Azores Islands) was extruded from Pico das Camarinhas, one of the 46 flank eruptions of Sete Cidades Volcano (Nunes *et al.*, 2004). Pico das Camarinhas basaltic scoria cone has a summit multiple crater, elongated like the cone along a general W-E trend, which defines a radial tectonic alignment of the central volcano of Sete Cidades. According to ^{14}C age determinations done by Moore (1991), the strombolian-type volcanic eruption responsible for the formation of Pico das Camarinhas scoria cone and the Ponta da Ferraria lava delta took place 840 ± 60 years B.P. (e.g. around the year 1140 A.D.).

The *aa*-type lava flow from Pico das Camarinhas monogenetic volcano moved in a westerly direction, down the steep sea cliffs and into the Atlantic Ocean, originating the lava delta of Ponta da Ferraria and preserving the shoreline prior to the eruption as a fossil sea cliff (about 400 m long, 100 m high and average slope of 35º), where the geological formations of Sete Cidades Volcano can be observed. Among these are basaltic and trachitic s.l. lava flows, *lapilli* and pumice deposits, ignimbrites and sub-vertical dykes (Fig. 2). Moore (1991) reports a 74,000 ± 6,000 years B.P. K-Ar age for a tristanite flow at the base of the Southernmost part of the fossil sea cliff, near the natural thermal swimming pool.

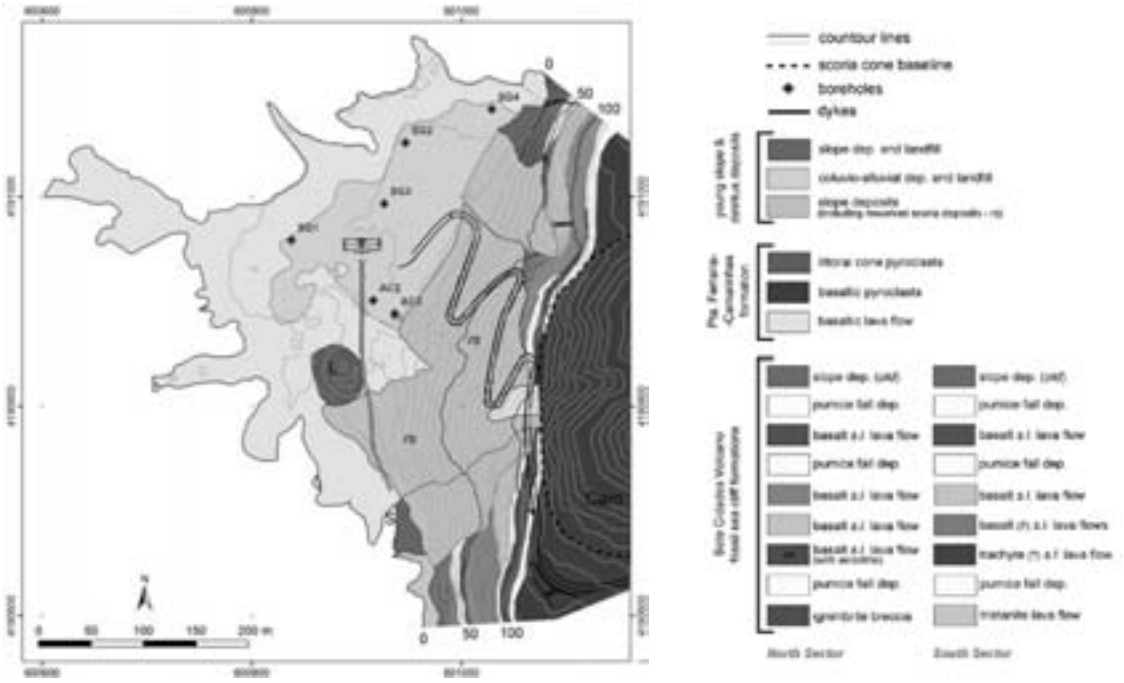

Figure 2: New geological map of Ponta da Ferraria area. Topographic map by INOVA (2007); scale 1/2,000, Local Datum "São Brás" (see also Fig. 1).

According to information gathered from boreholes done in 2003 at the Ponta da Ferraria lava delta for thermal water exploitation purposes (Fig. 3), the Pico das Camarinhas lava flow as a thickness of about 20 m at Ponta da Ferraria, with top and bottom clinkery layers (Carvalho *et al.*, 2009). As the lava flow moved over the sea water, it formed a small pyroclastic cone at the surface of the lava delta, called a littoral cone (or pseudocrater – Fig. 1 and 4), since it does not have a deep feeding conduit and it was formed by small explosions of steam accumulated underneath the lava flow as a result of the contact between the base of the lava flow and the sea water. That littoral cone is one of the few and the best preserved landform of that type in the all Archipelago.

The Ponta da Ferraria/Pico das Camarinhas lava flow is very enriched in xenoliths/cumulates (Fig. 5), with a relatively homogeneous mineralogical composition (e.g. plagioclase and

amphiboles) but with very diversified textures. Also, at the north sector of the fossil sea cliff and dispersed in the ankaramitic lava flow and scoria deposit of the Várzea Cone (aged 5 ka to 15 ka – Almeida, 2001 – Fig. 1), there are ultramafic xenoliths of granular rocks rich in olivine and pyroxene (mainly of spinel harzburgites and subordinately of spinel wehrlites, -lherzolites and –dunites), which were formed at depth in the mantle, and were brought to surface by subsequent eruptions.

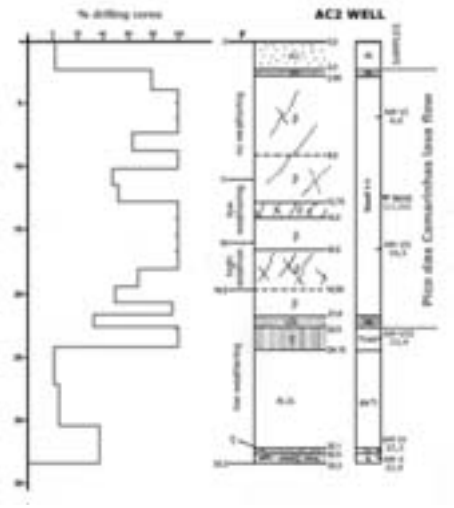

Figure 3: Geology of the AC2 thermal water well. At- landfill; β- basalt s.s.; clk- clinker; τ- trachyte s.l.; ig- ignimbrite; (py ?)- probably pumice lapilli/ash fall deposits; N.D.- no drilling core.

Figure 4: Ponta da Ferraria geosite. L- littoral cone; T- thermal building; F- fossil sea-cliff.

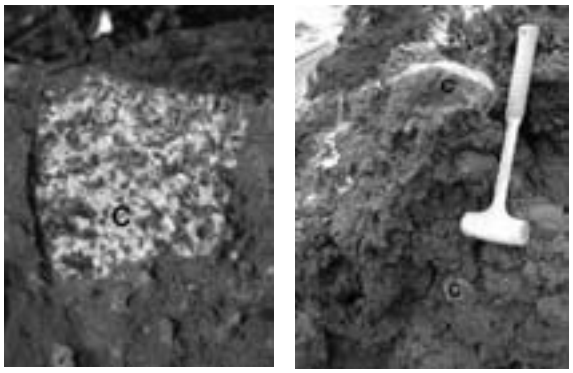

Figure 5: Cumulates (C) in the Pico das Camarinhas-Ponta da Ferraria basaltic lava flow.

The trachytic dome located immediately East of Pico das Camarinhas scoria cone (see Fig. 1) is emplaced on the same radial fracture of the Sete Cidades Volcano, and it is formed by trachytic lava flows erupted prior to the Pico das Camarinhas cone, as they are mantled by its basaltic scoria.

In June 1811 A.D., at the sea and about one mile away/West from Ponta da Ferraria lava delta, a volcanic island was formed during a basaltic s.l. surtseyan type eruption. That island, that disappeared in middle October due to sea erosion, was named "Ilha Sabrina" (Sabrina island) by Capt. Tillard, the commander of the British frigate *Sabrina* sailing nearby: the toponomies in the area (e.g. Sabrina street and Sabrina belvedere) still recall the 1811 volcanic eruption.

The Ferraria thermal water emerges at the sea level with maximum temperature of *ca.* 62ºC, is of sodium chloride type (as the result of seawater mixing) and has supplied the nearby thermal building during its running (1880-1983). Nowadays, two thermal water wells managed by INOVA Institute will ensure the water supply to the old thermal building that is

presently under reconstruction. The therapeutic properties of the thermal waters are referred by Medeiros (1964).

3. Valuing Ponta da Ferraria Geosite

Ponta da Ferraria – Pico das Camarinhas area was classified as a Regional Natural Monument in 2005 (Decreto Legislativo Regional n.º 3/2005/A, 11th May) due to its unique geological heritage and its historical, geographical, biologic, scenic and socio-economic importance (Braga *et al.*, 1988). Since 2008 this area is also part of the S. Miguel Island Natural Park, under management of the regional department of Environment (Decreto Legislativo Regional n.º 19/2008/A, 8th July).

Thus, besides its relevance in terms of geology and volcanology as shown on the previous section, this area has also high value in what concerns namely:

i) Flora: Pico das Camarinhas cone has one of the last formations of *Myrica faya* - *Erica azorica* (faya tree and Azorean heather) on the island; littoral vegetation (as *Festuca petraea* – "Bracel-da-rocha") and other endemic species (as *Erica scoparia* ssp. *Azorica* – "urze") are also present;

ii) History: as the closest site to the 1811 A.D. Sabrina submarine eruption (Figure 6) and is well known due to its natural thermal waters (referenced since the XVI century Gaspar Fructuoso´s book "Saudades da Terra") and the thermal building, in activity since 1880 A.D.;

iii) Tourism: being one of the most visited places of S. Miguel island and, together with Vista do Rei belvedere (over the Sete Cidades caldera) the major ex-libris of the Western sector of the island; besides its scenic beauty and wild quietness, Ponta da Ferraria visitors usually search for the talassoterapy properties of its warm and healthy waters (Figure 7);

iv) Education: as a site visited by several students and classes, to observed and interpret in general the volcanic phenomena and in particularly the eruptive history of Sete Cidades Volcano;

v) Recreation: at the site there is a climbing wall (on the ignimbrite formation) and walking trails to Pico das Camarinhas cone and surrounding areas;

vi) Research: recent studies revealed the presence of extremophile micro-organism (e.g. bacteria) in this thermal water (Aguiar, 2005) with great scientific importance and potential economic interest, since these microbes might be valuable, namely on food and drugs industries and genetic engineering.

According to Lima (2007), that analyzed 59 sites with geological interest among the environmental areas of the Azores, the Ponta da Ferraria/Pico das Camarinhas area occupies the 17th position among the 36 geosites with national or international importance. Its Q=44 relevance or value factor (with the highest value being for Furnas Volcano, Q=51) is correlated to its uniqueness, for being an excellent site in terms of educational and scientific purposes, by the associations with other important natural elements (like the endemic flora), for its high potential to promote several Nature activities and its good accessibility and excellent observation conditions.

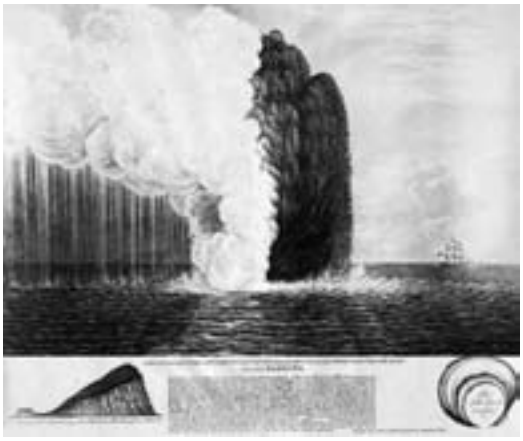

Figure 6: Sabrina submarine eruption (1811 A.D.) seen by Capt. Tillard, the commander of the British frigate Sabrina (in: Chaves, 1920).

Figure 7: Ponta da Ferraria natural swimming pool, at the South end of the lava delta (cf. Figs. 1-2). Thermal water spring location is indicated by "S".

At the site there is a well located and excellent viewpoint all over the entire area, and a secondary road allowing good (and possibly controlled in the future) access to the area. Furthermore, major investments on infrastructures (e.g. visitor's reception center and a new thermal building, with SPA, restaurant and logging) and recovery/improvement of the environmental and safe conditions in the area are on-going, that for sure will enhance the geotourism in the area.

Those improvements (cf. ~4 M€ investment) include new sanitary and dressing facilities close to the natural swimming pool, building of a Wastewater Treatment Plant (e.g. "ETAR") and, most important, the definition of the land use of the all area, with better defined parking and meals areas, walking trails and protection of the natural values such as the littoral cone, araucaria trees and the littoral vegetation and other geological features (including the cumulates).

Nevertheless, the scientific, educational, environmental, historical and economic value of Ponta da Ferraria/Pico das Camarinhas area surely justifies the investments of the public authorities as long as they promote the (geo)conservation of the geosite and contribute to its valorization.

Acknowledgements

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GEOPARK IDRIJA – »THE TRAIL OF NATURAL SCIENTIST OF IDRIJA«

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Until the middle of 18th century Idrija and its mercury mine was the centre of natural science development in Slovenia. Natural scientists were coming to Idrija because of the mine and they worked as doctors, pharmacists, botanists or in mine administration. Here they wrote numerous works from the area of geology, metallurgy, chemistry and botanic, which represent the basis of modern research and are still used today. Many botanic and animal species as well as cultural and natural attractions in Idrija were named after the beginners of Slovene and European natural science development.

The development of natural science in Idrija started already in 16th century, when a famous doctor and botanist **Pier Andrea Mattioli** worked in Idrija, who along with many others studied vegetation in Slovenia. The first doctor in Idrija and a well known naturalistic polymath in Europe **Joannes Antonius Scopoli** worked in Idrija between 1754 in 1769. This was a very successful period for his scientific and publicity work. He was doing research in the area of botanic, zoology, chemistry, mineralogy, geology and set the basis of European occupational medicine. During his stay in Idrija he corresponded with the famous Swedish naturalist Carl Linné and wrote some of his most important works. In 1766 a naturalist **Balthasar Hacquet** came to Idrija and worked as a surgeon and doctor until 1773, when he continued his work as a professor at the Ljubljana lyceum.

In 1774 **Johann Jacob Ferber** contributed the first coherent geological description of the Idrija region. His study surpasses the local Idrija borders, since he also studied the geological composition of broader Slovene territory. However, the author of the main work on Idrian geology is **Marko Vincenc Lipold**, the manager of Idrija mine. With his thorough field work he already determined the basic characteristics of Idrija ore deposit and made the first detailed geological map of Idrija region, which obtained a special award at the Work exhibition in Vienna in 1873. The Idrija region was studied throughout the history by numerous Austrian geologists, although its final composition was analysed by Slovene geologists in the seventies. In this period the "Geologic school of Idrija" was founded in Idrija, well known in Slovenia as well as in other parts of the world.

Today, the town of Idrija and its habitants keep memory of the researchers of Idrija in the collections of Idrija Municipal Museum and Mercury Mine of Idrija. Six memorial plates with dedications were raised in the centre of the town in front of the warehouse in honour of the researchers in Idrija and a square in the neighbourhood is named after Scopoli.

Near the water channel »Rake«, which pumped water for 350 years with large wheels or »kamšt« a school trail named **»the trail of natural scientists of Idrija«** was arranged, going from the town Idrija to the Wild Lake. **Scopoli memorial garden** is situated at the beginning of Rake and at the same time represents the entrance to the **Zgornja Idrijca Landscape Park.** The trail reveals colourful mineral structure, vegetation and botanic particularities as well as the history of the town related to mining. One especially interesting topic for school groups is the relation between minerals and vegetation, in other words between living and non-living nature. After two and a half kilometres the trail passes a Wild Lake, the biggest karst source in Slovenia. The water springs at the bottom of the lake from a steep cave passage. In spring time the area is covered with flowers, which were analysed already by the first naturalists and were named after them, such as "tevje" (*Hacquetia epipactis*) and "kranjska bunika or volčič" (*Scopolia carniolica*). However, the most important flower is autochthonic "kranjski jeglič« (*Primula carniolica*), analysed by Hacquet.

These trails have been preserved for centuries. In the past naturalists of Idrija have been walking along them and today they invite us to stop and discover the things that amazed them and encouraged their research already centuries ago.

THE BRAZILIAN ARARIPE GEOPARK: THE MATERIALIZATION OF A DREAM FOR CEARÁ PALEONTOLOGISTS

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1. Introduction

The Araripe Geopark has as major natural attraction the abundant and well-preserved Cretaceous fossil assemblages of fishes, pterosaurs, insects, plants among others, that occur in the Araripe sedimentary basin. This Geopark is located in the south of the Ceará State, Brazil, and has geotopes with carbonate concretions and limestone lamina containing the splendid paleobiodiversity of the region around 110 million years ago. Harder than the marls and shales in which they occur, the carbonate concretions tend to detach by erosion and accumulate along roads, margins of rivulets and ravines. Traditionally these concretions are locally called 'pedras-de-peixe' (fish-stones) while the laminated limestones are called as 'lajes' (flagstones), and 'pedra cariri' as a natural stone. The fossilized minute fishes that occur in them are popularly called 'piabinhas'. Everybody from the region, children or adults, illiterates or scientists, rich or poor. know these fossils, but few know its cultural and natural value or how these fishes fossilized into these rocks.

Brazil was still a Portuguese colony, when the carioca naturalist João da Sylva Feijó published, at the Royal Press of Rio de Janeiro, his "*Preâmbulo para um ensaio filosófico e político sobre a capitania do Ceará para ser usado em sua história geral*" (Preamble for a philosophical and politician assay on the captainship of the Ceará to be used in its general history). In this assay from 1810, Feijó, a member of the Royal Sciences Academy of Lisbon, described his expedition to the south of the Ceará between 1799 and 1800, during which he collected petrified fishes in the Gameleira mill, between the Missão Velha and Milagres villages. Records show Feijó sent a copy of his work to the Ceará governor, annexing a collection of 'pedras-de-peixe' (Antunes *et al*., 2005).

During Brazil Empire, many Ceará entities tried to call the attention of the scientific community to the fossiliferous wealth of the Cariri subsoil. Prestiged politicians and academics, as Senator Thomaz Pompeu de Souza Brazil (1863), Deputy Marco Antônio de Macêdo (1878), Senator Francisco de Paula Pessôa (1905) and Professor Thomaz Pompêo de Sousa Brasil (1909), published documents stressing the value of these rare fossil occurrences. The Historical Institute of the Ceará continued this task, publishing in its quarterly magazine, the letters of João da Sylva Feijó on geologic aspects of the Araripe (1912).

2. The people from Ceará and the Araripe paleontology

Although natural and abundant, the occurrence of the fossils in the region of the Araripe was never seen by Ceará populations as a natural heritage resource to be valued and protected.

Only during the 1960's, the priest Neri Feitosa, a Ceará vicar from Jamacaru, an almost forgotten village in the Brazilian northeast hinterland, near to the place where Feijó collected fossil fishes, initiated another collection of Cariri fossils, with the laborious contribution of his parishioner. Thus, the village of Jamacaru, in the Missão Velha District, hosted the first paleontological collection of Ceará, in a building close to the local church. After collecting more than 6 000 specimens and without resources to expand its installations and welcome more visitors priest Neri Feitosa claimed, already in 1971, the development of an outdoor park in his District, where people could observe the fossilized fishes, the pterosaur bones,

and the petrified trunks in the geological formations in which they occur. This became the visionary seed for the creation of a Geopark in the Araripe region aiming the preservation and popularization of its important fossil assemblages. Priest Neri Feitosa tried to get aid next to the governmental authorities to materialize this idea, but his initiative did not prosper. Later, in 1978, the Ceará professor and historian Geraldo da Silva Nobre, member of the Historical Institute of the Ceará, published the book *"João da Silva Feijó: A naturalist in the Ceará"*, in which he rescued for the current generations the important contribution of this naturalist for the Araripe Paleontology.

In 1985, the 9th Brazilian Congress of Paleontology took place at the Federal University of the Ceará in Fortaleza, congregating a lot of national scientists to discuss the results of their research on Brazilian fossils, including the south of the Ceará. In the same year and with intention to value and to divulge the fossils among his fellow citizens, the mayor of Santana do Cariri, the sociologist Plácido Cidade Nuvens created a paleontological museum in this city, during the centenarian commemorations of the District. With the support of diverse segments of the local society and national paleontologists, this museum prospered slowly and continuously, becoming a reference point for visitation, not only for scientists and students, but also for the general public, curious about the mysteries of the Ceará subsoil. Later, with a collection of almost 7 000 specimens, this museum was donated to the Regional University of Cariri (URCA). As part of the National Department of the Mineral Production, a geologist from Ceará, José Ferreira de Souza created at the Crato city the 'Centro de Pesquisas Paleontológicas da Chapada do Araripe' (Center of Paleontological Research of the Araripe Plateau), inaugurated one year later. Slowly and discreetly, with a small exhibition of fossils from the Araripe Basin, this center became another point of obligator visitation for students and researchers interested in local paleontology. In 1988, the geologist Maria Somália Sales Viana publishes her initial contribution on the fossilization processes of the Araripe fossil fishes. Subsequent research gave her the title of Doctor in Sciences in 1999, being the first person from Ceará to have a PhD on the study of the Cariri fossils.

In the decade of 90, through the initiative of the Regional University of the Cariri, three important paleontological events mobilized Crato population: at 1990 and 1997, the 'Simpósios sobre a Bacia do Araripe e Bacias Interiores do Nordeste' (Symposiums on the Araripe Basin and Interior Northeast Basins) and, at 1999, the 16th Brazilian Congress of Paleontology. With the affluence of famous national and foreign scientists to the region where still occurs wonderful fossils of unknown fauna and flora, the Araripe was never the same in geo-paleontological terms. Many paleontologists started to dispute the fossils of the Araripe Basin to study them and the local academic community started involving with the geoconservation and protection of the fossils that had always been part of their lives.

Together with the scientific presentations from several Ceará geologists, as Eva Batista Caldas and Maria Somália Sales Viana, Ceará José Arthur Ferreira Gomes de Andrade, Alexandre Magno Feitosa Sales and Antonio Álamo Feitosa Saraiva, popularizing publications were also produced. These include *'Pedras de peixes de Santana'* (Stony fishes from Santana) of Plácido Cidade Nuvens (1994), for an adult public, and *'Viagem ao Cretáceo'* (Journay to the Cretaceous) of Francisco Assis Bezerra da Cunha and Francisco Willian Brito Bezerra (1997), for children.

With the arrival of the new millennium, Ceará researchers and other authors, during previous decades committed to the preservation of the Araripe paleontological heritage, continued to participate on scientific conferences, producing new documents on these fossiliferous occurrences, stressing the importance of the Cariri museums and thematic parks. The geologist Alexandre Magno Feitosa Sales (Sales, 2005) and the biologist Antonio Álamo Feitosa Saraiva (Saraiva, 2008) obtained their PhDs with dissertations based on taphonomic aspects of the fossils from the Santana Formation, the most fossiliferous unit of the Araripe Basin. In this same year the Ceará geologist Francisco Idalécio de Freitas produced a Master

on the silicified trees from the Jurassic forest of the Araripe Basin, (Freitas, 2008).
It become also important to recover the history of the study and research of the fossils of this region before these discoveries and the naturalists that made them became forever forgotten. Francisco Idalécio de Freitas, together with the Portuguese paleontologists Miguel Telles Antunes and Ausenda Balbino, contributed to this task (Antunes et al., 2005).

3. Materializing a dream: The Araripe Geopark

The creation of Araripe Geopark meets a long waited desire of the community of politicians and academics from Ceará, and more specifically of the Cariri community. The creation of an in situ park to show to the world the beauty and rareness of the Araripe Basin fossils was already been announced half century ago, by the voice of the priest Neri Feitosa. However, the interest of a recognized international institution, the UNESCO, was fundamental to make it an effective movement to make this dream come true.
The Araripe Geopark integrates three highly fossiliferous geotopes, site locations of the stratigraphic units that contributed the most to the local museums paleontological collections. The Missão Velha Geotope contains large petrified trunks of conifers of a Jurassic forest that once covered the Araripe hills. The Nova Olinda Geotope registers the existence of the numerous shoals of minute fossil fishes that dwelled on a shallow and calm lagoon, bordered by swamps and marshes with pioneering vegetation. Frogs, geckos, insects and other small animals were the possible base of the food web for a varied fauna of large and strange pterosaurs, the lords of the Cariri Cretaceous skies (Kellner, 2006). And the Santana Geotope with its paleobiota of a coastal lagoonal system in contact with the Cretaceous warm seas, populated by several species of fishes, crocodiles and turtles, warming along its shores, full of ferns and other lower plants, and overflied by amazing pterosaurs.
Associated to the Santana Geotope, the Museum of Paleontology of the URCA in Santana do Cariri, displays fossils of organisms that after millions of years can be appreciated by the human eye. One of its goals is to show the importance of the paleontological natural heritage of the Ceará region, and implement into the children and young students the interest to learn about the fossils of the Araripe Basin. One of the Araripe Geopark initiatives was to train young guides among the students of Santana do Cariri and Jardim, to present the museum specimens to visitors, and provide detailed scientific information about the fossils, a task they have been carrying out with much joy and a legitimate pride of the natural richness of their land.
Human resources on Paleontology are still scarce in this region and further scientific research must continue. However, there are several students from local universities who have shown interest in becoming paleontologists and in dedicating themselves to the research of Cariri paleobiota. In this aspect, the Araripe Geopark has been an important agent in promoting and motivating the creation of new human resources. These resources are critical to accompany all exhibitions related to scientific events and lectures held at colleges and institutions, on all districts around the geotopes., The Araripe Geopark team provides to all Crato visiting students a series of initiatives to show the importance, the variety and the rarity of the fossils of the region, motivating new vocations.
The dream to see the Araripe fossils recognized as a major value of the Brazil is close to be accomplished. and the Araripe Geopark young team is working hard to materialize it. The small team of professionals and the reduced available financial resources have not been an obstacle to promote and to value what it is the uniqueness of the Araripe Geopark, the exceptional and abundant Cretaceous fossils of the Ceará!

4. Conclusion

Brazil is a rich country on natural resources, despite not always being recognized as such by its inhabitants. A group of Ceará born men of vision, despite their diverse professions, became worried on the fate of the natural heritage known since the time of the Cariri indigenous populations, alerting their communities about the fossilized animals and plants that were found in limestones and other rocks around the Araripe plateau,.

These fossils disclose unknown stories from a time that precedes man. Books and articles have been published, museums, collections, expositions, scientific gatherings were organized, masters and PhDs have been made based on them. Thus, slowly the Paleontology of the Cariri is being developed at Ceará.

With the creation of Araripe Geopark, the dream becomes true: to train and constitute a specialized staff, to be able to study its natural paleontological heritage with modern research methods and to present to the world all the splendid paleobiodiversity of the Araripe Basin.

Located in one of the richest and most interesting Cretaceous areas of the world, the Araripe Geopark allows all visitors to see and touch fossils that registered the life that inhabited the quite distinct ancient environments that once existed in the region. These fossil are witnesses of climatic dynamics helping us better understand the planet we live on. And reflect on how ephemeral life is, while invites us all to live harmoniously with nature, as in the old days…

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SCIENCE IN THE SUBBÉTICA GEOPARK

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The Subbetic Mountain Ranges (Fig.1) offer wide rocky outcrops, mainly Jurassic and Cretaceous, where an important part of the History of the Betic Mountain Range and the Tethys Sea can be read.

Figure 1: Subbetic Mountain Ranges at Subbética Geopark.

The Subbética Geopark supposes the most representative stretch of the External Subbetic Domain.
Since the end of the XIX century, the Córdoba Subbetic has attracted the attention of numerous researchers interested in different fields of Geology (Regional Geology, Karstic Geomorphology, Stratigraphy and Sedimentology, Paleontology and Biostratigraphy).

Among these fields of research, Palaeontology has had, and still has a special importance. The continuity of the stratigraphical record (Fig.2) and the abundance of a special fossil group, the ammonites, that suffered a very rapid evolution, offer the possibility of making high resolution biostratigraphy and paleoenvironmental studies.

Figure 2: Jurassic beds, in Cabra.

A great number of PhD thesis on ammonites include many outcrops of the Geopark. Many new taxa have been defined, using local names of the Subbetica.
Ammonites represent the symbol of the Subbética Geopark. Their wide occurrence and abundance supposes an additional attraction for the territory.
Their attractive shapes (Fig. 3) can be used for the design of original merchandising products.

Figure 3: Jurassic Subbetic ammonite

As geological techniques progress, studies in new fields have arisen in recent decades in the territory (hydrogeological and hydrochemical, mineralogical, palaomagnetic, radiometric measurement, etc).
Additionally, important advances in other fields related to Geology stand out in the Subbética Geopark:
The numerous cavities in the Geopark (more than 850 inventoried) offer a very complete record of the human history. The Neolithic has special relevance in the Bat's Cave (Fig.4). This Natural Monument offers the oldest record of this period in Andalusia.
Still many caves and galleries are being discovered, and a great quantity of raw material is available for future archaeological investigations.

Figure 4: The Bat's Cave.

During the last two decades, important discoveries on Mycology have permitted the definition of numerous new fungi taxa, especially truffles. Likewise, the development of new techniques for mycological cultivation is permitting new possibilities of agriculture and use of land, as a way to enhance local sustainable development.

As a Geopark, the Subbética commits itself to exploit the deep scientific knowledge of the territory and transform it in an available language for the general public, it's to say, to put Science at the disposal of the local people, enterprises and visitors, for use and enjoyment of society.
In this sense, new fields of investigation arise:

- Transformation of scientific knowledge into an understandable, but precise language;
- Development of didactic tools based on the Geology and Nature of the Subbética Geopark;
- Study of the estate and the potential of uses of geological sites as geo-resources (touristic, scientific, didactic, etc);
- Development of new tools for conservation;
- Development of marketing strategies.

TRESNJEVICA GEOSITES – VOLCANO TRACES FROM THE PAST

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Papuk Mountain is made mostly of metamorphic and igneous pre-Alpine rocks. One of three igneous – metamorphic complexes which can be found on Papuk Mt. is "Papuk complex" composed of migmatites, paragneisses and granitoids where Tresnjevica geosites are situated.

At the Tresnjevica geosites the volcanic rock dike swarms cut the older igneous complex and geological peculiarity of these geosites can be found in the surprisingly numerous varieties of rocks – Rhyolite, Andesite, Basalt, Tuff, Granite, Pegmatite, Gneiss and Migmatites.

Tresnjevica geosites, which occurred in a disused quarry, represent outstanding geological site very suitable for education purposes considering igneous and metamorphic rocks. Geological exposure is well visible and site provides useful information about different types of rocks, their mineralogical contents, textures, forms of occurrence as well as geological settings between them. Due to all that Tresnjevica geosites are a valuable resource for introducing geology to the general public which illustrate a varied and interesting Papuk geology.

THE AZORES ARCHIPELAGO IN THE AMERICA-EURASIA-AFRICA TRIPLE JUNCTION: A GEOLOGICAL FRAMEWORK AS THE SCIENTIFIC BACKGROUND FOR THE CREATION OF THE AZORES GEOPARK

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The Azores Archipelago (a Portuguese Autonomous Region) is located on the triple junction between the North American, Eurasian and African (or Nubian) plates (Laughton & Whitmarsh, 1974; Searle, 1980; Vogt & Jung, 2004). In general terms, the intervening plate boundaries are the Mid-Atlantic Rift (MAR), separating the American plate from the Eurasian and African plates, and the Azores-Gibraltar Fault Zone (AGFZ), bounding the latter two plates (Fig. 1).

In the Azores area, the MAR trends N-S to N20E and is divided by transform faults into seven short segments (Luis et al., 1994). The western AGFZ segment, in the Azores region, with a WNW-ESE general trend, is oblique to the spreading direction allowing magmatic intrusion along faults, feeding the volcanism that built the islands (Lourenço et al., 1998). Volcanic and tectonic activities are well displayed in the geomorphology of the islands, the former includes 26 eruptions since the settlement of the islands in the early 15th century (Zbyszewski, 1963; Weston, 1963/64; Queiroz et al., 1995; Madeira & Brum da Silveira, 2003). Earthquakes reaching magnitude 7 that caused about 6,350 deaths, and successive pre-historic surface fault ruptures, that produced well-developed fault scarps, represent seismotectonic and neotectonic activity (Madeira & Ribeiro, 1990; Nunes *et al*., 2001; Madeira & Brum da Silveira, 2003; Nunes, 2008).

Figure 1: Azores Plateau bathymetry, after Miranda et al. (1998), left and location of the Azores Islands in the Atlantic Ocean and its general tectonic setting, modified from Madeira & Brum da Silveira (2003), right. MAR- Mid Atlantic Ridge; EAFZ- East Azores Fracture Zone; GF- GLORIA Fault. Shaded area is the shear zone that constitutes the Azorean segment of the Eurasia - Africa plate boundary.

The Azores Islands are formed by 16 major polygenetic volcanoes, most of them silicic and with summit subsidence calderas. Nine of these polygenetic volcanoes are active and are located on the islands of S. Miguel, Terceira, Graciosa, Pico, Faial and D. João de Castro Bank. Moreover, there are about 1750 monogenetic volcanoes in the archipelago, either dispersed along the flanks and inside the summit depression of the polygenetic volcanoes, either belonging to the 11 basaltic fissural volcanic systems located in different islands (Nunes & Lima, 2008). These monogenetic eruptive centres include domes and *coulées*, tuff rings and tuff cones, *maars*, scoria and spatter cones, and eruptive fissures.

Many of those features may be considered as geosites, together with other volcanic structures (such as historical eruptive centres and products, hydrothermal fields, pillow lava and prismatic jointing outcrops, volcanic caves and primary pyroclastic deposit exposures),

tectonic structures (fault scarps, sag ponds), sedimentary deposits (fossiliferous marine deposits of Miocene to Quaternary age, flood deposits, secondary *lahars*), and littoral features (e.g. littoral platforms of volcanic or landslide origin – locally called "fajãs"). Additionally, some offshore sites are also worth mentioning, such as the Lucky Strike and Menez Gwen submarine hydrothermal fields and the D. João de Castro Bank submarine volcano that erupted in 1720 A.D., whose summit, at a depth of 12 m, presents an impressive fumaroles field (Nunes *et al*. 2003).
Thus, the Azores may be considered a natural laboratory of international relevance with regard to active volcanism, volcanic and tectonic landforms, global plate tectonics, and neotectonics (Figs 2-3). The archipelago displays varied and abundant geological features of scientific, educational, scenic, socio-cultural and economic (touristic) interest, both on the islands and at sea, whose intrinsic value is under evaluation.

Figure 2: Examples of volcanic features and landforms from the Azores Islands: **a-** Lava delta and tuff cone (Velas, S. Jorge Island); **b-** Prismatic jointining (Ribeira do Maloás, S. Maria Island); **c-** *Maar* (Caldeira Negra, Flores Island); **d-** Subsidence caldera (Caldeirão, Corvo Island); **e-** Stratovolcano (Pico Mountain, Pico Island); **f-** Boiling water-type fumarole (Furnas, S. Miguel Island); **g-** Silica stalactites (Algar do Carvão volcanic pit, Terceira Island); **h-** Slumping marks (Monte da Guia, Faial Island); **i-** Volcanic neck (Ilhéu da Baleia, Graciosa Island). Photos by J.C. Nunes, except (a), by J. Madeira and (g), by "Os Montanheiros" SEE.

The international relevance of the Azorean geodiversity, the high number and quality of its geosites and the undoubted importance of its geological heritage (Brilha et al., 2005; Lima, 2007), together with the rich biological and cultural heritage, all supported on a major effort of the Azores Government to implement Geoconservation and Environmental Education policies, strongly justifies the creation of the Azores Geopark and its application to the UNESCO's Global Geopark Network. The future Azores Geopark will also be supported on the strategic decision of the regional and local authorities to develop Nature Tourism policies based on the most effective touristic icon of Azores: its volcanic landscape.

Figure 3: Examples of tectonic features of the Azores Islands. **a-** Oblique slip (dextral/normal) faulting in a scoria cone (Cabeço Vermelho, Pico Island); **b-** Fault scarps of Pedro Miguel *graben* – north sector (Faial Island); **c-** Lagoa do Capitão fault scarp and sag pond (Pico Island). Photos by J. Madeira (a, b) and J.C. Nunes (c).

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GEOPARK IDRIJA – GEOLOGICAL HERITAGE OF OUTSTANDING VALUE

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The Idrija region is situated at the crossing of the Alpine and the Dinaric world and this to a great extent affects its basic natural properties. The area with its typical gorges, steep slopes and tablelands surrounded by mountain tops with magnificent views is extremely dynamic and picturesque.

The morphology of the region is a consequence of geo-morphological processes and diverse lithological composition. The process of superficial washing and river erosion affected the impermeable rocks; meanwhile the dissolution and denudation processes influenced karstified limestone and dolomites.

The most important geological phenomenon of the presented region is the mercury ore deposit, which is a consequence of turbulent geological past. The ore deposit in the Idrija region developed in the remote geological past, in the tectonically and volcanically active Ladinian stage, some 230 million years ago. A real rarity of the ore is its sin sedimentary origin and native mercury.

A very interesting tectonic composition of the region contains four thrusted units. These units are built of various beds, from the oldest Carboniferous to the youngest Eocene strata, which are part of today's Idrija region.

98 % of the rocks on the surface are composed by sediments, from clastic to carbonate rocks. The so called "Tratnik landslide" is among the most representative Carnian sediments in Slovenia, where clastic Julian layers are most visible.

In the last period of of the Alps build up, approximately 5 million years ago, the Idrija region was divided with numerous faults in the NW-SE direction. The most powerful among them was Idrija fault, which we can follow over complete Slovenian territory.

And the right combination of the position of permeable and impermeable sediments together with tectonics is the main cause for a heterogeneous morphology of the region, the phenomenon of Wild Lake and its shape. The ground is composed by impermeable flysch sediments dating from Eocene with carbonate rocks from the Lower Cretaceous period thrusted on top of them. The hinterland of the Wild Lake is composed by strongly karstified carbonate sediments, where we can find various precipices, sinkholes, "škraplje" and other Karst phenomena.

All the described phenomena and the already initiated activities have encouraged us to start thinking about the foundation of Geopark Idrija, which would present this heritage in a popular way and encourage the visitors to think about nature and naturalistic science.

GEOMORPHOSITES: INVENTORY AND VALORISATION FOR GEOTOURIST PURPOSES. A CASE STUDY IN THE SERRA DE CANDEEIROS (ESTREMADURA LIMESTONE MASSIF, PORTUGAL)

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1. Structural framework of the area

The study is located in the Estremadura Limestone Massif (ELM), a small mountain system in the occidental border of the Portuguese Western Mesocenozoic Basin, which is a distinct geomorphological unit from its surrounding areas: the Cretaceous basins of Leiria and Ourém to the North and NW and the Cenozoic Basin of the Tagus River to the SE and the old Plio-Pleistocene coastal platform shore platform to the W. As we can see in Fig. 1, the study area is formed by materials of the Middle (*Dogger*) and Upper Jurassic.

Figure 1: Location sketch of the Estremadura Limestone Massif (ELM).

The ELM is probably the most important limestone unit within Portugal, not really in terms of area it occupies, but for the diverse range of structural forms, and erosive karstic forms that it displays (Rodrigues, 1998), sharing its paleogeographic evolution as Mesocenozoic Basin. Among a set of original geological, geomorphological and hydromorphological features, we highlight the absence or near absence of permanent surface subaerial drainage, as a result of the typical permeability of limestone rocks (Ferreira *et al.*, 1988) and the multitude of exsurgences in the periphery of the Massif, the most important located in the western border in the contact, by overthrust, with the Tagus Basin.

Differential erosion is due to different resistance to mechanical erosion of limestone. Compared with the surrounding material's altitude, it contributes to emphasize the Massif's altitude (Fig. 2), which explains the almost precise coincidence between hypsometry and the spots of Jurassic limestones. In terms of tectonics, the faults seem to command the relief, structurally conditioning the Massif's volumetry (Ferreira *et al.*, 1988), which thus represents, in general, a raised block between two major peripheral accidents with Betic orientation: the accident of Nazaré (Lousã-Pombal-Nazaré) and the alignment of Serra de Montejunto-Serra de Aire, which is the overthrust (reverse fault) of the Jurassic compartment over the detrital Tagus terrains. Rodrigues (1998) also mentions other accidents with major morphological expression in the ELM: fault scarps, overthrust scarps, anticlinal structures, horsts and grabens, and so on which form the major sub-units within the ELM.

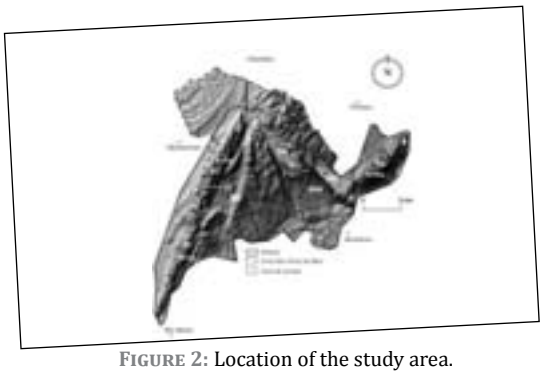

Figure 2: Location of the study area.

Most of our interest, because the studied area is inserted therein, is the complex tectonic accident of the Serra de Candeeiros, sometimes referred to in the literature as an anticlinal NNE-SSW oriented, but "appears rather to be a semifold consisting mainly of Dogger limestone, with faults, especially the eastern side, limited by the Fonte da Bica-Porto de Mós diapiric valley" (Ferreira *et al.*, 1988).

The materials have been deposited in subsiding ditches during the Mesozoic, and the compartments correspond to more recent movements along late-Variscan strike-slips that divided the craton at the end of the Paleozoic (Ribeiro *et al.*, 1979), twisting the material in folds, faults and mixed accidents, but with strong influences of diapirism due to the existence of an Hetangian clay evaporitic complex (see Figure 3), lying under the hard sedimentation of Jurassic limestones, contributing to understand that the material is Oxfordian in the tectonically depressed areas in comparison to the Dogger limestones (Ferreira *et al.*, 1988; Rodrigues, 1998).

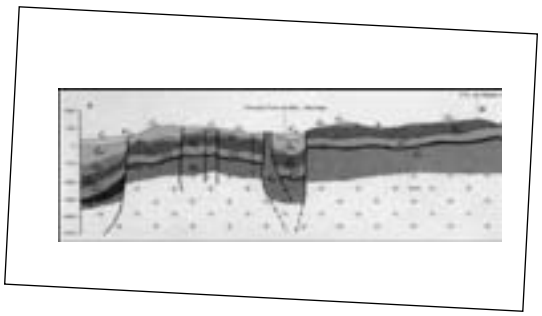

Figure 3: Geological profile of the ELM western sector, after the Carta Geológica de Portugal, sheet 27-A.

2. Aims

Identification of geomorphosites, its inventory and quality evaluation, aiming:

I) to build an integrated database of sites with geomorphological interest within Serras de Aire and Candeeiros Natural Park, enhancing the recovery of natural abiotic heritage and contributing to the development of a strategy for integrated management of the natural heritage of the park;

II) to create a flexible geotourist route, integrated in the tourism promotion strategies of the park;

III) to better understand the evolution of Quaternary geomorphology of that sector, which is rich in morphological and sedimentological indicators, the morphodynamic proxies and the local and regional morphotectonics;

IV) to create a solid knowledge on the actual value of geomorphosites that allow a sustainable management of geoheritage;

V) to carry out a detailed field survey (at 1:5000 scale), to map and identify the geomorphological assets.

3. Methodology

We used large scale mapping and detailed field survey to carry out the geomorphological map. In recent years, several contributions to methodologies for assessing the geoheritage were made. The common denominator to these proposals is series of four steps: identify, assess, classify and promote the geoheritage.

So we picked medium scale mapping (Geological Chart at 1:50 000 scale), large scale (1:10 000 from Military Charter at 1:25 000) and detailed (orthophotomaps with contours at an interval of 10 m), and built partial applied maps, based on field surveys. In the field we worked on a scale of *ca.* 1:2000 not to miss potential geoheritage (e.g. small scale Karren). Back in the office we turned the collected information back into 1:10 000 scale, with everything already spotted. The scale that we believe good enough to mark geosites and geomorphosites was *ca.* 1:10 000. But we chose a larger scale for to map the Vale Maior valley due to its importance to understand the Quaternary geomorphological evolution of the Serra de Candeeiros.

4. Results

The survey resulted in the identification of 17 geosites. The characterization of the identified features led to the selection of a set of 15 geomorphosites, which by its educational, scientific, cultural and scenic value (Gray, 2004; Rodrigues and Fonseca, 2008), are to be considered geoheritage.

The inventory contains: a valley, a coal mine, a quarry and an interfluve, two dolines, two ponds unique in the Massif context, a strongly consolidated crioclastic deposit, a sandy deposit, four *Karren* fields consisting of *Grubchenkarren*, *Deckenkarren*, *kamenitzas*, *Karrentisch* or *Flachkarren*, *Spitzkarren* and *Rinnenkarren*, a fault with morphological expression, and a series of cornices.

The potential for geotourism is high, and so is the risk of obliteration by limestone quarries prospecting and exploitation, so we urge local officials to develop a geotourist route concerning a sustained development policy and avoiding the depletion of such valuable non-renewable resources, unique in the country.

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SCIENCE AS A TOOL FOR GEOSITES ATTRACTIVITY INCREASE: VOLCANOLOGY IN THE BOHEMIAN PARADISE GEOPARK (CZECH REPUBLIC)

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Bohemian Paradise and tourism evolved over time, beginning in the late nineteenth century. Region is widely popular and offers to tourists exciting visual attractions and activities such as hiking, trekking or climbing.

The Bohemian Paradise Geopark is fortunate to have a spectacular landscape built on a foundation of diverse rock types. Historically, a few iconic "Rock Cities" were the main attractions for the many thousands of tourists that visited each year. The igneous rock and lava flows are also highly sought after attractions. This region has a large variety of volcanic landscapes including cinder cones and columnar jointed lavas.

The following list presents a number of volcanic features as example for volcanic environments in Bohemian Paradise Geopark, which are actively promoted for tourism:

- Lava-filled volcanic crater (Kumburk Hill);
- Columnar jointing or basalt columns (e.g. Smrčí, Trosky);
- Scoria cones, Spatter cones, Tuff cones;
- Root-less cones;
- Pillow lavas;
- Mantle xenoliths and gems;
- Volcanic veins.

Systematic volcanological research in the Bohemian Paradise started in 2007 (Rapprich et al., 2007, Rapprich, 2008) and already the first results have shown that there is much more to be presented in popular form to common visitors.

The Permian volcanism displays variability in eruptive styles as well. Lavas were emplaced in both subaerial and subaquatic environments. Ropy structures on pahoe-hoe subaerial lava were documented on one site and pillow lavas associated with hyaloclastic breccias on two localities. The eruptions were of Hawaiian, Strombolian and phreato-magmatic styles (Rapprich, 2008, Stárková & Rapprich, 2009).

The scattered isolated Cenozoic volcanic bodies present in the Bohemian Paradise Geopark were traditionally interpreted as remnants of volcanic conduits exposed by selective erosion. The interest paid to Permian volcanism wasn't much higher, and the bodies were divided among two groups: lavas and intrusions giving no information on eruptive styles. Individual sites were presented to tourist on very simple panels. The information on these panels was usually focused on detailed petrography, which is in fact boring for common people. Many of the Cenozoic volcanic bodies have presented the superficial facies, hence the eruptive style can be reconstructed and compared with modern volcanoes. Volcanism here is characterized by the presence of small monogenetic volcanoes and three types of these monogenetic volcanoes were distinguished: cinder cone, tuff cone and lava-filled *maar*. The eruptive style was influenced by pre-volcanic hydrogeology and hydrology. The cinder cones have formed where Cretaceous sandstones formed table-rocks, the tuff cones where marches formed over the Cretaceous marlstones and maar eruptions took place where basaltic magma penetrated hydrogeologically distinct Upper-Paleozoic Formations.

Most of the visitors are also interested in the age of the volcanic activity. The ongoing research

continuously extends the number of volcanic bodies dated by the K-Ar method. Currently available data show, there were two main events of the Cenozoic volcanic activity. The first event took place ca 17 Ma and the second ca 4.5 Ma (Cajz et al., 2009). The older activity is characterized by the presence of scattered monogenetic volcanoes, whereas a single scoria cone resulted from the younger activity. The 4.5 Ma scoria cone (Prackov Volcano) produced several kilometres long lava flow which entered Paleo-Jizera valley. On contact with water saturated gravels, root-less cone has formed. Just this single volcano provides variety of volcanic features (changes in eruptive style, Earth-mantle xenoliths, and root-less eruption), those can be explained to visitors in attractive form.

The prerequisite for volcano tourism are features such as volcanic landforms, rock formations and other phenomena, preferably in area with easy road access and other necessary infrastructure. Czech geologists are engaged in the process of sustainable geotourism development. Geotourism is tourism related to geological sites and features, including geomorphological sites and landscapes. A remarkable part of geotourism addressees are non-professionals.

In 2008, a project managed by the Czech Geological Survey was started. The Czech Ministry of Environment decided to financially support Geological research in the Bohemian Paradise focused on creation of Geo-informative system presenting to visitors the interesting sites, their setting and origin. Scientific contribution within the geopark and protected areas is extremely important. The science is essential for gathering the information required to manage the park, understanding geological processes and its effects, and advance our understanding of geology and ecology. Science can help protected areas by analyzing and sharing information, and building credible constituencies. Geotourism is closely tied to education.

The research on volcanic activity in the Bohemian Paradise is supported by the project VaV SP/2e6/97/08 granted by the Czech Ministry of Environment, by the project AA300130612 granted by the Grant Agency of the Czech Academy of Sciences and by ROP NUTS II. CZ.1.13/3.2.00/02.00200.

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4. Geoconservation best pratices and wrong ways

GEOEDUCATION, GEOPARKS AND GEOCONSERVATION

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Geoconservation can be defined according to Sharples (2002) as the conservation of the diversity of geological, geomorphological and soil features, assemblages and systems. Geoconservation seeks to prevent or minimize degradation of geodiversity in order to protect the natural and intrinsic values of bedrock, landforms and soils, rather than only to maintain their usefulness to humans.

A broader view consider geoconservation being more than protection and conservation of the non–living entities for their intrinsic or aesthetic value which is rather a static or defensive position against economical use of natural resources or landscape degradation due to human activities. In this perspective geoconservation is considered a new and developing area of applied geology aiming to assure a holistic approach of nature conservation and to offer new tools in sustainable use of the natural resources for socio-economic development (Andrasanu, 2007). The author has identified the basic concepts, of which few of them were already known for a long time but now integrated into a logical and coherent framework. These concepts are: geodiversity evaluation, geotourism, geopark and geoeducation. In this sense geoconservation requires a new type of specialist: *geoconservationist*.

This paper presents geoeducation as part of the geoconservation activities, its structure, educational packages for secondary schools and university curricula (Andrasanu, 2005). The methodology used includes research studies of national curricula, student opinion analysis, case studies from Romania and other countries, development of new educational tools, and basic requirements for specialists in geoconservation.

Geoeducation has to be considered in a broader perspective as part of education for nature conservation and ultimately part of education for sustainable development. An educational strategy is required to be set-up in partnership with schools, universities, and local councils, in order to develop training packages and courses for local teaching staff and students, to organize events for public awareness for natural and cultural heritage.

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THREE CASES OF SUCCESSFUL GEOCONSERVATION IN THE NATURTEJO GEOPARK (PORTUGAL)

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1. Introduction

Geoparks are mainly social/political commitments and not strictly geologist projects. They must include local communities that everyday experience, but usually have only empiric inherited knowledge about their Geodiversity. The Geologist work is simply to learn from the Geopark' rocks and then place gently, but firmly and progressively, important issues of the geological landscape on people's culture, educating consciousness and opening new opportunities for local economy development. It is to follow local decision-makers and the needs of populations from direct contact, giving advice and guiding in decisions concerning the protection of Geological Heritage and the interpretation of Geodiversity. The Geoconservationist work is fundamental to find the equilibrium between population wishes and environmental wealth mostly appreciated by ecotourists that can be the last solution for deprived local economies. With the communication strategy being applied every day and invariant concerning the scale of action, from local to national, interest by Society is kept high, and visitors increasingly arrive, both national and international ones. But their interest on the Geopark must surpass during the visit by other means the idea they got from promotion. So, promotion must be followed with a good communication (signing) strategy that easily takes people to visit the best of the Geopark. Being here, visitors must find the best conservation efforts and facilities to understand easily and fully enjoy geological attractions and all heritages. This is the way to transform curious visitors in recurrent happy tourists. This is the way to foster local economy and proud among local communities. The protection and interpretation of ecosystems, including geodiversity that supports the biodiversity where Man is part of, is a fundamental part of the Geopark's daily life.

Geopark Naturtejo Meseta Meridional was integrated in the European and Global Geopark Networks in 2006 before the protection of geological heritage was defined in the National Law. The pioneering work of geologists and geoconservationists starting from the seventies and mostly during the nineties led to protection of geosites with the support of society and created the basic conditions to develop such kind of Geopark project for the first time in Portugal. Naturtejo Geopark born from the social/political need to protect the important trilobite trace fossils from Penha Garcia. In those times (after 2000) the national Cultural Law was preferably used, by its speedy wide range application, to protect geosites and to manage them from municipalities. The work the Portuguese geoconservationists and ProGEO-Portugal, the existence of Naturtejo Geopark as part of European Geoparks Network which is closely cooperating with the Institute for Nature Conservation and the Environment Ministry since almost its early beginning and the huge success of the celebrations of the International Year of Planet Earth changed the national Nature Conservation Law. The newly published Decree-Law 142 of 24th July that defines the political standards for environment establishes the new juridical regime of Nature Conservation in Portugal. Geosites, Geological Heritage and Natural Values (including geosites) are herein defined. The Law also creates the Fundamental Network for Nature Conservation including the National Network of

Protected Areas and areas protected under international agreements with Portugal. Geoparks are also included in this Law and have now proper integration and rules under the status of Areas with Conservation Designations of Supranational Importance, i.e., the Decision of the Executive Council of UNESCO (161 Ex/Decisions, 3.3.1), adopted in Paris in 2001, related with Geosites and Geoparks.
At the information organizational level, this Law creates the Natural Heritage Information System that fosters the inventory of geosites in the country and in waters under Portuguese jurisdiction. Also, the development of a National Inventory of Protected Natural Values archives all the information about geosites. Both operational instruments promote scientific research and knowledge about natural heritage, as well as monitoring of geosites as far as the recognition by Society of the intergenerational, economic and social heritage value of biodiversity and geological heritage.
But Nature Conservation goes beyond laws. It is the vision of some for the long-term benefit of many. But there are cases where short-term big investments, neglect or just lack of vision are constantly threaten special areas for Nature such as Geoparks. Here we present a resume of the work done (and the main responsible) for the successful protection of three geomonuments in the Naturtejo Geopark. Resulting from this work was the two Geoconservation Prizes attributed to the territory by ProGEO-Portugal and National Geographic-Portugal in 2004 and 2007.

2. Portas de Ródão Natural Monument

Portas de Ródão is a Natural Monument extending for 965 ha. Portas de Ródão was considered the most important Portuguese geomonument, at the landscape level, by the pioneer geoconservationist Prof. Galopim de Carvalho. "And the river (Tagus), at that point, forcing its narrow, deep, and angry course between lofty and precipitous banks, which rise into Brown and barren mountains, forms a grand imposing picture…" writes Moyle Sherer, at the end of the 18th century, about Portas de Ródão.
The request for protection of Portas de Ródão started many years ago but only after the development of Naturtejo Geopark municipalities reunited to work together for the cause of Portas de Ródão, since ancient times an *axis mundi* for these people. During the UNESCO Geoparks Conference in Belfast (2006), and following the integration of Naturtejo in the European Geoparks Network, the State Secretary of Environment approved the protection of Portas de Ródão. The application was coordinated successfully by Dr. Jorge Gouveia from the local Association for Studies of High Tejo NGO on behalf of the municipalities of Vila Velha de Ródão and Nisa, with the multidisciplinary scientific cooperation of the Naturtejo Geopark and several other regional and national institutions (natural parks, universities) and was finished in 2005.
In these studies and besides Portas de Ródão geomorphosite itself, the inventory includes: 32 geosites of geological, geomorphological, palaeontological and geomining interest; 10 EU Habitats with 2 Priority Habitats (temporary Mediterranean ponds and fluvial forests of *Alnus glutinosa*), 119 species of birds (15 endangered), 20 of mammals (1 endangered), 10 of river fish (3 endangered), 10 of amphibians (1 endangered) and 12 of reptiles (1 endangered); 26 archeological to historical sites from Lower Paleolithic to modern times; and, 13 legends. After a meeting between the Geopark's managers and the State Secretary of Environment, Dr. Humberto Rosa, and the successful integration of the Geopark Naturtejo in the EGN finally the first Portuguese geomorphosite was declared protected under the Law for Nature Conservation in 2009 and a management plan will be prepared. With the Institute for Nature Conservation, Vila Velha de Ródâo and Nisa municipalities will manage the Natural Monument with the commitment of Naturtejo. This the 7th national Natural Monument in Portugal and the first not mainly related with paleontological findings.

Figure 1: "Rock Detectives" visiting the newly declared Portas de Ródão Natural Monument (left). Black stork (*Ciconia nigra)* is increasing its number in Portas de Ródão, an Important Bird Area.

3. The flooding of Portas de Almourão geomonument by the building of Alvito Dam: an old quest won

In September 2007 the Government presented the new Dam National Plan. This presents the project to build 10 new big dams until 2020 in order to face the high energetic dependency on fossil fuels, whose prices increase every day, substituting by renewable sources of energy. One of these dams will be the long expected Alvito Reservoir, at the Naturtejo Geopark. This dam was to be built in the Ocreza river right in the Portas do Almourão geomonument! The project to build it started during the forties with the idea of creating a concrete monster 140 m high. The new project intended to create a dam wall right before or after the geomonument changing forever and for sure one of the finest cultural landscapes of the Geopark. It is an investment of 67 million Euros and this reservoir will produce 48 MW of installed energy and 62 Gigawatt/year, which means 5 million Euros per year of energy. The reservoir would have 209 million cubic liters implying submersion of the valley along several dozens of kilometers.

The dam is considered a strategic investment for the region for the next ten years. The mayors from the affected municipalities were very glad because they were promised environmental, tourist, water for agriculture and human consumption opportunities. However, there's still missing the studies of environmental impact. According to the study about the viability of the project, natural values in the building area are unimportant (flora, fauna among others). Among others are the outstanding geological heritage of Portas de Almourão (Fig. 2), one of the most important geomonuments of the Naturtejo Geopark and responsible for the integration of the territory in the European Geoparks Network under the auspices of UNESCO, which would be drilled and "concreted" forever. Concerning biodiversity, the area is part of an internationally recognized Important Bird Area (PT037), where several endangered bird species are nesting in the area, like the Bonelli-Eagle or the Black Stork and the Griffon Vulture, which will be disturbed and probably gone during 4-5 years of work for building the dam. Some of their habitats are Priority for EU concerning protection. In cause is the total eradication of one of the last natural corners of Naturtejo Geopark but all the politics and people agreed in favor of the dam. Only the people that live nearby, in the Foz do Cobrão schist village and Sobral Fernando, did not want the dam. The building of the dam goes against the ongoing development of nature tourism in these villages, disturbs deeply local ecosystems and local life, changes weather conditions for traditional use of land and the right to the landscape of their ancestors is condemned.

The building of these ten dams implies the non-emission of 570000 tons of CO_2 to the atmosphere each year. In the next 10 years the demand for energy will not stop, for sure. The electricity business is also a fast growing one in Portugal and it needs power to be competitive. Building dams give a lot of money to the electricity and building companies and generally only has impacts on local economy during the building period (no more than 6 years for a big dam, less than one for small ones). There are almost no new jobs coming with the concrete. Tourism may be locally fostered by the existence of an artificial lake but in Portugal hinterland areas hope to bring closer the sun & beach tourism which are destroying the coast with resorts. Most of our dams are just deserted areas without people. Only very few dams represented substantial development of local economy through tourism. In the Geopark there are already 5 big dams and not a single one enabled the development of tourism. The agriculture is just a dream in our country of very old farmers and water has poor quality for bathing or consumption. The quality of the landscape built by thousands of years of local culture and millions of years of Earth dynamics, during Variscan and Alpine orogenies, and Life evolution, were about to be submerged or severely injured.

The Vale Mourão citizen meeting reunites one night every month in the small Schist Village of Foz do Cobrão to discuss the main issues of local society with the support of Incentivos Outdoor tourism company. For the second time, the theme was the destruction of Portas do Almourão geomonument by the Government decision of building a dam. People were first enthusiastic with the idea without knowing the real unsustainable environmental problems of building a dam. But this time the well informed Friends of Foz do Cobrão NGO, with the support of the Association for the Studies of High Tejo and Naturtejo Geopark, brought positive reinforcements to the discussion. In the meeting was shown unequivocally how the geological importance of Portas de Almourão prevented its destruction by the building of a dam: there are too many active faults in the area to fill with concrete! Later, the Mayor of Vila Velha de Ródão presented the new decision of the Government to build a smaller dam 1,6 km upstream from the Portas de Almourão, not interfering with the fascinating cultural landscape surrounding the geomonument. The cause of this sudden change on the plans was assumed recently in the newspapers by the director of the National Electrical Company: in cause was the protection of Almourão geomonument included in the Naturtejo European Geopark!

Nowadays the National Electricity Company is working with all local stakeholders to respect the demands of local people concerning their needs, as well as natural and cultural heritage protection. Quercus NGO - the national association for nature conservation and Geopark Naturtejo Meseta Meridional, with the strong support of Association for Studies of High Tejo and University of Minho, started an application to protect Portas de Almourão as Regional Natural Park. There were already inventoried 29 geosites and the protecting area for geoconservation was defined. This work sums to the biodiversity inventory developed by Quercus, the archaeological cartography already done by the Association for Studies of High Tejo, and to the cultural inventory made some years ago by the Group of Friends of Foz do Cobrão local association. The municipalities of Vila Velha de Ródão and Proença-a-Nova, local NGO's and companies, with the support of Naturtejo Geopark, developed geo-related short trails (Secrets of the Almourão Valley, Foz do Cobrão Schist Trail, Travel to the Bones of Earth and Roman mines Trail) to explore the geomonument (Fig. 2).

Figure 2: Portas de Almourão geomonument and setting, without the dam (left). Searching for gold as star-tourism product of this area (right).

4. Fraga da Água d'Alta: the last remains of the Tertiary subtropical forest

Before the Geopark first inventory to characterize geosites Fraga da Água d'Alta waterfalls were almost forgotten and invaded by the threatening *Acacia* neophyte. Naturtejo Geopark elevated this differentially-eroded lithological isocline scarp 50 m high divided by waterfalls (Fig. 3), in the Moradal quartzite ridge, to the condition of one of the 16 Geopark' geomonuments. Paulo Urbano, the president of the small village of Orvalho, took the right opportunity to benefit the area building accessibilities for the increasing number of visitor (more than 4000 in 2008!), cleaning old rubbish and controlling *Acacia* which gave space again for the autochthonous forest to flourish. After 4 years-long project Paulo Urbano launched the Orvalho GeoTrail, the thematic visit to Orvalho geosites and one of the most fascinating trails in the Geopark. Orvalho village organizes an annual event under the European Earth Festival with the support of Naturtejo Geopark. In this launching year more than 600 participants between 4 and 80 years old discovered a new world in Oleiros municipality! 7 km of hidden beauty, explanations about the Fraga de Água d'Alta waterfall and Cabeço Mosqueiro geomorpholoical viewpoint and the revival of Orvalho traditions of linen embroidery fulfilled the curiosity of all. On the top of the Mosqueiro mountain the Orvalho village prepared a cultural night with the Medieval Dinner and Celtic-derived rhythms at the sunset. Recently, researchers from the Institute for Nature Conservation visited the Água d'Alta deep valley and found a hidden treasure: in this mist environment protected from sunlight, in silica-rich soils one of the largest populations of *Prunus lusitanica lusitanica* still persists. The *Prunus* habitats are one of the most important from EU Habitat Directive (Code 5230). From the subspecies *lusitanica* less than 6000 trees exist in the world. Here researchers were marvelled to find more than 200 coexisting with *Viburnum tinus* (Fig. 3), Alders and the small fern *Omphalodes nitida*, an Iberian endemism. Altogether and *Arbutus unedo*, whose fruits are used in local production of jams and liquors, represent some of the last remains of the "Laurissilva" subtropical forest that during the Mio-Pliocene covered the SW of Europe and still persist mostly in some Macaronesian islands like La Gomera, in Canary Islands. Geodiversity and Biodiversity of Fraga da Água d'Alta deserves now to be protected as Natural Monument.

Figure 3: Fraga da Água d'Alta waterfall (left). Orvalho GeoTrail by the Água d'Alta deep valley surrounded by large numbers of the very rare *Prunus lusitanica lusitanica.* Photos: João Geraldes.

Naturtejo Geopark is special for its geodiversity and people living there know their rocks better than any geologist…well, at least in their own ways! They are proud users of their geological legacy and they honestly ask for help concerning protecting and managing of geosites for local development. Since Naturtejo began the project to create a Geopark it plays fair firstly with the locals, but also with the institutional supporters, service enterprises and evaluators. Naturtejo Geopark is part of UNESCOassisted European and Global Networks without having used others for comparison, asked for favors or acted with influences to reach international recognition. Naturtejo is a European Geopark after much work still ongoing, interest of local people and politicians, and several right decisions. And do not ever forget: a Geopark is never the will of only a bunch of geologists, usually outsiders; locals shall desire to be deeply involved, and we are all working for a common goal which is local development: Geology is just another weapon…well, in our case and for now, the chosen weapon!

OPENING OF A URANIUM-ORE QUARRY: A SERIOUS THREAT TO THE NATURTEJO GEOPARK

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1. Introduction

The uranium ore of Nisa, in the south of Naturtejo Geopark, is the most important one found in Portugal and has been causing strong controversy among the public opinion. The uranium price reached historical maxima in recent times with the increasing demand of countries such China and India and the projected building of 90 new nuclear plants all over the world. Moreover the fast increase of oil prices and the climate changes resulting from fossil fuel burning stimulate among EU energetic diversification and use of renewable sources of energy. The "Empresa de Desenvolvimento Mineiro" (EDM=Mining Development Enterprise) is the public institution that inherited more than 100 years of diversified geological resources exploitation and 175 abandoned private and public mines which oblige to heavy investments (118 million euros until 2013) to mitigate enormous environmental damages. Resulting from the generalize increase of the price of mineral resources, an unrecorded charm operation among public was set by EDM with the environmental qualifying of Urgeiriça uranium mines and few others. EDM is now preparing to be part of a joint-venture with one of 10 multinational companies interested to exploit uranium in Nisa. The application dossier for the international public competitive examination by invitation is now ready. This dossier obliges the starting payment of 5 million euros to Portuguese State for concession rights, the sharing of 25 to 40% of partnership capital to EDM, as well as the payment of 2,5 to 6,5% on the annual ore selling. This excuse will led to privatization in a good moment of EDM, the only entity in Portugal with responsibilities in environmental mitigation of mines.

The history of uranium mining in Portugal and the project for the Mining Enterprise of Nisa show the irrelevance of these mines to national economy or local development and the serious environmental and public health damages, with regional range and still unknown consequences for thousands of years. Recent integration of Geopark Naturtejo da Meseta Meridional composed by 6 municipalities including Nisa, under the Geoparks Network with the support of UNESCO, was officially declared by the coordination commission of the Centre Region as the umbrella for development based on Tourism. Naturtejo Geopark is now included in the National Strategic Plan for Tourism Development as 1st priority concerning Nature Tourism projects. Environmental degradation and lost of geodiversity by the opening of the Nisa gigantic uranium quarry will affect irremediably all the Geopark and the quality image of the remaining EGN.

2. Historical review of Uranium exploitation in Portugal and the importance of Nisa

In 2007 was celebrated 100 years on the discover of the first uranium-radium ore in Portugal. But already in 1905 studies were performed by Marie Curie on uranium minerals collected in Portugal. The most important uranium mine from Portugal, Urgeiriça (Viseu), opened in 1913, becoming the factory centre to prepare and export uranium. The exclusive interest for uranium ore starts in 1944, anticipating the nuclear holocaust in Japan. The destiny of Portuguese uranium is marked in 1949, with the signing of an agreement with the old allied England just before the beginning of the Cold War. In total, there were exploited 4370 tons of uranium oxides in 61 mines spread by the districts of Guarda, Viseu and Coimbra, the majority small mines being nowadays all closed and dangerously abandoned.

And what are the environmental impacts resulting from decades of uranium mining in Portugal?
- Existence of poor level ore, unprofitable uranium phosphates, as well as radioactive dust and muds;
- Percolation of acid waters contaminated with Radium (radioactive element) and heavy metals in quarries;
- Existence of enormous piles of chemical rejected, with 85% maximum of radioactive ore;
- Adulteration of the landscape by rock piles and giant quarry holes.

Nisa reservoir was discovered in 1957 and was never exploited due to economical impracticability despite of several attempts, the last one in 1999. The last uranium mine operating in Portugal closed the doors in the same year.

The lower prices trend during the last 30 years Portugal finished uranium production in 2001 and led to the bankruptcy of Empresa Nacional do Urânio (ENU= National Uranium Company) during the next year. Then, a study presented by Eng. Belarmino Silveira, former president of EDM and ENU, showed that "Considering size and contents of the Portuguese uranium reservoirs and the context of the international uranium market there is no justification to pursuit the ENU activity,(…), after equating the problem of environmental impact, the most important one is the radioactive impact". Belarmino emphasizes still that "(…) there are good conditions for contamination of food chain which can be irreversible with time" (Silveira, 2001). By closing ENU remained 13 million tons of dangerous wastes near the town of Canas de Senhorim and the mining galleries of Urgeiriça were submerged during the abandonment process, allowing the local contamination of underground water.

Concerning public health surrounding the mines the radioactive pollution already occurs in a moderate range but with a fast aggravation, according to MinUrar project studies conducted by the Geological Survey and several Health institutions and presented in 2006 (Falcão *et al.*, 2006 and references there). Contamination can be made by air, water and food chain. The most capable agent to spread faster and longer radioactive elements from the mine hole is wind. Uranium insoluble compounds install in lungs by simple inhalation and radioactive emission develops cell mutation and cancer development. On the other hand, rock faults and fractures mineralized with uranium enable deep percolation of acidic waters contaminated with uranium soluble compounds. Their ingestion and travel through the human food chain cause a double risk of chemical and radioactive toxicity. For José Delgado Domingos, former Senior Professor of the Instituto Superior Técnico University, in a testimony presented in the book "Nuclear: the debate on the new energetic model for Portugal", our country might be considered a world example of irresponsibility by the way uranium exploitation was performed without the accomplishment of EU or any environmental norms (Domingos, 2006). The ex-State Secretary of Environment Carlos Pimenta goes further saying that the legacy from those times is a case for Court (Publico newspaper, 18th January 2008).

However, after 2004 the uranium prices jumped to the historical 135 dollars per pound (about 453g) of uranium oxides (July 2007). Living a time of "fat cows", EDM developed an innovative project for remedying the radioactive waste piles and muds from Urgeiriça trying to clean the image of environmental and public health degradation of past uranium mines. This project for confining and sealing radioactive wastes, as well as for neutralizing acid waters cost 6000000€ to Portugal, but was well considered by the inspectors of EURATOM. Despite of this effort, only 2 of more than 3 million tons of wastes were controlled in the Barragem Velha da Urgeiriça. There are still more than 60 mines and 10 million tons of radioactive wastes waiting for mitigation work with an estimated cost of 60 million euros, which by the way must be immediate, due not only to the impact seriousness, but also for their proximity with towns. According to Dr. Delfim de Carvalho, the Presidente da EDM, these works can "last for many years".

3. The Mining Enterprise of Nisa

The biggest uranium reservoir of Portugal, with estimated reserves of 3080 tons is only an insignificant part of the world uranium production. Canadá and Austrália have together 52% of the annual production of Uranium and 1/3 of the known and exploitable reservoirs (in a total of 4,7 million tons). Nisa ore is distributed by 8 zones between Nisa and the Portuguese borderland, following the brecciated and weathered metamorphic aureole of Nisa Granite in the Neoproterozoic metassedimentary rocks for 5 km, being less than 400 m wide. Uranium occurs disseminated by the rocks as yellow, green or dark "dusty" minerals. These colors show diversified composition of uranium minerals in Nisa, such as Autunite, Torbernite, Sabugalitem, or the "Nisaíte" here described during the seventies. The most relevant concession is only 2 km W from Nisa, between this town and Montes Claros village. It has an exploitable size of 33 soccer fields, almost all the area belonging to National Ecological and Agriculture Reserves. Despite of the high content in radioactive minerals, soils there act like a filter, enabling high natural radioactivity in this region to be lower than the health limits considered for inhabited areas.

In 1999 the project Mining Enterprise of Nisa was presented. This project, valid still today despite of economically unprofitable then, shows that mining exploitation will run for 6 to 10 years, creating 71 new direct jobs, very few of them for non-specialized workers such as the ones find in Nisa region. The quarry will be a gigantic open-sky hole, reaching 30 m deep, and being estimated the extraction of 6300000 tons of rock and 650 tons of uranium oxides with a total value of 53 million Euro by the present price (June 2009). In one year the estimated value of uranium oxide reserves in Nisa decreased in 16 million Euro due to the descreasing trend of U_3O_8 price. The estimated investment will be of 5000000€, with only 1000000€ for buildings and environment(!). The exploitation methods, contrary to the affirmed by EDM in the Environmental Impact Study, concerning experience and environmental best practices, consist in an open-sky quarry with rubbish piles. Such kind of large-size quarry enables the transport of mining-resulted dust by the wind, spreading radioactive compounds and exhalations of the dangerous Radon gas by a vast area. It is important to emphasize that, from the three radioactive ways resulting from the natural transformation of Uranium in Lead, the most persistent emissions are of γ radiation that reach the surface only through a mining quarry. Ore will be lixiviated with sulfuric acid and the resulting "liquors" will be transported to Urgeiriça, leading to the opening of the old washing factory complex. This mining process using large water resources substitutes the expensive operation of bulldozing responsible for important emissions of green-house gases to atmosphere. The resulting concentrates have less than 5% of Radium, Thorium and Polonium. This means that mine wastes reunite more than 95% of these unprofitable radioactive chemical elements. The Study considers the opening of a station for effluents cleaning. However, the fact that the waste piles cannot be rendered impermeable may lead to deep contamination of municipal underground water resources, including also Montes Claros dam and Nisa thermal springs. According to the Fonte Nova newspaper, presidents of S. Matias and Arez villages are very worried because location of the dam and municipal water springs are just downstream in the drainage area of the projected mine, conducting most probably to contamination of waters as it happens already in Urgeiriça and Cunha Baixa mines and confirmed by the MinUrar studies (Falcão *et al.,* 2006). Concluding, the uranium mine in Nisa will never be "the solution for the big problem Nature created in the region", as pointed out recently by the president of EDM in an advertising supplement of Primeiro de Janeiro newspaper.

Uranium price recorded historical peaks never imagined in the last years, fueling 10 multinationals in the contest for the now most wanted Nisa vein. Nevertheless, the *UxC Nuclear Fuel Price Indicators* show that the uranium price swung like a pendulum, decreasing

almost 100 dollars in 1 year to 36,89 €/lb by 29th June. Nisa ore is valuing currently 53 million Euro but the market is very variable. It is also important to remember that, only in the year of 2006, the Neves-Corvo mines in the Iberian Pyrite Belt produced copper and zinc valuing 388 million Euro, being the most lucrative Portuguese mine. Based on INE, in 2005 the total lucrative amount of the Mining Industry in Portugal was 1096 million Euro, corresponding to 1% of the Country productiveness.

4. Geodiversity makes difference in the National Strategy for Tourism and is defended by local politicians and Nisa population

Geodiversity is outstanding at the Naturtejo Geopark! Granites and schists, quartzites and sandstones, greywackes, conglomerates or breccia: there so many types of rocks. Weird granite morphologies, beautiful deep valleys carved in schist and quartzites, gigantic faults and folds or fossils dated to 600 million years old; millenary cultures non-invasive to Nature, rock art, megaliths, sacred fountains and legendary rocks or troglodytic houses. There are plenty to dig out from the landscape puzzle of this particularly pleasant corner of Europe. This geodiversity is also the reason for biodiversity exuberance. Soils, orography and socio-political history made Naturtejo Geopark a unique place where species and traditions long lasts. It happened with the elephant *Elephas antiquus* in Vila Velha de Ródão 33500 years ago as still occurs with some of the most genuine Portuguese culture. Tejo Internacional Natural Park, close to Nisa, is a European-level sanctuary for endangered bird species and all the Natura 2000 sites from Nisa and Castelo Branco are just small ecological breaths in an injured Planet.

But in the present world, geodiversity can be also be a threat for the ecological effort in the sustainable survival of Human populations. Since the seventies Nisa suffers by anticipation with existence of the most important uranium ore in Portugal. In the near future, all this geological richness may mean one (possible more) gigantic scar(s) in the pristine landscape, with regional consequences for environment and public health. There will by profits to share between the State and one multinational for less than 10 years and a heavy heritage for decades of environmental degradation and expropriation of the people's right to their own cultural landscape. It will be a true *topocide* in Nisa, as defined by the anthropologist Paulo Castro Seixas (Seixas, 1999). A uranium quarry will lead to a rupture of socio-cultural (and environmental) integrity of the landscape, with its consequent annihilation. How much will be the real cost of this business to all the interested parts? Will 1 million Euro be sufficient to reestablish environmental and landscape conditions? Or may the State have to pay heavily again to confront EU demands, as it happens already in Urgeiriça and will be multiplied by almost 200 abandoned mines. What are the real gains for Nisa population and surrounding region necessarily affected by contamination of air, waters and…vision?

The possible opening of a uranium mine in Portugal can be fuel to fire the already started discussion on the building of a Nuclear Plant in Portugal (Rodrigues & Azevedo, 2006). In the present where solutions are needed to face the energetic crisis, and considering the strong dependency of Portugal on fossil fuels, it would be expectable to have a coherent politics of energy efficiency, still almost inexistent. On the other hand, there are immense potentialities for the implement of renewable energies in Nisa and Naturtejo Geopark. However, despite of abounding wind mill parks and dams in the territory, there is still a long way to develop solar potentialities and to profit from the forest biomass, as well as from biofuels and individual production of energy.

Local Agenda 21 developing for Nisa considers thermalism, traditional products and rural tourism as the best support for sustainable development under the umbrella of the label Naturtejo Geopark supported by UNESCO. The local politicians, farmers, associative delegates and general public from Nisa do not thrust in the Mining Enterprise of Nisa project which comes against the sustainable development strategy embraced in the last years.

Population created a movement (No for the Uranium from Nisa Movement) and associations (Associação Terra, Nisa.Com and Associação de Desenvolvimento de Nisa) to fight for their rights. In January 2008 the movement sent a petition to the President of the Republic Assembly. In February 2008 the Municipal Assembly of Nisa voted for a position against the Uranium exploitation in its territory. ProGEO-Portugal, the Portuguese delegation of the European Association for Protection of the Geological Heritage sent an official letter in May 2008 supporting the claims of Nisa and Naturtejo Geopark. The National Association for Nature Conservation - Quercus-organized with local NGOs and the ex-workers from Urgeiriça organized the National Workshop against Uranium Mining last September 2008 and several local information meetings. The investment in the new Iberian-class thermal complex is about to be openedin Fadagos a de Nisa, a financial effort of 9 million euros challenged by Nisa municipality that will create 80 direct and 300 indirect but healthy jobs for the population. There are many other sustainable projects being carried out for Nisa, in all the municipal area, through the Tourist development Plan of the Naturtejo Geopark, such as technological and interpretive centers and museums and protection of the geosites under national laws (e.g., the recently declared Portas de Ródão Natural Monument).

The future of Nisa and its uranium, as well as the future of the Naturtejo Geopark projects, are waiting now and only for the Government final decision. It is not expected the attribution of mining concession before the end of 2009, and only after the Elections.

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QUANTITATIVE ASSESSMENT OF PSILORITIS' GEOTOPES WITH EMPHASIS ON PROTECTION AND GEOTOURISM (CRETE, GREECE)

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Assessment of geodiversity's value has gradually been studied on a scientific base during the last two decades. Starting from Australia, Tanzania and other central European countries this effort was first based on the description of the different features of geodiversity and on the determination of the qualitative value that certain geotopes may have at certain places. However, for the purposes of comparisons and monitoring of the geotopes in recent years new models to quantitatively evaluate geotopes have been published using approaches developed for the evaluation of geomorphosites and landscape. Regardless the scientific value that these assessments may add to a territory, quantitative evaluation of geotopes should be a strong tool for the management and conservation of a geopark and a basic constituent of a realistic action plan.

Till now similar efforts have been carried out in some Spanish geoparks, as well as for Lesvos Petrified Forest. In Psiloritis Natural Park a qualitative assessment of the known geotopes had been elaborated several years ago in order to identify their value and define their potential contribution to scheduled educational and geotourist initiatives. This early study was the base for the detailed quantitative assessment presented here, that was carried out during the preparation of the park's new action plan. A sum of 63 main geotopes was used which refer to the great variety of Psiloritis geodiversity, including landforms, fossil sites, water resources, caves and other karstic features, tectonic structures, as well as cultural landscapes. The necessary input data were taken by the geopark's data base and were additionally enriched by field observations and published data helping to update conservation and environmental status.

In order to assess the geotopes a certain methodology had to be developed. This was produced after comparing and testing several models proposed to evaluate either the touristic value or the conservation status of landforms and geomorphosites, as well as similar models developed in other geoparks, like the one for the Lesvos Petrified Forest. However, all these models seem to be dependent on the specific nature of the studied sites or/and to certain protection environments, and couldn't be applied to an extended, multi-protected and much varied in geotopes territory, like Psiloritis Mountains. Hence, our methodology is based on earlier proposed criteria combined in such a way that can be applied to all kind of geotopes and be used to assess all the aspects of geotopes' value. Defined criteria are separated in six main groups: 1) "scientific", 2) "ecological and protection", 3) "cultural", 4) "aesthetic", 5) "economic" and 6) "potential of use". Each main group is comprised by a number of sub-criteria, and for each one a common scoring system (ranging from 1 to 10) is applied.

The application of this methodology to the 63 Psiloritis' geotopes resulted in the recognition of some very important geotopes which fit well to the previously suggested as of international or national importance sites, where as others having lower score can be assigned to those regarded previously as of regional or national importance.

Finally, in order to fulfil the purposes of this assessment a new formula had to be produced in order to estimate the touristic, economic and educational value of each geotope, as well as the need of protection. To test the formula we used about 15 geotopes for which their individual values are known and well established in local societies. These are open to public caves, sites with intense educational and scientific activity, or even very remote

and inaccessible to the majority of the visitors. The suggested formula is thus based on a combination of the afford mentioned criteria groups using for each different weighting coefficients depending on the studying value. For the educational value we combine the scoring of scientific, cultural and aesthetic criteria, for the touristic value we combine the scoring of aesthetic, cultural, potential of use and economic criteria and for the need of conservation the scoring of scientific criteria plus a factor presenting the protection status. This elaboration of the 15 used geotopes gave very sufficient results and can be regarded as the most reliable from the five produced.

Applying this methodology on geoparks' geotopes certain and compact results can be delivered, useful both for comparisons and future planning, as well as for monitoring purposes. The only individual decision that a geopark has to take is where to set the base line for the selection of geotopes suitable for tourism or educational development or for those requiring conservation measures.

GEOCONSERVATION IN NORTH PORTUGAL: DIFFERENT SUCCESSFULLY EXAMPLES OF GEO-HERITAGE RECOVERY PROCESSES

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This work emphasizes the importance of combining different scientific disciplines in a jointly approach towards the recovery of geo-archeological sites of cultural relevance. Two distinct successfully case studies, one in the countryside and the other in an urban environment will be presented. The first study is concerned with the importance of recovering abandoned mining heritage into geo-mining museums, as an example of an organization transformative process towards a second life-cycle. Such interventions represent important measures for sustainability, to both the organization itself and the surrounding environment. At a social-economic level, the main advantage is the promotion of regions where economy has been supported heavily on the exploitation of mineral resources, and where huge investments have been made for the extraction of raw materials, produced from the excavation of underground galleries and the construction of railway lines, roads and buildings. The *Aveleiras* Mine is an old wolfram mine (*ca.* 1940-1962), belonging to the St. Martin of *Tibães* Monastery, near Braga (NW Portugal). By initiative of the *Tibães* Monastery, this mine will be rehabilitated, partially, into a geosite and, in the near future into a geomining museum. Based on geotechnical and geomechanical studies, a stabilization plan is suggested towards the protection and security of the *Aveleiras* Mine, to be defined in agreement with materials, tools and equipments used during the excavation of the mine. Subsequently, specific actions will be developed to rehabilitate some areas, in order to facilitate their inclusion in selective classified itineraries. The second study is focused in an urban area – Porto City (NW Portugal) – and is directly connected with the ancient water supply system that was performed, for more than six centuries, through fountains fed by numerous springs. Several underground galleries were excavated throughout the centuries to conduct the groundwater of these springs. A geoenvironmental approach will be applied to the recovery of *c.* 3,2km long of the tunnels system, to allow hydrogeological and geotechnical tours. Both studies already led to cultural actions, namely a trail inside the Monastery of *Tibães* Fence, where aspects of geodiversity, particularly, a visit to the *Aveleiras* Mine were emphasized, and regular tours in the ancient underground water-supply galleries. These events were both integrated in the *Geology Activities in the Summer by Ciência Viva* program (*http://www.cienciaviva.pt/*).

GEOPARKS – STRATEGY OF GEOCONSERVATION AND DEVELOPMENT

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After the creation of Global Geoparks Network – GGN by UNESCO in 2004 (Eder & Patzak, 2004), the interest in the creation and implementation of geoparks have been increasing worldwide.

In 2006 the first Brazilian geopark was created, the Araripe Geopark in Ceará State - (it is the first of the Americas). Since then, other initiatives for creation of geoparks have emerged in different regions of the country, showing the geological community interest in preserving the geological heritage and yet fostering development.

Recently, the Brazilian Geological Survey – CPRM created the Geoparks Project aiming to identify, classify, catalogue and georeference the geological heritage of Brazil, as well as to define guidelines for its sustainable development. This activity will have to be developed by CPRM together with universities and other institutions or federal and state entities, which may have common interests, and in accordance with local communities. This project presents circa 50 potential areas for the creation of geoparks, scattered around the different Brazilian geological provinces.

There are several proposals going on: Alto Ribeira (SP state), Campos Gerais (PR state), Quadrilátero Ferrífero (MG state) and Serra da Bodoquena-Pantanal (MS state) among others. These areas constitute geological contexts of special heritage value and are highlighted in the Geodiversity map of the Brazilian States (CPRM, 2008).

Presumably the creation of Geoparks can contribute to the protection of geosystems in regions of special interest for geodiversity studies, for geotourism and geoconservation, including paleontological and mining heritage, natural monuments and scenic landscapes.

In the elaboration of different proposals for geoparks creation in Brazil, the geological community points out the importance of the implications and potentialities that geoparks aggregate, considering three standing pillars of such strategy: conservation, education and geotourism.

On an educational approach, the public universities of São Paulo State will promote a symposium in São Paulo city in July, 2009, with invited lecturers from Brazil and abroad, regarding educational projects on geoparks issues.

Pereira *et al* (2008) define geoparks as: "Territories where the geological heritage is the foundation for a strategy which promotes the populations´ well being, keeping the outmost respect for the environment". This way it strengthens the understanding of an integrated concept of protection, education and development.

One recognizes, therefore, that the creation and implantation of geoparks constitute valuable tools or resources for the geoconservation and development. However, this initiative is covered with many complex implications and aspects, which demand vast considerations, studies and planning of concrete actions, so that its potential value for development may not be hindered by risks, also potential, which its sudden implantation allows for.

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GEOLOGICAL HERITAGE AND MUSEOLOGY: CHALLENGES AND CONCERNS

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Since the beginning of the nineties the National Museum of Natural History has been promoting the preservation and musealization of geological sites. This work led to a reflexion about the implications of our intervention on the geological sites and on the landscape.

First evidence is, as we all know, that Geotourism is a meaningful contribution to local development, mainly if it is included in an integrated development project. The geological heritage is a way of attracting tourists, of involving and fixing populations. It can also acts as a central project promoting the regional planning of the territory in which it is inserted and contributes to an approach of sustainable development supported on and valorising the characteristics of the region.

And we can also consider the geological heritage contribution for the development in a more wide approach once it allows an easier contact between citizens and science as the geological objects and features are in their natural context allowing a better communication. In fact, the public understanding of science in this realm is a fundamental tool when we need to be aware about natural resources management or to understand the role we must play face to the fragile balances of the Earth system.

In fact to understand how mountains were built or destroyed, how oceans opened and closed, how climates changed, how, as a result of these processes, living beings disappeared or evolved along thousands or millions years until the forms with whom we share the planet today, may be a way to understand that we, human, are no more than a short and passing moment between past and future. But, at the same time, that we are powerful (and sometimes dangerous) actors in the Earth-Life system change.

Perhaps by this way we can discover that only a sustainable development (as it considers environmental and social elements) will avoid a global disaster.

But when we manage the geological sites in order to make easier to the publics contemplation or interaction or observation, even if it is a minimal intervention, we are putting a sign, a brand of a time and a cultural belonging. To begin, the site selection itself is according with today's understanding about what is meaningful or represents moments of Earth history that we want to interpret, is according with the state of art of the knowledge on these thematic and with the expected level of the public's information on these subjects. In other epochs the selection may be done according with other criteria.

In other hand, as in every process of (re)building a memory of the past we have not information about the totality of facts or phenomena happened. And we know, also, that the evolution of science leads to new approaches and readings of the phenomena in the future. Those will come after us will have another tools, other accumulated knowledge, briefly, other means to look again to the same geological features and make new or deeper interpretations. So it is important that the geological record may go on. The processes of protection and musealization *in situ* contribute to the preservation of objects in context to future research. And also by this way they are contributing to development.

Because of all of these questions we must be prudent when we use the "power" of the museologist or cultural manager. Because it is the power of remembering what we find meaningful or forgetting what we don't find important. Because we are making of these sites places of memory but, at the same time, places of forgetfulness. And we need to remember that they are places for contemplation, places to the relationship with time. A time bigger than the time we know at the level of the human scale or of the historical scale: it is the time of the Earth. The time that allows to feel the true dimension of our presence in the Universe.

As the geological sites allow a better understanding of the world in which we live, of the space in relationship with time and, even, for certain cases, a clearer vision about what natural resources are and how they must be managed in a more correct way according with environmental and social implications, they allow, also, a deeper awareness about the meaning of the Geological Heritage and the acquisition of a Memory of Earth.

And, as in all processes, recognizing a heritage and acquiring a memory leads to the assumption of a collective identity. In this case it should be our collective identity of biological species resulting from a long chain of interactions between lithosphere, hydrosphere, atmosphere and biosphere conditioning the development of life on Earth until the species we know today and ourselves.

By this way perhaps we can find a way of life not against, but more in harmony with the rules of Earth system.

PROMOTING THE GEODIVERSITY OF THE MALTESE ARCHIPELAGO – ISSUES AND CHALLENGES

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1. Introduction

In spite of the small land area of the Maltese Archipelago, 316 km^2, it is surprisingly rich in geodiversity as this paper will highlight. It consists of Oligo-Miocene limestone rock formations of marine origins and their associated clays, marls and conglomerate beds; and scattered Quaternary beds of terrestrial, aeolian and alluvial origins. Landforms range from Coralline limestone plateaus; Coralline limestone cliffs; karstic caves; Blue Clay slopes; boulder scree slopes or as locally known *rdum* areas; Globigerina hills and plains; dry valleys or as locally known *widien*; dolines; low rocky coasts; and sandy pocket beaches. Soils are also diverse represented by seven different soil types (Paskoff, 1985; Pedley *et al.*, 2002; and Vella, 2003).

Pedley (*in* Bajada, 2005) points out three main areas in the Maltese Archipelago of geological and geomorphological significance. These include Il-Qammieh Horst, Id-Dwejra Dolines and Il-Maghlaq Fault Coastline. All three sites feature distinctive geoheritage in terms of stratigraphy, landforms and palaeontological features of intrinsic, scientific, ecological and educational importance, as well as aesthetic beauty amongst their many other environmental and cultural values. These three sites have the potential to be become Geoparks under the initiative of the European Geoparks Network. In this way they can be enjoyed by the wider public and tourist alike whilst conserving their distinctive geodiversity. The issues and challenges involved in the protection and promotion of the Maltese geodiversity are also discussed in this paper.

2. Geography

The Maltese Archipelago is well known for its rich archaeological and historical heritage (Schembri, 1994) but not for its geoheritage. The Maltese Archipelago consists of three main islands, Malta (the main island), Gozo (mostly rural) and Comino (almost uninhabited). It is located at the center of the Mediterranean Sea, 96 km south of Sicily and 320 km north of the North African coast. In total, the Maltese Archipelago has a land area of only 316 km^2 and a coastline stretching for 272 km. Lengthwise the Archipelago stretches for a maximum of 44 km and has a maximum width of 16 km.

3. The Geodiversity of the Maltese Archipelago

In spite of its small land area, the Maltese Archipelago is surprisingly rich in geodiversity, exhibiting a diversity of sedimentary rocks, landforms and soils. The geology of the Archipelago has attracted the attention of many scholars for many years, unlike geomorphology and soils (Magri, 2001). Much less attention has been given to the conservation of geoheritage. So far, much of the geoheritage of the Maltese Archipelago has been coincidentally protected by the designation of protected areas to safeguard the Archipelago's biodiversity. Such trend is also experienced on the global scale (Gray, 2004, 2008).

3.1 The diversity of rocks

The Maltese Archipelago consists mainly of Oligo-Miocene limestone rock formations of marine origins and associated clays, marls and conglomerate beds. Spratt (1843) first established the general stratigraphy of the Maltese Archipelago. This consists of (i) the Lower Coralline Limestone, the oldest rock formation, (ii) the Globigerina Limestone,

(iii) the Blue Clay, (iv) the Greensand and (v) the Upper Coralline Limestone, the last rock formation to be deposited before the Maltese Archipelago was uplifted above sea level during the Pliocene Epoch some 10 million years ago. Pedley (1978) further classified these rock formations into different Members and Beds, accounting to 23 in all, and this, highlights further the diversity of the Maltese lithostratigraphy. Such diversity is attributed to the changing palaeo-environmental conditions of the central Mediterranean region through the geological timescale, which is well recorded by the different composition, structure and texture of these rock formations (Pedley *et al.*, 2002).

Numerous values can be ascribed to the Maltese rock formations, including intrinsic, scientific and utilitarian values (Bajada, 2005). The intrinsic value simply relates to the existence of the Maltese rock formations. The scientific value arise from the similarity of local rocks to the carbonate rock formations of the Hyblean region in south-east Sicily, and to the Apulian plateau and Istrian promontory (Alexander, 1988). This provides valuable scientific information in reconstructing the geological history and palaeo-environmental conditions. Locals attach a more utilitarian value to local rocks especially to the Globigerina limestone, *Il-Franka*, which supplies most of the building stone of the Archipelago, as its 'soft' nature easily enables its extraction and shaping. This practice has persisted since the Megalithic period *cir.* 3,000 years BC when local rocks were used to build temples, which are now part of World Heritage.

Being sedimentary in type, and therefore permeable, the rock succession of the Maltese Archipelago provides a favourable hydrogeological system, which as Newbery (1968) claims could be attributed as a factor in the rich history of the Maltese Archipelago when compared to the other Pelagic Islands which are composed of impermeable volcanic rock. Two aquifers the Oligo-Miocene succession supports include (i) the mean sea level aquifer contained within the Lower Coralline Limestone, accounting for almost half of the drinking water supply and (ii) the perched aquifer contained within the Blue Clay, which accounts for all the agriculture irrigation demand. This further adds to the utilitarian value of the Maltese rock succession.

Other types of rocks occur in the Maltese Archipelago and these consist of scattered Pleistocene rock deposits of terrestrial, aeolian and alluvial origins. The karstic caves, most importantly Ghar Dalam in the south of Malta, preserved very well much of these deposits due to their characteristic stable environmental conditions. These rock deposits are of high scientific value as they yield much of the information about the climatic conditions of Quaternary Malta through their contained fossils.

3.1.1 The diversity of fossils

Each rock formation is associated with specific fossil types. Fossil corals and remains of marine calcareous/coralline algae are the main fossils found within both the Lower and Upper Coralline Limestone formation. The *Scutella Bed*, in the Lower Coralline Limestone formation, is a prominent echinoid fossil horizon consisting of a great concentration of large flat sub-circular shells of burrowing sea-urchins.

Remains of *Globigerinae* and *Orbulina spp.* are the main fossils within the Globigerina limestone formation, which consist of microscopically small fossil shells of planktonic foraminiferans (Pedley *et al.*, 2002). Scallop shells, molluscs, echinoids, and extensive thalassinoidean burrow systems are also found within this rock formation.

Other fossils that are found within the Oligo-Miocene succession include a variety of fish skeletons, dugongs, dolphins, manatees, shark teeth, remains of *Tryonyx* (turtle) and

Tomistoma (crocodile). More exotic fossils were found within the terrestrial Pleistocene deposits of karstic caves and these include remains of the European pygmy elephants, hippopotamus and deer (Shaw, 1951). The epicontinental land bridge that emerged between Malta and Sicily during the Pleistocene sea level fluctuations facilitated the migration of such exotic fauna to Malta (Pedley *et al.*, 2002). These fossils all provide valuable information about the palaeoenvironmental conditions of the central Mediterranean region.

3.2 The diversity of landforms

Tectonics, climate and hydrology have played a major role in contributing to the geodiversity of the Maltese Archipelago whose different actions on the bedrock produced a wide diversity of landforms. Paskoff (1985) and Pedley *et al.*, (2002) give detailed accounts about the formation of these landforms, including the Coralline limestone plateaus, Coralline limestone cliffs, karstic caves, Blue Clay slopes, *rdum* areas, flat-floored limestone basins, Globigerina limestone hills and plains, *widien*, dolines, low rocky coasts and sandy pocket beaches. These landforms have an important ecological value as they provide diverse physical settings for several ecosystems to flourish.

The tectonics of central Mediterranean meant that the Maltese Archipelago is heavily faulted by two sets of normal faults (Pedley *et al.*, 2002). The first system consists of the NE-SW trending faults, which are today extinct, and give rise to the typical horst and graben landscape of the northern region of the Archipelago. This system is also responsible for separating the islands of Gozo and Comino from mainland Malta. The Great Fault of Malta is the main feature of this system. It bisects Malta at its maximum width and displaced the land by over 200m creating a huge escarpment along which the British colonial rulers built the Victoria Lines as part of their military efforts in defending Malta. The second system consists of the NW-SE trending faults, which are associated with the Pantelleria rift system that is still active today.

These fault systems have influenced the hydrology of the Maltese Archipelago, with the main *widien* draining rainwater during the wet season in a north-eastern direction.

3.3 The diversity of soils

The diversity of soils of the Maltese Archipelago has been the target of the MALSIS Project that was launched in 2002 with the help of funds from the European Union's Life III programme. On the basis of previous work by Lang (1960), who defined only three main categories of soil types, the MALSIS Project outlined seven major soil reference groups. These include the Calcisols, Leptosols, Vertisols, Luvisols, Cambisols, Regosols and Arenosols whose distribution is greatly influenced by the parent material and anthropogenic activities (Vella, 2003). Information about the distribution and quality of these soils are nowadays contained in the National Soil Information System, which is updated constantly, in an attempt to facilitate the conservation of soils of the Maltese Archipelago (Vella, 2003).

4. Protection of geological heritage in the Maltese Archipelago

Geological heritage in the Maltese Archipelago has been protected by a series of legal instruments since the early 20th century, first by the *Preservation of Antiques Ordinance* (1910) and then with the *Antiquities Protection Act* (1925) (The Superintendence of Cultural Heritage, 2003). In 1990, the *Structure Plan for the Maltese Islands* provided protection for geological and geomorphological sites of importance through the establishment of Sites of Scientific Importance (SSI). Another complimentary system was recently being developed, based on the Earth Conservation Strategy of the UK Nature Conservancy Council. Yet these attempts remained largely on paper.

Current protection is provided by three different legal instruments. Through the *Environment Protection Act* (1991) nature reserves for species of national and global importance can be designated. Alternatively the *Development Planning Act* (1992) provides for the protection of remains of geological, palaeontological, archaeological, architectural importance as well as areas of natural beauty, ecological or scientific value. The *Cultural Heritage Act* (2002) considers geological heritage as part of the national cultural heritage and extends protection to geological sites and deposits, landscapes, groups of buildings, scientific collections, manuscripts, books, archives, audio-visual material and reproductions. Consequently, the legal framework for the protection of local geoheritage and designation of nature reserves exists. Yet there is no strategy in place and no initiatives taken to effectively conserve and manage the geoheritage of the Maltese Archipelago.

4.1. Potential areas for the designation of Geoparks

Designating Geoparks is one effective way of protecting and enhancing geoheritage whilst stimulating local economic development (Gray, 2004). Pedley (*in* Bajada, 2005) pointed out three main areas in the Maltese Archipelago that could be designated as Geoparks for their geological and geomorphological importance. These include Il-Qammieh Horst, Dwejra Solution Subsidence Hollows and Il-Maghlaq Fault Coastline, which all feature distinctive landforms of scientific, ecological and educational importance as well as of aesthetic beauty amongst their many other valuable environmental and cultural attributes. Such designation ensures that these sites are protected for their geoheritage while they are appreciated and enjoyed by the public and tourist alike. In this regard, very positive results have been obtained through the research carried out by Bajada (2005). This research shows that the public is keen in seeing the establishment of a local geopark.

4.1.1 Il-Qammieh Horst

Il-Qammieh horst is located on the north-west coast of Malta. Its geological significance is attributed to the Oligo-Miocene lithostratigraphic section which is entirely exposed at Il-Qammieh in just one easily accessible location from the land (Bajada, 2005). This site therefore gives the opportunity to the public to appreciate and learn about the different rocks of the Archipelago without having to travel from one place to the other. There are other features of significance at Il-Qammieh amongst which there are the spectacular Blue Clay slopes that descend the Upper Coralline Limestone plateau down to the sea level, at which point, massive Coralline limestone boulders litter the coast to form a typical *rdum* area.

4.1.2 Id-Dwejra Dolines

Id-Dwejra dolines are located on the western coast of Gozo. The geological significance of this site is attributed to the concentration of twelve dolines in this area; three of which are well visible offering spectacular views to the public. These dolines formed by cavern roof collapse and are characterized by sub-circular land depressions, forming the large Qawra depression which trapped Quaternary deposits inside, an inland sea where seawater enters the doline through a cave in its wall and two adjacent round-shaped bays. Within this area there is also a natural sea arch, the Azure Window, which is one of the most popular touristic sites in Gozo.

4.1.3 Il-Maghlaq Fault Coastline

Il-Maghlaq fault coastline is located on the western coast of Malta. Its geological significance is attributed to the still active fault line trending in a north-east south west direction, forming part of the eastern flank of the Pantelleria rift system. With its movement, this fault tilted the Maltese Archipelago to the north-east, forming cliffs of up to 252m high on the south-west coast (highest point of the Archipelago) and drowned the *widien* along the eastern

coast of Malta, including the natural Grand Harbour of Malta. Rocks at Il-Maghlaq coast are heavily deformed and are tilted in an almost vertical position from their original horizontally position. Other important landforms are the remnant sea caves which are now exposed high above the present sea level.

4.2. Issues and Challenges in protecting the geoheritage of the Maltese Archipelago

Issues range from legal to technical to administrative issues. Although there are legal mechanisms in place, they still need refinement, enforcement and implementation to protect the geodiversity effectively. This is in part because there are insufficient technical and professional experts in the field of geology, geomorphology and geoconservation in the Maltese Archipelago. Insufficient financial resources further worsen the problem as the lack of funds limit the extent of protected areas and their management, with priority being given to the protection of biodiversity and thus neglecting the need to protect the geodiversity. Consequently, these issues prove to be a hurdle in designating Geoparks locally. Lastly, and perhaps the most challenging issue, is the low public awareness on the values of geodiversity (Bajada, 2005). This is mainly due to the fact that knowledge regarding the local geodiversity has so far been limited to scholars and academics (Grima *in* The Superintendence of Cultural Heritage, 2003).

5. Concluding remarks

To promote the geodiversity of the Maltese Archipelago the issues and challenges outlined in Section 4.2 must be addressed immediately to avoid further destruction of the local geoheritage. The development of a geoconservation strategy and the designation of a local Geopark is here believed to be the way forward in ensuring the protection and conservation of the geodiversity of the Maltese Archipelago. A Geopark initiative would help by (i) protecting specific geological monuments and sites through the establishment of a geological protected area; (ii) stimulating research about the values of the local geodiversity (iii) enhancing the geodiversity of the site through the establishment of geological trails and informative panels; (iv) raising awareness among the local public about the local geodiversity through the educational opportunities associated with Geoparks; (v) stimulating local economic development though the income generated by the increasing visitors; (vi) developing geotourism which at present time is locally non-existent and (vi) creating an employment opportunity for geo-conservationists and protected area managers.

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LATIN-AMERICAN AND CARIBBEAN NETWORK FOR THE DEFENCE AND CONSERVATION OF THE GEOLOGICAL, MINING-METALLURGICAL AND PALEONTOLOGICAL HERITAGE

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The processes that led to the creation of the Latin-American and Caribbean Network for the Defence and Conservation of the Geological, Mining-Metallurgical and Paleontological Heritage (REDGEMP) will be explained. The necessity of the creation of this network, its organizational form, and protocols for cooperation, constitution, benefits and future projects will be shown.

REDGEMP was created on March 20th, 2009 during the celebration of the 1st Latin-American and Caribbean Congress on Geotourism Initiatives in Margarita Island, Venezuela and it was organized by the Fundación Geoparques de Venezuela. The main objective of this network is to develop international cooperation mechanisms in order to achieve common goals on the protection and rational use of the regional geoheritage.

EDUCATION IN EARTH SCIENCES AND GEOPARKS A RELATIONSHIP OF MUTUAL IMPORTANCE

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Without the educational foundation it is not possible the interaction between economical and cultural development and the environment conservation, necessary in the creation of a geopark, according to UNESCO´s concept.

It is understood that for constituting a multidisciplinary field, the Earth Sciences enables the teaching of science in a contextualized and globalized way, in which information and knowledge can awake, beyond a bigger interest in learning, values and competences for citizenship (Piranha, 2006).

In consonance with programmes of international institutions (UN, UNESCO, IYPE) for scientific education and for popularization of knowledge on the planet Earth for a sustainable culture, the teaching of Earth Sciences allows the understanding of natural processes as well as the evolution of landscapes and environments, with time.

Scientific education is then recognized for the benefits it brings to individuals, families and communities; among such benefits are: self-esteem development, the notion of individual and group empowerment development and responsibilities, the development of competences of creativity and critical thinking, the increase of the capacity to participate politically and consequently to participate in the democratic process. It contributes, therefore, for a culture that facilitates the sharing and transformation of values, attitudes and behaviour, through critical reflexion and the development of relevant social and ethical values (UNESCO, 2003, 2004, 2006).

Thus, making use of the holistic, historical and systemic condition which the Science of the Earth aggregates, the educational process can get new and wide resources, facing the conception, preparation and application of innovative teaching practices, which promote the differentiated and pertinent teaching of Science.

The United Nations Education Decade (Literacy), 2003-2012 shows a collective wish of the international community in promoting a literate environment for all, not only in developed but also in developing countries. In order to reach the aims and purposes of the Education Decade, UNESCO created, as a global strategy and operational mechanism, a 10-year campaign of cooperative work – the *Literacy Initiative for Empowerment* (LIFE) (UNESCO 2006). Among other strategies the campaign highlights the importance of *innovating*. The educational practices and policies imply the support to existing qualities as well as the access to information and construction of knowledge.

It depends on education the role of extreme relevance as the revitalizer of the social-cultural memory and promoter of innovations legitimated by the communities, which constitute the immaterial heritage of geoparks.

Despite the fundamental role that geodiversity plays, a geopark gets richer as it aggregates more and more of other kinds of heritage, either in biodiversity, or cultural (Pereira *et al*, 2008). On the other hand, while the geopark promotes the heritage conservation it not only uses and implements educational strategies to involve and value communities, but it also enables new possibilities for local development.

In educational terms, the primary and secondary education syllabuses in Brazil do not cover satisfactorily geoscientific concepts in forming individuals, what may explain a great difficulty of citizens in understanding how the planet where they live works (Carneiro *et al.*, 2004). This lack of information reflects directly on the low value concerning the geological and natural heritage of the country and on the destruction of it in general terms (Reys *et al.,* 2007).

Thus, it is considered that, in order to change this picture and to have a fair valuing of the natural heritage, it is necessary to address appropriately the concepts related to the Science of the Earth in the syllabuses. Beside schools, geoparks are adequate sites in order to promote the heritage education and popularization of geological knowledge. Over the last years, universities, aware of these questions, have created graduation courses to graduate professionals able to teach geoscientific questions in formal and non-formal education (Bacci, 2009).

Education focused on Geosciences can constitute the best form of preserving cultural and environmental heritage, contributing effectively to sustainability. Given its importance, while one of the dimensions related to geoparks themes, it deserves and needs to be better and thoroughly thought over and considered.

Zouros (2004) points that European geoparks have an active function in the organizing of activities of education and training in all educational levels in Earth Sciences, in valuing the natural environment and in the sustainable development policies.

An important differential between geoparks and North American parks in that they constitute important means for education in Geosciences (Nowlan *et al.,* 2004).

In such context education understood, above all, as an element of transformation and promotion of quality to development, desirably sustainable, shows that the strategies of geological heritage protection enable the conservation of unique elements of geodiversity, at the same time that allow the creation of new cultural and developmental paradigms, which contribute to the quality and sustainability of life on the planet.

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GEOSCIENCES AND ENVIRONMENTAL EDUCATION: TRAINING PROFESSIONALS TO DEVELOP EDUCATION PROJECTS

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Geoparks are centers for instruction and diffusion in Earth Sciences. They are visited by people from different cultural levels and ages that search for knowledge and funny activities on Geology, Paleontology, Archaeology, History and Environment. Receiving heterogeneous public is a challenge. To satisfy interests ranging from simple curiosity to the science education and from new scientific research, it is necessary the presence of a professional who works in the interface between Education and Geosciences. To form professionals capable of executing the work described above, the University of São Paulo (USP) was the pioneering institution in Brazil to consider an undergraduate course in Geosciences and Environmental Education Teaching Degree (Toledo *et al* 2005). The course was created in 2003 and is the only one in which the main focus is the geosciences educator. This professional is able to provide a complex view of nature, especially with respect to the relationship between the history of life and the geological history of planet Earth. The course is based on lectures that address Geological and Environmental Sciences, allowing students to learn the strategies and applied methodologies of Geosciences Education using field activities and environmental studies applied to the environmental education (Compiani 2002). To Compiani (1996) geology knowledge is related to action of the society in nature and it permits social inclusion by means of science understanding, promoting a real perception of the world.

The organization of the first Geopark in Brazil - Araripe Geopark, in 2006, known by the fossil assemblages and preservation, requires a professional with a new profile. This person must be able to work with the public, developing research, teaching to other professionals methods for working on Environmental Sciences, especially in local scope. Such an action contributes for spreading the culture on the environmental heritage represented by the Geoparks and in the awareness on the importance of preservation of the natural resources. The creation of the Araripe Geopark and the perspective of more other four geoparks, brings an excellent perspective of regional development for Brazil, for which USP can contribute through the formation of specialized professionals.

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TURKEY GEOLOGICAL HERITAGE INVENTORY; AN EXAMPLE SITE BIGA PENINSULA

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"Determination of Geological Heritage Sites" studies which was launched in 2003 by General Directorate of Mineral Exploration and Research (MTA), started to take a new direction in 2009. At the beginning of the project, geotourism maps were prepared after determining the main features such as geosites, stop points, geotourism routes, sight watching locations and other resource values, within two study sites, transformed to Geographic Information System.

In 2007 a collaboration protocol was signed among two governmental institutions (MTA, General Directorate of Nature Protection and Natural Parks (DKMPGM)) and a willing establishment (Nature and Environment Society). The Additional Protocol was signed in 2009 and explains duties and responsibilities of protocol partners. Thus an institutional structure has been created to be able to serve the scope of the geological heritage inventory in Turkey. According to the protocol, sites and structures will be determined by MTA and taken under protection in described form within maximum two years by DKMPGM. At the end of the project, "Turkey Geosite Data Bank" and a "Turkey Geosite Atlas" will be created. While the Turkey Geological Heritage Inventory is produced, at the same time those studies which have been carried out in the study sites are proceeding. Moreover the data which were obtained in the last studies will also be a source to the inventory studies. One example of these studies, which is also a subject of this article, is Biga Peninsula. It is located in the North-east Turkey between Aegean and Marmara seas with an approximate area of 133.100 hectare.

Since the Paleolithic era, many civilizations passed by Biga Peninsula as an important settlement place, not only underground and aboveground geological features richness but also occupying geographical position. The ancient mine quarries, which were source of richness of settled civilizations in the area, are the main resources value of the area. Especially, there are ancient granite quarries which have invulnerable massive columns (Fig. 1). The significance of these columns came from multiplicity of technical handwork. Besides, within the area there are different geological features such as volcanic structures as basalt columns, sedimentary structures as delta systems and tide sediments, waterfalls and canyons (Fig. 1), Gelibolu natural sandstone statues (Fig. 1), hot water resources, salt formation sites, coast lines where mammal fossils can be seen and ancient cities as Truva (Fig. 1).

As a result Biga Peninsula has a big geotourism potential. Determining geosites of Biga Peninsula will be evaluated in the inventory project, some of them will be taken under protection and as well as the planning study will be made for geotourism in the area.

Figure 1: Biga Peninsula Sites, from left to right, from top to down: Koçali Ancient Granite Column Quarry; Sütüveren waterfall and canyon. The ancient city of Truva; Gelibolu natural sandstone statues.

5. Marketing strategies for a strong EGN brand

EUROPEAN GEOPARKS NETWORK REVALIDATION PROCEDURES AND THE BUILDING OF A STRONG BRAND FOR GEOPARKS

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In 2000, a new heritage brand was created in Europe - geoparks. In the nine years that have passed, this label has developed from being one that was completely unknown to a brand that is becoming increasingly recognized and respected as representing a high quality brand of ecotourism based on the heritage of our Earth (geotourism). The use of the geopark label, including both the logos of the European and Global Geopark Networks is strictly controlled and both are legally protected. However, the continuing use of the Geopark brand must be continually monitored to ensure that the quality image the brand is intended to portray is not only maintained but that it is enhanced.

Every four years all members of the European and Global Geopark Networks undergo a revalidation procedure. Central to this procedure is an evaluation of the use of the geopark brand and an evaluation of the efforts of each geopark to help in its promotion and enhancement. Geoparks do not exist in isolation as many other heritage designations or brands do. Geoparks form a network and it is the responsibility of all geoparks to work together in marketing and promoting the core ideas of the network and its quality image. Geoparks wish to portray themselves as areas of excellence in terms of sustainable ecotourism based on their geological heritage. As such the revalidation procedure has been designed to evaluate their efforts. A crucial part of this is an evaluation of the visibility of the geopark identity and whether that visibility is to the benefit or detriment of the geopark brand as a whole.

We examine the revalidation procedure for geoparks and in particular discuss the issues around the visibility of the geopark identity in members of the European and Global Geopark Networks.

DEVELOPING SUSTAINABLE TOURISM PRODUCTS AT GEOPARK NATURTEJO: THE IMPORTANCE OF COMMUNITY INVOLVEMENT

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1. Introduction

Geopark Naturtejo Meseta Meridional (GNMM), the first in Portugal under the auspices of UNESCO, established a sustainable development strategy, with lines of action geared towards qualification and heritage of its population, based on the consolidation of activities related to Nature Tourism, through the design of innovative tourism certified products, leading to increased efficiency and competitiveness of public and private institutions.

The relevance of an installation and development of a matrix of internal networks, based on the lines of strengths identified in the territory and introducing the concept adopted by the European Geoparks Network has high chances of success, and is a crucial and unique opportunity to its implementation.

The coordinated integration of local staff, according to the "vision" designed here, is involving the technical training and its reversion to the follow-up sessions (diagnosis, construction, information and entertainment network, induction of ranks, construction and project support, continuous assessment process).

The strategy behind the development of the Geopark Naturtejo is to*:*
1 - Stimulate and coordinate the various stakeholders - both public and private - who act or are related direct and/or indirectly with the Environmental/Geological, Historical and Cultural heritage by committing them to contribute and be pro-active in the development and implementation, in the formation and consolidation of the proposed network;

2 - Enhance the capacity of the territory, respecting the principles of classification of assets already assimilated and promoted by Naturtejo, allowing the perspective of the diversification of tourism products, with a particular focus on the skills of traditional products, through innovation in the supply markets and the production and acquisition of knowledge. Ensuring the contribution of these to increase the attractiveness and competitiveness of the territory and act effectively in the promotion and distribution, applying the same philosophy of the network mentioned.

GNMM has a certain number of geological sites of particular importance in terms of their scientific quality, rarity, aesthetic appeal and educational value. GNMM has also a strong historical, cultural and human component connected with nature, promoting the integrated development of tourism. GNMM is a stronger partnership of municipalities and local players for developing innovative synergies in local economy and sustainable development.

Geopark Naturtejo has an active role in the economic development of the territory through enhancement of a general image linked to the geological heritage and the development of Geotourism, Nature Tourism and Ecotourism.

GNMM is having a direct impact on the territory by influencing its inhabitants to recover the values of the Geopark heritage and actively participate in the territory's cultural revitalization as a whole.

Naturtejo worked from an early stage with local companies who can provide not only investment but also skills, such as foreign languages and specialised knowledge. Naturtejo establishes linkages between the community and the national and international tourism market.

The Strategic Plan for the Establishment of Geopark and even the Tourist Development Plan and the Marketing Plan, were followed and monitored by the Forum that assessed and analysed the various lines of action and projects, giving suggestions and involving the people of the territory in order to them feel totally involved in the actions undertaken.

It should be noted, that in addition to the active participants in Naturtejo, who finally have the opportunity to influence the strategy for the integration of all their views within the Forum, Naturtejo promotes sessions and dissemination of information with minimum monthly intervals throughout the territory.

Nature and Sustainable Tourism is a niche market that is showing significant growth rates, both domestically and in other markets issuers. Increasing the capacity of accommodation and training of operators in the domestic market, including the growth and consolidation that has occurred within the local companies, confirm this trend.

The strategy of developing a Nature Tourism product relies primarily on the existence of a particular environmental context in which the natural characteristics are preserved and are likely to be tourist resources and cultural elements that are interesting and representative of a certain region. Accordingly, the "original offer" supported by those local resources, should be promoted and consolidated.

The concept of Nature Tourism assumes that the project should contribute for sustainable development of the location or region where it installs. In this vein, the planning and development of tourism must necessarily integrate the compatibility of the following 4 levels of interest: 1. The population receiving (hosts); 2. tourists (guests); 3. tour operators; 4. natural environment.

The philosophy of Nature Tourism relies on recovery, use and improvement of natural and cultural systems, but also on building and launching of innovative and creative activities compatible with the sustainable use of components of biological and cultural diversity.

Naturtejo Strategic Development Project is based on the definition of a particular context of environmental, natural and cultural conditions with characteristics of strong traditional components, taking into account the actions proposed by Centre of Portugal Tourism Agency and the priorities selected by the Tourism National Strategy Programme.

It is intended that Naturtejo must be a consolidated and innovative touristic destination, under the Strategic Tourism Plan and representing an additional "apport" of quality in tourism development through the implementation of the following objectives:
• GNMM as a touristic destination, clarifying the emphasis on increasing tourist demand;
• Increasing the range of provision of tourism products based on the main drivers of Naturtejo and that are in its Strategic Development Plan;
• Consolidating the role of GNMM on the EGN and GNN, including with Spanish Geoparks, with whom Naturtejo set up an Iberian network;
• Improving products and services related with nature and cultural tourism;
• Restoring and enhancing the natural, historical and cultural heritage;

• Promoting tourism and cultural programming, bearing in mind the regional and national planning for this area;
• Increasing the level of use of equipment and services and cultural tour to both the resident population and the tourists, developing networks

Local leaders became the “movers and shakers: and the “spark plugs” providing the driving force for programs, festival and special events. They provide leadership and in terms of strengthening relationships, get others actively involved and coordinate activities of different agencies and organizations.

Reliance on volunteers is critical to an event’s or program success. The success of many projects has rested upon the demonstration capacity of local leaders and officials to coordinate efforts among local residents and both local and outside agencies. As volunteers working with volunteers, such leaders unselfishly work on key committees throughout the year, up-front or behind-the-scenes.

The result of this process of overall involvement and strengthening relationships can be understood as a global ownership of a festival, a special event or program by whole the community.

GEOPARKS OF THE WORLD: MARKETING THROUGH A NEW BOOK SERIES OF SPRINGER

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1. Introduction

The Geopark initiative is booming! Spectacular geomorphological landscapes and regions with special geological features or mining sites, notably promoted through "Geoparks", have proven to be excellent tools to educate the public about "Earth Sciences". Moreover, Geoparks involved in the networks of EGN and GGN can also be shown to be areas for recreation and significant sustainable economic development through geotourism. More and more national and international stakeholders are engaged in projects related to "Geoconservation", "Geoparks" and "Geotourism" and have thus positively influenced the general perception of modern Earth sciences, remarkably.

The "International Year of Planet Earth" (IYPE) also served as a strong platform for the launch of several international initiatives, and often provided the "label" for many countries to create new 'Geoparks' as a generic Earth Sciences vehicle for global geology.

In order to develop further the understanding of Earth Sciences in general and to elucidate the importance of Earth Sciences for Society it is envisioned to launch a **new** geo-scientific book series **"Geoparks of the World: Development and Management"** under the professional supervision of "Springer Publishing Company", (Springer Verlag, Heidelberg, Germany). The new book series is considered to be complementary to the new Springer-Journal "Geoheritage".

2. Aims & Scope

The series aims to provide a place for in-depth presentations of existing and potential Geoparks and the developmental and management issues that surround them. The series should complement rather than detract from the Geoheritage Journal, providing a level of detail which is not suited to journal articles.

While it is foreseen that the majority of the books will deal with individual Geoparks or regions, the series may also include general books on Geopark development/management and also the proceedings from scientific meetings focussing on Geopark/tourism/ conservation issues.

- The target groups are natural and environmental scientists, planners and politicians.
- The main language of the series will be English. However, in each case licenses to translate and publish each volume by local publishers will be provided. Where appropriate bi-lingual volumes can also be produced.
- For each book, organisations involved in the books preparation will have the opportunity to buy bulk orders of the books at 40% of the list price for orders of 50 copies or more. However, this is not mandatory.
- The inclusion of more than 20% colour images/figures will require financial support or can be offset by a larger bulk order.

An Editorial Board shall be established to acquire and review manuscripts for the series.

The first volume of the "Geoparks of the World: Development and Management" book series will be provided by Danxiashan Geopark, China (Author: Peng Hua).

⑥. Man and Nature: cultural landscapes

COMMUNICATING MAN AND NATURE IN THE EUROPEAN GEOPARK BERGSTRASSE-ODENWALD (GERMANY)

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The relationship between man and nature is one of the most vivid and fascinating topics for Geopark territories.
Telling this multifaceted story creates fascination and attracts the people, which is one of our most important objectives. The European Geopark Bergstrasse-Odenwald has developed a wide range of special tools to communicate this relationship (Weber, 2008a).
During the last years, the Geopark also has created a variety of cooperation projects, which combine Earth history, man and nature.

In close cooperation with the Bergstrasse wine growers, the wine and rocks adventure trail, which has been implemented 2 years ago, has been extended by a Mediterranean garden with arboretum, and arts trail with focus on the relationship between man and nature. One art piece inside a vineyard made of wood, steel and sandstone, which is called "Thanks to the grapes", symbolizes a wine grower, working hard for his grapes (Fig. 1). This art piece by itself communicates an intense message, which touches the viewers and gives them an impression about their own position in nature (Weber, 2009).

Figure 1: "Thanks to the grapes", sculpture by Alfred Wolf (Photo: Jutta Weber).

Additionally, a new vineyard has been planted in the area of the wine and rocks trail, which represents a range of old, autochthonous grape varieties from the medieval age. All grapes can tell a fascinating story of wine growing, climate and landscape cultivation in former times. At the same time, the vineyard represents an important genetic resource for future generations, which is strongly connected with the aims of the Agenda 21 process (Fig. 2). Telling the medieval story, connected with the Agenda 21 aims, enjoying the special vineyard atmosphere in combination with local wine is a very attractive approach and a successful event.

Figure 2: The Agenda 21 vineyard (Photo: Jutta Weber).

Another important tool to communicate the vivid relationship between man and nature is the implementation of "Geopoints", which are single locations with a special story. This story is multi-faceted – it contains Earth history and connects it with local history and tradition. This year, an abandoned quarry has been implemented as Geopoint. Integrated in the quarry, there is a sculptor studio and an outdoor museum with some relics of the former quarrying equipment (Fig. 3). Additionally, the Geopark has delivered geological information telling the volcanological

story of the site (Permian porphyric volcanoes from the Variscan Orogeny) and connected it with the local quarrying history and the faunistic aspects of recultivation. The outcome is a "historical adventure quarry", which has the potential to give a holistic view of the interconnected processes between man and nature.

Figure 3: Geopoint "historical adventure quarry" (Photo: Jutta Weber).

This year, the Geopark has integrated a new member into the regional network: the Geopark information center "Bioversum", museum of biological variety. The museum has implemented an interactive and educational exhibition, which tells two stories.
The one is the story of the direct environment – the biodiversity in our territory. The other story tells the influence of trading and international travelling on our flora and fauna. It shows how neophytes could enter new biotopes, displacing local flora.

Both parts of the exhibition are connected with educational tools and games, where kids as well as adults can experience surprising new aspects of their home territory, and learn a lot about global processes. At a market place with a wide range of fruits, vegetables and other goods, the fascinating provenance story of each single product can turn out to a trip around the world - a real global approach. An important part of the exhibition deals with the question of our role as human being in influencing and changing processes in nature.
The exhibition is accompanied by an experimental laboratory for workshops (families and school classes) with modern equipment for exciting investigations (e.g. microscopes).
With this wide range of different opportunities - exhibitions, events, workshops, presentations, meetings – the Bioversum is a location, where people can discover the connection between man and nature in many intellectual, but also emotional ways (Fig 4).

Figure 4: Discover nature in the "Bioversum" – Geopark information centre and museum of biodiversity (Photo: Bioversum).

The time and space cycles of Earth and nature are inspiration for man since ages. The International Forest Art Association as close cooperation partner of the Geopark develops every two years a special Forest Art Trail with artists from all over the world, who realize their art pieces as interconnection between nature and human beings in the forest. The artists live and work in the forest for 3 weeks, which is a concentrated, contemplative as well as exciting experience (Fig.5). This spirit will be transported to the visitor during the directly following 4 weeks symposium and exhibition. The Geopark delivers information and communication, and co-

organizes events (e.g. the International Forest Art Conference, Ritschel & Weber, 2008) and connects Forest Art with partners of the Global Geoparks Network. Forest Art touches the people and allows a deeper understanding of our own place on Earth and our responsibility to care for it (Weber, 2008b).

Figure 5: "Float" – Forest Art sculpture by Megan Lotts (USA) (Photo: Jutta Weber).

For the Geopark Bergstrasse-Odenwald, this special combination of information, emotion and experience is the most important approach to communicate messages. Man and nature – this important relationship is an integral part of the Geopark philosophy and therefore we use each opportunity, to communicate it through our projects, events and presentations.

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EUROPEAN GEOPARK COOPERATION PROJECT: DIALOGUES BETWEEN MAN AND EARTH

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Two Geopark members of European Geopark Network and Global Geopark Network have decided, in the frame of the celebration of the International Year of Planet Earth, to work on a common project and to realize an exhibition to illustrate the dialogue between Man and The Earth. They have integrated in the project another territory from France.

1. Shared Approach: Three Different Exhibitions

Exploring the bonds between The Man and The Earth has been the main goal of three European territories. The same questions gave birth to three different exhibitions: Hateg Country (Romania), Geological Reserve of Haute Provence – (France) and Fédération Châtaigneraie Limousine (France). Each of these lands made use of the same types of artifacts and designed three different exhibitions, each of them with their own approach according to the local culture and the scenographer's design. The objects, each with its own geological tale, depicted a part of our planet as a whole (Fig.1).

Figure 1: Location Map

2. Shared Idea: from the item to the material

Either valuable or ordinary items, most of the objects surrounding us are made from materials of the Earth crust: rocks, minerals, metals. Millions or hundreds of millions of years have passed since the formation of the raw material until the moment when the Man turned it into objects. The relationship between the material and the object has actually been the materialization of the Man-Earth relationship.

3. From The H-earth Custom to The Earth

The notion 'hearth custom' makes us think about something specific and particular. The geology of a location is by definition particular. Its elements have influenced the History, Culture and Local Traditions. The Earth's History has been the same, as such has the Cultural History been, but these histories are the sum of local particular histories.

4. Inter-Cultural Dialogue

Exploring the dialogue Man-Earth, as well as the differences and resemblances between the local and the universal, is not the outcome of a solitary reflection. On the contrary, it requested shared stamina. People, countries, various cultures and people with various knowledge, preoccupations and sensitivities have been involved: researchers, artists, scenographers, teachers and peasants.

5. Three exhibitions in brief...

5.1. Telluriques: «Du terroir à la Terre»

«The analysis on the local specificity of Châtaigneraie Limousine, as well as the scenographer's preferences, led to the idea of displaying the Earth's surface as converging point between the theme and the display. The surface is not seen as a frontier, but as a space where the worlds of animals, of plants and minerals meet. The exhibition intends to catch the viewer's eye gradually, beyond the surface, making him discover the earth's guts.» (Extract of «Regards croisés sur la relation de l'Homme à la Terre» - GAL Châtaigneraie Limousine creation book (Fig.2).

FIGURE 2: Exhibition Telluriques.

5.2. Util Y Terre

The Haute Provence Geological Reserve has suggested a cinematographic approach whose gist points to the relationship object – raw material, connected by the time line, common to the Earth's and Man's history. The School of Belle Arts of Digne les Baines has joined in with a series of sculptures and paintings (Fig.3).

FIGURE 3: Exhibition Util Y Terre

5.3. Memory – Dialogue between The Man and The Earth

The exhibition opened in Hateg has focused on the memory of the places and the dialogue between Man and Earth. It has tried to highlight the shapes and aesthetics of the items, as the geological history has just been sketched in an introduction into the natural and cultural environment of the three regions. The items have been grouped according to the role they played in the traditional economy, from utilitarian to artistic.

The cooperation has been a complete success which will definitely induce other shared projects.

These project events have been promoted by PUZZLE – National Cultural Project of Romania dedicated to the European Year of Inter-Cultural Dialogue and by LEADER + program for the French partners.

LANDSCAPES AND LIVELIHOODS: THE CULTURAL LANDSCAPES OF MARBLE ARCH CAVES GLOBAL GEOPARK

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Marble Arch Caves Global Geopark has changed dramatically in the past few years. Firstly, with an expansion further into County Fermanagh in Northern Ireland (U.K.) and secondly, with an expansion across the international border with the Republic of Ireland into County Cavan. This expansion has not only taken the Geopark from being one of smallest within the European Geoparks Network, to being one of the largest, but it also gained the accolade of being the first international cross-border Geopark in the world!

The most apparent reason for expanding the Geopark on such a mammoth scale is the geodiversity of the region. The increase in size not only means that the geological story of the region is no longer only half told, but it has also added a much greater diversity of sites to the geological repertoire of the Geopark.

Perhaps less well known is the addition of a wealth of cultural heritage sites to the Geopark, ranging from Mesolithic hunting sites right up to farmers crofts abandoned as recently as the 1950's. The entire span of Irish history is represented within the Geopark; Neolithic megalithic tombs, Bronze Age cairns, Iron Age forts, early Christian monastic sites, Plantation Castles, Irish famine roads and 18th & 19th Century farming heritage.

The amount of cultural heritage preserved within the Geopark is certainly not by chance. The landscapes and natural resources found in the region made it an ideal place for many settlements over the millennia. Ranging from the abundant water sources found in the many glacially-carved lake valleys, and the meandering rivers used as trade routes during Early Christian times, to the beds of chert used as tools during the Mesolithic period and the glacial erratics used as raw materials in the construction of megalithic tombs. The underlying geology has been instrumental in the livelihoods that developed.

The cultural heritage of the region is now an integral part of the Geopark landscape, acting as a demonstration of how generations of people have lived in harmony with the world around them. It is therefore imperative that we encourage and promote such heritage, not only increasing the understanding and awareness of such heritage but also using it as an example of best practice from our ancestors!

"THE SHEPHERD'S SKY" NOTES ON THE DEFINITION OF A SHEPHERD COSMOVISION

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The Idanha-a-Nova region has an historical relation between its vast territory and the ancient shepherd activity and, thus, it is assumed as a land of shepherds. Within this context and due to permanent mobility and loneliness, the shepherd developed a millenary culture where the surrounding natural environment knowledge assumed a special relevance in the everyday's life. He learned how to read and locate himself by the natural cycles, by the Sun, Moon and stars "trajectories", and to make "magical" conjugations remitting to an archaic period, a time dominated by animism. This contribution leads towards the archaic shepherd cosmovision in 2009, declared by the United Nations as the International Year of Astronomy.

1. Introduction

The Idanha-a-Nova municipality is located in the far Southeast of the Centre region, belonging to the Castelo Branco district. It is inserted in a remote and heterogeneous region named Baixa Baixa (Beira Interior Sul), described by Orlando Ribeiro as "as a scraps blanket, some already *estremenhos* or *alentejanos*, a juxtaposition of units well delimited in the landscape and the daily life of the inhabitants" (Ribeiro, 1995, p. 431). Historically is a territory related with cattle breeding, which is confirmed by the oldest records as was shown by Orlando Ribeiro: "The Idanha plains breed more sheep than all Estrela Range (96849 sheep, 347 per 100 inhabitants, in the municipality of Idanha-a-Nova"; Ribeiro, 1941, p. 88). Concerning the most recent data on the General Agriculture Census from 1999, in the Idanha-a-Nova was registered 87 954 sheep and 7 679 goats. Thus, it is referenced as an intrinsically shepherd region.

The shepherd activity in the municipality of Idanha-a-Nova is intimately connected to traditional route shepherd and the cultivation of cereals. This strong symbiosis between cereals and cattle breeding is associated to the extensive exploitation of grasses, which defines the shepherd way of life. Thus, it involves movements of sheep flock followed by the shepherds. From this archaic mode of life rhythmicallized by the infinite movement of the sheep flock, sleeping and eating in the deepest loneliness, the shepherd created one of the most ancestral arts, the art of being shepherd.

2. "The Shepherd's sky": shepherd cosmovisions

The secluded and remote life of shepherds, away from the rhythms of the village´s bell and the common clock, made them excellent observers of their natural environment, leading to assimilate a recreate other time based fundamentally on the natural cycles, the Sun "movements" and the Moon stages. In this way, shepherds developed a whole deepened knowledge of the surrounding natural elements learning how to read the involved landscape taking from it, besides resources, know-how, purposes, omens, adages and, sometimes, even prays; they learn to read time using Sun, to orientate by the stars, to make weather forecasts through innumerous relations based on the daily experience with the involving environment and cattle management.

About the millenary shepherd knowledge, magical in a certain way, we may say that above all reveals archaic reminiscences close to "primeval people", as it is described by the anthropologist Eliseo Cuesta:

"The shepherd thought has characteristics found in primitive people (…) defined by intuition and animism. Intuition is clearly observed in certain processes of knowledge, such as climatology, the prediction is made by previously experienced association of perceptions not logically connected. As an example 'sheep bring wind when jump, or bring rain when stay close to the pen wall'. It is a intuitive process connected to other feature of the primitive thought: the animism or, in a egocentric way, the projection of own behavioral trends to the animals and things, thus animated by the same purposes as Man" (Cuesta, 1983).

3. "Guessing weather": weather forecast

"*When the Moon has a ring around after three days will rain, or if the Royal Owl fly Tejo River and starts to "sing" in the hills, after three days will rain, or when sheep wool is cut, if they lay down for a long time, the next day will rain. My father was who teach me this and he was also shepherd*." (Rui Sanches, 26 years old, shepherd, Rosmaninhal).

"My father guided the weather already by the Moon. He said that when the Moon was turned would rain. Here, we have the experience when crows are there looking around and singing, quá, quá, quá and the clock from Soalheiras or Cegonhas sound, the weather changes quickly, or the wind will be stronger or clouds will appear or cold starts or rain will come. I already told many times to my daughter: she is Isabel and in former years the clock of the village of Soalheiras and the crows seemed only to guess water and this year they only guess wind and. But it is for sure!" (Maria Caldeira, 69 years old, shepherd lady, Rosmaninhal).

"*When herons come from the river or bring water or cold. This year they came many times, but only brought cold. When Moon is turned to Tejo River it is sign of water*." (Clementina Magro, 77 years old, shepherd lady, Soalheiras).

"When we get up in the morning and the sky is open from clouds to the South and the clouds appear here on top of the hill, that day it rains; when it is to dark down to South and clear in the hill, it doesn't rain. When the Moon is small and has the two tips pointing up, water does not fall down, but when goes somewhat inclined brings water. When toads "sing" also guess water, the goats also guess water, when it is raining they move more arrumaçadinhas (*closer to each others)*" (Ti Domingos "Menoucho", 79 years old, goat shepherd, Penha Garcia).

"By the shack of the goat bells at night we know that is going to rain in the next day. This happens when they shack themselves a lot during the night. When cattle are moving too close to each other also guess rain. When the Moon is blurred and has a ring, the water is far away; when it is close we only can see a mist in its centre, which is sign of rain." (António Santos "Cacarne", 85 years old, retired shepherd, Idanha-a-Nova).

"*The cattle predict water, when is about to rain they shack the bells more, we note by the sound of the bells. Also say when the Moon is turned upside down we get water. The* piquençaro-bacorero *bird also guesses water when it starts to sing a lot."* (João Pires, 73 years old, shepherd, Idanha-a-Velha).

"*We looked to that set of dark clouds that appears under the hill, if it appears suddenly under the hill, it rains. Some days ago I noticed, the dark set came, I said, today is raining and during the afternoon it rained! The Moon, they say when it is upside down gives water, when it turns right does not give water. The birds also guess water, when we pass in a stream and they are taking bath is because it will rain; the chicken when search a lot for bugs in their bodies and swell also will rain; when swallows fly flat in the middle of the cattle also guess water.*" (João Chambino, 67 years old, retired shepherd, Rosmaninhal).

"It is the Moon that commands all! It is cold due to the Moon, In ten days weather gets warm when the new Moon comes. It always makes a small revolution or much ice will come, much hot or much cold, much wind or much rain." (Joaquim dos Santos, 62 years old, shepherd, Salvaterra do Extremo).

"Guessing water through the Moon, my mother already told: Moon circle from far water from close. When the wind is low we look to the cock from the tower: when it is directed to Idanha will rain, if it is turned to Gata Range is even worse." (Ifisénia Maria, 85 years old, retired, Proença-a-Velha).

"When the Moon goes inclined sends water, when goes straight it rains. When the Royal Owl flies along the hills, it rains or if the Cotovia bird is in the Holm-oaks guesses water." (Ti Marcos, 74 years old, shepherd, Cegonhas).

4. Orienting by the stars

"Once there were no clocks, only by the stars in the sky we were guided. During the sowing we woke up to see how the "seven-star" were going to lead the cattle to food. We saw three stars in a queue, called* cachero*, and regulate by the shepherd's* cachero*."* (Clementina Magro, 77 years old, shepherd lady, Soalheiras).

* Reference to Plêiades. This term is also in the Bible, Book of Jó: 9-9 "[…] who made the bear, Orion, the **seven-star** and the rechambers of Sun."; 38-31 "Or could you tie the chains of the **seven-star**, or release the ties of Orion." José Leite Vasconcelos describes the term: "The people call **seven-star** or seven-stars [star is masculine] to Pleiades. To this constellation the following songs are dedicated: The seven-stars fo high/Miss, go to bed: That I'll do the same/That I have to wake up early; The seven-star fell down/On a rock, was limping: The lily was missing/soon dressed purple; The seven-star goes high/Even higher goes the Moon/ Higher goes happiness/Which God has to give me; Stars from the sky come to Earth/I want to choose mine: From four I want the biggest/From three the smallest." (Vasconcelos, 1986, p.63).

"*To know the Moon we need to sleep outside, many people know nothing because never slept out of doors. As soon as we could see the morning star we know what time was it.*" (José Lourenço, 90 years old, former transhumant shepherd, Manteigas).

"When at night I followed the stars, we called the seven-star, when they were about to appear, we said it is that time and never failed. To wake up in the morning, I looked first to the seven-star to know what time was it. During the day, I was oriented by the shadow of the Holm-oaks. I did like this: when I found someone with clock I would ask what time is it and then I looked to the shadows of the Holm-oaks and made there a mark. As soon as I passed by this place by the signalled hour I looked to the mark to know exactly the hour. Even today, already with clock, I use to do the same. It may be broken and thus I know! I mark the place, if by any chance the shadow is before the mark it is because is sooner, if passes is because it is later. I know the exact hour in the mark." (João Chambino, 67 years old, retired shepherd, Rosmaninhal).

5. Other influences from Moon

"All moons have four quarters, two from new Moon and two from the old Moon. I learned this with my father in the field, it was their rule. The elders knew better than us, now everyone knows to read, if they don't read they are incapable of see anything. Os antigos traziam aquilo mais que a gente, agora tudo sabe ler, se não lerem não A man that does not how to read, how does he know this? I know this by heart and don't know how to read. All the quarters have seven days, each seven days the Moon turns, now is only to count the quarters, every month have four

quarters, every quarter changes, one because is new Moon, other because is decreasing Moon and other because is full Moon. This was used for us to make the cattle. I was to cut the balls of lamb and couldn't be in the new Moon, it would have to be in the old Moon. The old Moon always get shorter, if you cut yourself in the arm, if it is new Moon, the infection is bigger than during the old Moon, everyday shorter. But in the new Moon is always growing to reach the full Moon. Doctors must know also those things! To give a male to a female is the same, the decreasing quarter in everything. If we go to sow some greens, if it is during the increasing quarter soon it will ear, the decreasing quarter is stronger. If a man goes to a women in a decreasing quarter it will be female, if in a decreasing quarter will be male, it never fails!" (Joaquim Folgado "Carrapato", 71 years old, retired shepherd, Rosmaninhal).

"Moon has many influence on the animals,when is full Moon they reproduce, become further on or late, if by any chance if they reproduce in the increasing quarter, they become later on, if it is during the decreasing quarter, they get late." (João Chambino, 67 years old, retired shepherd, Rosmaninhal)

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THE NORTH PENNINES – 500 MILLION YEARS IN PICTURES, POEMS AND PERFORMANCE

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Geological evolution of the North Pennines – from 500 million years ago to today – is used as a way of showing some of the interpretive and educational projects done in the North Pennines AONB and European Geopark.

The story of the North Pennines – like any other landscape – is a long and fascinating one. From the ancient ocean of Iapetus 500 million years ago, to the landscape and communities we know today, there is much to tell and many different ways of doing it. Many of the rocks formed in Carboniferous tropical seas and rainforests. With their teeming life and vivid colours they make superb subjects for paintings and models. The layers in the landscape are reflected in a sculpture which is built as a traditional dry stone wall. The rich mineral veins that thread through the landscape and lives of North Pennine people are animated in a film made by a local school, to show how they formed from hot water and a buried granite. The movement of vast ice sheets is re-enacted by children with white sheets, and the intrusion of the Whin Sill is illustrated with modelling clay and toothpaste. Children whose ancestors once worked deep underground act out the lives of lead mining families from the past.

Still images in a powerpoint presentation cannot do justice to all of these but, using the area's geological past, it will be given a flavour of some of the ways in which we interpret and illustrate our landscape and tell its stories. I hope this may give you some ideas – and I would love to hear about projects that have worked well in your areas.

SHETLAND'S CULTURAL LANDSCAPE

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Shetland is a group of islands lying 140km north of the Scottish mainland, at latitude of 60° North. Its rocks are extremely diverse for such a small area, but are predominantly hard and acidic, giving rise to poor, infertile soils on which extensive areas of blanket bog have developed as a result of the hyper-oceanic climate. The response of human populations to these environmental constraints over the past six millennia has given the islands a distinctive culture and landscapes.

Climate and poor soils limit agricultural potential, and this, together with isolation from potential markets meant that largely subsistence agriculture continued until well into the 20th century. Agricultural units are traditionally small "crofts", consisting of one or more strips of better quality land and share of the common grazings on moorland. This creates a landscape of small settlements on cultivable land that is divided into strips or "rigs" and separated from the surrounding moorland by a "hill dyke". Many hill dykes date back over a thousand years. More recent stone walls are associated with the clearance of small tenants from parts of Shetland to make way for large sheep farms as improved communications with Scotland in the 19th century led to the development of exports of meat and wool.

Shetland once had extensive areas of scrubby woodland, however this has all but gone due to a combination of early clearance of better soils for agriculture, climatic decline leading to the spread of blanket bog, and grazing by livestock preventing regeneration. In a treeless landscape, stone has long been the main building material and peat the only local source of fuel.

The absence of agricultural intensification until recently has allowed the survival in the landscape of features of earlier occupation and agricultural practices. These include many Neolithic homesteads and boundary walls, some of which have been overwhelmed by the spread of peat and are now being uncovered by peat working.

The island of Unst has the highest density of Norse building remains to be found anywhere, principally because of the use of stone, rather than wood, which was the normal material used in Scandinavia.

Shetland is well known globally as a tourist venue and was judged the 3rd best island destination in the world by National Geographic magazine in 2007. Visitors are drawn by the wildlife, particularly the birds, archaeology and historical connections and the unique landscape. Until recently the islands' geology was largely overlooked as an attraction, however over the past three years the establishment of Geopark Shetland by Shetland Amenity Trust with broad community support has changed this. The geology of Shetland is now being recognised as fundamental to the understanding of the islands' natural and cultural heritage and is being used as the unifying factor in interpreting those themes.

The story of Shetland is written in its landscapes.

GEOPARKS AND GEO-STORIES: IDEAS OF NATURE UNDERLYING THE UNESCO ARARIPE BASIN PROJECT AND CONTEMPORARY "FOLK" NARRATIVES

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Detailed scientific descriptions of fossils, sediments, and tectonic movements that shape geological formations with complicated Latinate names. Stories of enchanted orchards that appear and disappear, of stones on which holy figures write at will, of petrified creatures left over from the time of Noah's Ark that will one day resume their rudely interrupted lives. Both sets of narratives describe the area contained within the UNESCO Araripe Basin Geopark, which in 2006 became the first of these geological preserves to be established in the Americas. Located in the Cariri, a part of the Northeast Brazilian backlands best known for its economic backwardness and religious mysticism, this fossil-rich tableland occupies an area of approximately 3000 square miles.

At first glance, the two groups of stories appear so divergent in terms of both language and conception that they would seem to be describing not a single rocky landscape but completely separate planets. And yet, despite real and often dramatic differences, these narrative clusters—one primarily composed of academic-sounding documents including charts, maps, and photos; the other comprising generally oral, "traditional" stories—reveal similarities far beyond those that first meet the eye. It is argued here that both sets of narratives treat the natural world as ancient, fluid, composed of interrelated elements, mysterious, and deeply worthy of protection. Both recognize the special character of a portion of Northeast Brazil called the Cariri after the native residents whom early Portuguese colonists encountered. Long known to specialists as a paleontological treasure trove, this oasis set amidst the sun-baked backlands or *sertão*, is also regularly described as "um grande celeiro da cultura popular" or "a great storehouse of popular culture."

The two groups of stories share conceptions of nature that are of more than academic interest. They have policy implications of deep importance in strategizing a sustainable tourism that will preserve the region's geological and cultural heritage while bringing economic benefits to the local population—the primary goal of all UNESCO Geoparks. A successful policy must include not just well-to-do outsiders with environmental interests (the so-called eco-tourists who comprise the target audience for the overwhelming majority of Geoparks), but also a multitude of much poorer religious visitors.

These pilgrims or *romeiros* pour into the Cariri each year to honor a Roman Catholic priest named Padre Cícero Romão Batista (1844-1934) who has long functioned as an unofficial saint. It is they who constitute the bedrock of the "local" population to which the UNESCO program guidelines repeatedly refer. It is also they who have been excluded over the centuries from political power and from a long line of development projects mounted in their name. The following pages suggest that seemingly unrelated accounts of nature can be "translated" or made mutually intelligible through a highlighting of their underlying similarities. In addition, they

insist that the chances for the success of the Araripe Geopark will hinge on alliances made possible through such translations.

Here, it is not simply underscoring the well-documented benefits of including local stakeholders in environmental projects. Rather it is asserted the ways in which the systematic recognition of underlying similarities in different types of literary texts can highlight potential areas of cooperation. In the Cariri, as in many other places, cultural aspects are all too likely to serve as decorative add-ons to "the real business" of economic advancement and scientific preservation. However, the active participation of local populations—made possible through an awareness of those shared features highlighted in the two sets of stories—offers hope that the Araripe Geopark will succeed and thereby become a model for future Geoparks in the Americas.

WIND AND WATER IN THE CONSTRUCTION OF A CULTURAL LANDSCAPE

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1. Introduction

Wind and water have, throughout time, contributed to the unique nature of the natural and cultural landscapes of Cabo de Gata region. The nature of the cultural landscape is one of the most significant features of the Geopark and the influence of various cultures and how they exploited the natural resources is clearly evident.

In order to understand the climate features that conditioned how people occupied Cabo de Gata´s area we have to explain the Geopark's geological origin. It is also of great importance to explain the particular climatology features of this Geopark and also explain them in a geological key. The most relevant climate features are: Mediterranean sub-desert climate; ten months per year considered arid; average temperatures between 15ºC and 22ºC; no frost and no thermal winter; average rainfall of 140 l/m^2; less than 30 rain days per year; relative humidity above 70%; around 3000 hours of sunshine per year.

Geological key for Cabo de Gata´s climate is the Betic Range, the volcanic range and the Foehn effect. A **Foehn wind** or **Föhn wind** is a type of dry down slope wind which occurs in the lee side of a mountain range (Fig. 1). It is a rain shadow wind which results from the subsequent adiabatic warming of air which has dropped most of its moisture on windward. As a consequence of the different adiabatic lapse rates of moist and dry air, the air on the leeward slopes becomes warmer than equivalent elevations on the windward slopes. Föhn winds can raise temperatures as much as 30°C in just a matter of hours.

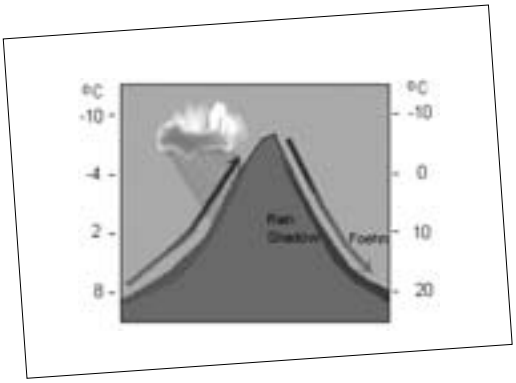

Figure 1: Model for the Foehn wind.

So, we have two geological explanations for understanding the climate and occupation in this area: the Betic range and Cabo de Gata´s volcanic range, and both are related to the very same tectonic process. The clash and subduction of the African plate under the Eurasian plate.

This isolated region, one of the few European semi-desert areas, has an extreme climate characterized by powerful winds, few continuously flowing streams and a lack of fertile soils. Consequently, settlers in this region constructed a system of water wheels, wells and windmills to extract water and cisterns to store it. In 2001, 145 widely dispersed sites of extraction (windmills) and storage of water (cisterns) were registered in the General Catalogue of the Historical Heritage of Andalusia.

The necessity for a conservation program concerned with the restoration of the traditional architecture of Cabo de Gata has resulted from the collaboration between Culture and Environmental's Ministries.

Cisterns (Aljibes) are one of the most abundant architectural features in Cabo de Gata's landscape and were built to store rainwater derived from rare torrential downpours and floods. They were constructed within small natural basins and stream beds from stonework, unrelated to rock from the local areas, and consist of vaults of differing shapes with whitewashed inner and outer walls. The insides of the vaults were painted with red iron oxides to prevent leakage. These structures, the majority of which are still in use, are well preserved owing to the simplicity of their construction and to the continued maintenance by the owners.

Water wheels were used to extract groundwater and were sited close to the courses of ephemeral streams. They are known as blood wheels as they were turned by animals. Generally a wheel consisted of two large hardwood wheels constructed above a wheel with a stone surround. One wheel, the water wheel, turned in a vertical plane and raised the water from the well in clay bowls secured to the wheel. The water was poured into a drainpipe and carried to a nearby pool where it was stored. The water wheel was turned by another wheel which revolved in a horizontal plane and was driven by mules or donkeys. The platform, used by the animals, is nowadays the only remaining evidence for the existence of a water wheel.

The windmills, classified as Mediterranean Windmills with Sails (Fig. 2), are located in the windiest positions on the tops of hills or on plains. The windmills have not been used since the middle of the 20th century. Only two mills contain some of the original machinery structure. Recently a restoration project is being carried out and the reason stems both from their significance in the history of the development of the landscape and because they comprise the mayor group of windmills in Andalusia.

FIGURE 2: The last windmills.

LOMBARDIA CASTLE, NEW "HOUSE" OF ROCCA DI CERERE EUROPEAN GEOPARK

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The holistic approach underlying the programming policy of the European Rocca di Cerere Geopark has in June of 2009 a new goal.
The scientific staff of the Geopark, not interested exclusively to the knowledge of the geology but the whole body of the assets of the territory, has developed a system of interpretation of the great teaching of Lombardia Castle, in Enna (Fig.1). Built at the Acropolis of the ancient city of Henna, the Castle is the largest part of the Themenos of Ceres, the peak sacred to the ancient Goddess, eponymous site of the park.
Today the fortress is one of the largest in Europe, with over 3 hectares of walled area, and finally can be visited with a complex series of scientific panels that illustrate history, structures, characteristics, myths, archaeological researches and results.
Just inside the castle was then open the new home of the Geopark, housed in a barracks of the Spanish seventeenth century.
The headquarters was inaugurated on 29 June 2009 with a public event appreciated by the inhabitants of Enna.
All panels are in two languages, Italian and English.
This is the first step of a new deal that Geopark become for knowledge and interpretation of Cultural heritage in the area.

Figure 1: Particular of Lombardia Castle in Enna

BRONZES AND CERAMICS FOR VALORIZATION OF GEOPARKS GEOLOGICAL TRACKS

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Geological tracks founded in Madonie Geopark have the logistic function to permit enjoyment in territory, using geology like an added value.
Five are already the founded tracks, whose two urban ones maybe unique in the European Geoparks Network.
Main reflection of operating who has constructed tracks about better utilization of posters and notice boards to permit to Geopark visitors the independency from an official guide in covering one or many tracks in absolute autonomy.
A different story has been undertaken in the urban geological tracks (Sclafani Bagni and Petralia Sottana), with the regular realization of a geological run in their historical centre. These two urban centers in Madonie Park, through geology, are included in Madonie Geopark.
The problem of Haliotis Association, the promoters of the tracks, was to make a poster in traditional ways and include them into historical centers submitted to landscapist bound, or to be inspired by alternative methodologies, the starting point of an old plan, the so-called Vie dell'Arte (the Art Road), where many modern artists were involved in works of art to landscape valorization and where art became access key in landscape reading.
Two Madonie artists were interested to make special signs, which should enable the identification of the urban track, but at the same time they should became attractive elements themselves.
Fruitful connected work between geologists and artists (a bronze's sculptor and a ceramist) resulted in ideas such as: concrete in ceramics tables for Slafani Bagni and bronze studies for Petralia Sottana.
The final product became a beautiful story of geology, art, anthropological learning and valorization of historical centers by eco-friendly and eco-compatible plans.

7. New Geoparks and their tutors

AZORES GEOPARK: VALUING ITS GEOSITES

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1. Introduction: General Setting

The Azores archipelago, located in the North Atlantic, at the triple junction of Eurasian, North American and African tectonic plates, is composed by nine islands, some islets and the surrounding seafloor (e.g. the Azores Plateau). The islands compose three groups: the Western group with Corvo and Flores islands, the Central Group with Faial, Pico, São Jorge, Graciosa and Terceira islands and the Eastern Group with the islands of São Miguel and Santa Maria (Fig. 1).

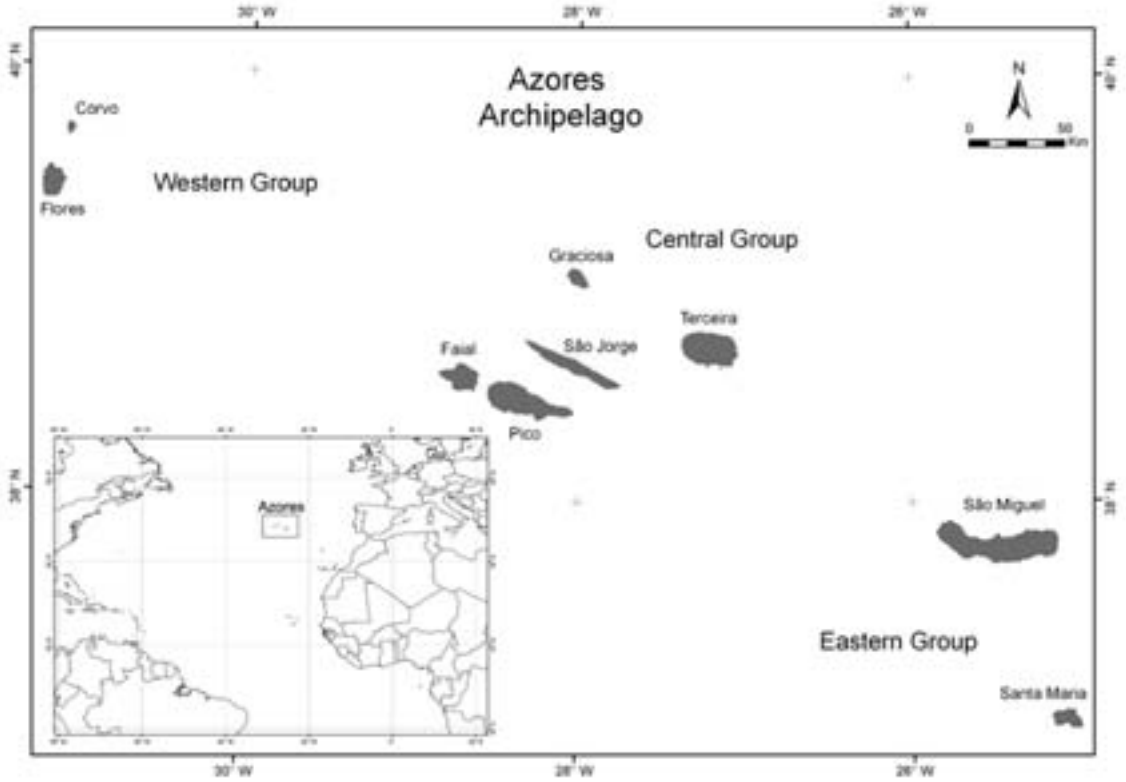


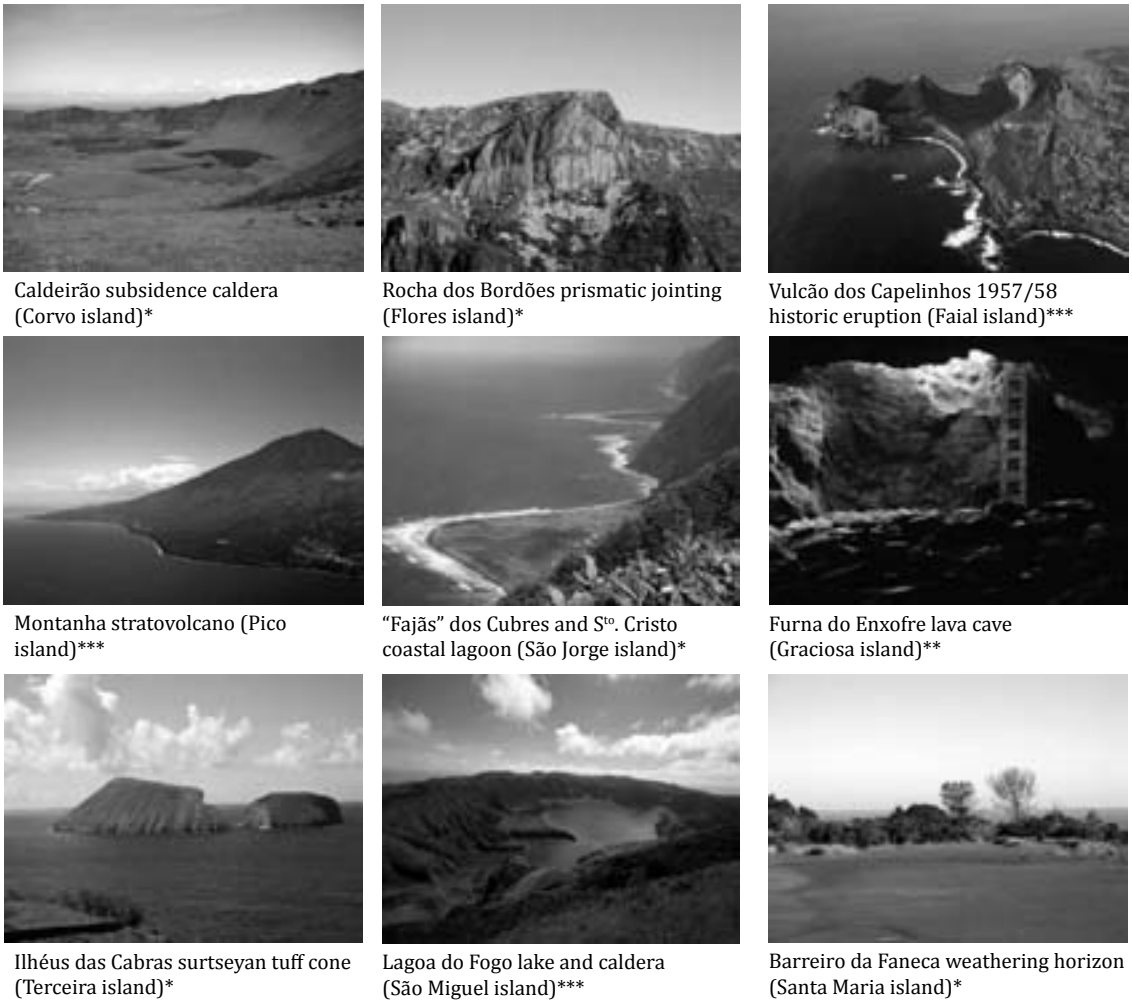
Figure 1: Geographic setting of the Azores archipelago.

The islands have a wide range of landscapes, forms and structures derived namely from the types of eruption, its dynamics and the subsequent action of weathering. This geomorphological factor together with the insular dispersion, isolation and the Atlantic climate, create distinctive ecological conditions (Nunes, 2002; Lima, 2007).

2. The Azores Geopark

The Azores geodiversity is characterized by elements closely linked to the dynamics of Planet Earth, and in particular to the volcanism and geotectonics of this region. Its landscapes include

different types of volcanoes and rocks, hydrothermal fields, volcanic ridges, volcanic lakes, black sand beaches and volcanic caves, among others (Fig. 2).
The imposing volcanic landscapes of the Azores archipelago and the value of their geosites, justify the establishment of a Geopark in this autonomous region, being a strategic goal of the Azores Regional Government.
Given the archipelagic nature of the region, the "Azores Geopark" will stand on a network of areas spread over the nine islands and the surrounding sea, representative of the geodiversity that characterizes the Azorean territory and its geological history. So its geosites will be valued and integrated in a supranational context of geoconservation (e.g. the European and Global Geoparks Networks – EGN and GGN) (Costa *et al*., 2008).



Caldeirão subsidence caldera (Corvo island)*
Rocha dos Bordões prismatic jointing (Flores island)*
Vulcão dos Capelinhos 1957/58 historic eruption (Faial island)***
Montanha stratovolcano (Pico island)***
"Fajãs" dos Cubres and S^{to}. Cristo coastal lagoon (São Jorge island)*
Furna do Enxofre lava cave (Graciosa island)**
Ilhéus das Cabras surtseyan tuff cone (Terceira island)*
Lagoa do Fogo lake and caldera (São Miguel island)***
Barreiro da Faneca weathering horizon (Santa Maria island)*

Figure 2: Some volcanic landscapes of the Azorean islands. Photos by: * Eva Lima; ** João Carlos Nunes; *** Centro Interpretativo dos Capelinhos.

Thus, the following general approach is being applied on the establishment of the "Azores Geopark":

1. Inventory and selection of geosites to be included in the "Azores Geopark";
2. Definition of the management structure (association, company, foundation, etc.);
3. Elaboration of the geopark management plan;
4. Establishment of the "Azores Geopark" and beginning of its activities;
5. Preparation and submission (expectable in 2010) of the "Azores Geopark" application to the EGN and GGN.

For now the motto is "9 ilhas – 1 geoparque" (9 islands – 1 geopark), based on a regional network of geosites with common strategies of preservation and promotion, a set of 2 to 5 geosites "anchors" on each island, and a management structure with support in all islands.

3. Protection of Natural Heritage and Geoconservation

The conservation and management of the natural heritage are important issues in environmental and land planning policies. The integration of the geological heritage and its conservation strategies in these policies promote its valorisation (Lima, 2007).

The Azores geological heritage was, until recently, poorly known because of the traditional concept of nature conservation focused mainly on biodiversity issues, and the lack of implementation of strategies for geoconservation.

Accordingly to Brilha (2005), an adequate strategy for geoconservation is supported on a methodology based on several stages including: geosites inventory; quantify their value or relevance and their categorization; its classification (e.g. protected areas); its conservation (e.g. vulnerability assessment); enhancement and dissemination of the geological heritage; and monitoring of the geosites.

4. Methodology and tasks performed for the selection and valuing of geosites to be part of the "Azores Geopark"

The inventory and selection of geosites should call for objective criteria, accepted by consensus. It is also important to ensure the involvement of a significant number of geologists and other Natural Sciences experts in the proposal of areas to join the regional network of geosites of the "Azores Geopark", valuing the intrinsic knowledge of these sites by the experts.

Thus, the "Azores Geopark" working group involved in these tasks is composed by geologists from the Azores University (e.g. a volcanologist and a geological heritage, land and environmental planning geologist) and the Regional Secretariat of Environment and Sea (e.g. the Department of Nature Conservation and the Interpretative Centre of Capelinhos Volcano).

The starting point of the work done by this group was the inventory carried out by Lima (2007) for the Azores Environmental Protected Areas, in which 59 geosites were identified. This list is being extended and updated to the whole archipelago, based on the knowledge of the insular territory by the working group and the compilation of information gathered from different sources (namely academic work, geo-environmental maps and itineraries). Today, that provisional list includes about 105 sites of geological interest dispersed by the nine islands and surrounding seafloor (Fig. 3).

The main criteria that guided this pre-selection includes: i) knowledge and scientific value of the site, ii) its representation across the archipelago, iii) its overall integrity and iv) its privileged or essential position for observation key features and elements of the regional geology and volcanology, taking into account its aesthetic, pedagogic and economic (tourist) values.

Work in progress includes the call for collaboration to other researchers and experts, in fields such as environmental, coastal and applied geology, neotectonics and hydrogeology and deeply familiar with the Azorean territory. All the received contributions, both as new sites or as improvements to the provisional list of sites, will be adequately analyzed and included, if suitable, on the regional network of sites, among which are the selected geosites to integrate the "Azores Geopark".

After this exhaustive inventory, each area/site will be characterized in detail based on objective and universally accepted criteria, as done by Lima (2007) for the Azorean protected areas and following the methodology of quantification by Brilha (2005). Thus, it will be possible to determine the quantitative value or relevance (Q) for each geosite and their raking.

The geosites that show international relevance or those who, for a given category (e.g. historical eruptions, volcanic caves, calderas, surtseyan cones, etc.), have the highest value will be selected to be part of the "Azores Geopark".

Being this an open and participative methodology it is foreseen that in a later stage the publish geosites list might be subject to adjustments, namely through new proposals (by persons or institutions) of sites of geological interest to be included in the "Azores Geopark". All eventual proposal and new sites/locations will be subject to an evaluation of its value or relevance (Q), using the methodology above mentioned.

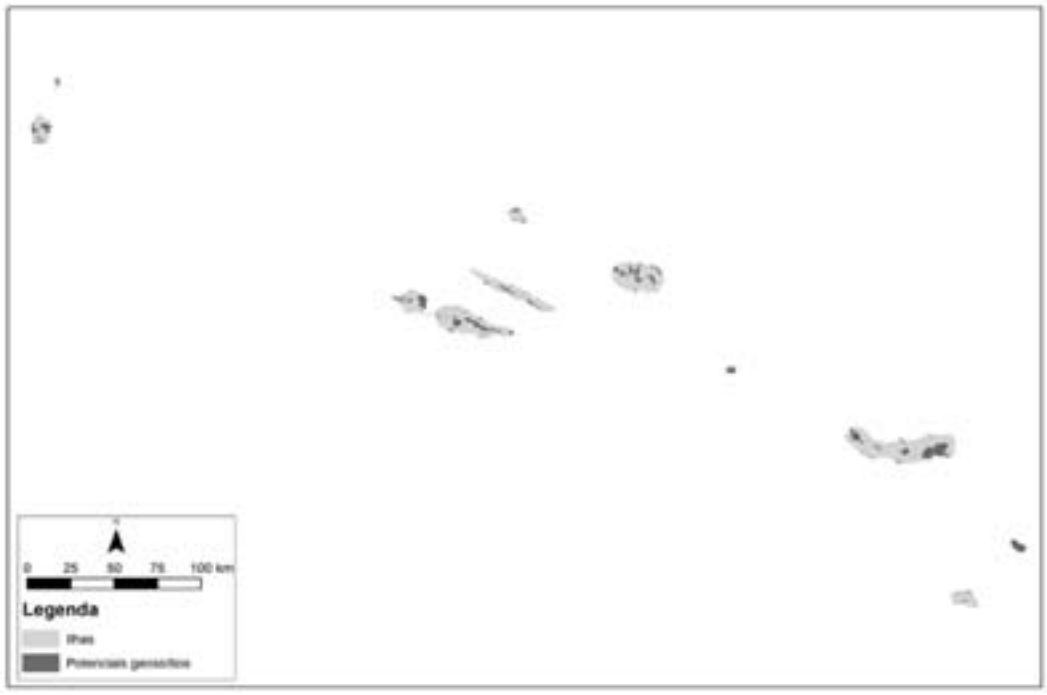


FIGURE 3: Location map of potential geosites to incorporate the Azores Geopark.

4. Conclusions

The "Azores Geopark" should assert itself as an area that combines the protection and promotion of their geological heritage with the sustainable development of the territory and its population. The selected geosites will be part of an integrated concept of geoconservation, education and sustainable territorial development.

The inventory, ranking and selection of geosites should call for objective criteria, accepted by consensus. Therefore, the working group involved on those and other tasks regarding the submission of the "Azores Geopark" application to the European and the Global Geoparks Network is following a well known and constrained methodology, that ensures a wide open and participative process and, thus, a less subjective value judgment.

The next steps will be the development of a proper model for the geosites management and its implementation and monitoring. Thematic mapping, as done for the Santa Maria geosites (Nunes *et al*., 2009) and a database of the "Azores Geopark" geosites will also be developed.

5. Acknowledgements

The present paper is a contribution to the Project "Azores Geopark", of the Azores University (LAGE- Laboratório de Geodiversidade dos Açores/Departamento de Geociências), financed by the Azores Government (Secretaria Regional do Ambiente e do Mar).

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QUADRILÁTERO FERRÍFERO, BRAZIL: GENERAL INFORMATION ABOUT A POTENTIAL GEOPARK

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1. Introduction

Brazil discovered in 1500 was a Portuguese colony until 1822. During that period of years various natural resources were extracted: initially brasilwood, then sugar cane and, in the 1700's, gold, diamonds and other precious stones. Mining activities were relatively limited during the 19th century, but in the early 1900's iron ore began to be increasingly mined, along with other mineral resources. Since its beginnings, a good portion of Brazil's mineral production came from an area now called the Iron Quadrangle (Quadrilátero Ferrífero, QF), which Barbosa & Rodrigues (1967) define as a block of Precambrian structures, elevated in its four sides by differential erosion. Located in the central-southeastern part of the State of Minas Gerais, this area of about 7000km^2 is surrounded by crests with altitudes of 1300-1600m, belonging to four mountain ranges.

Rich in mineral wealth, scenic landscapes, and geological and human history, the QF is the subject matter of a project for the creation of a Geopark, operated by a Forum supported by various institutions: the State Government; the State Research Supporting Foundation (FAPEMIG-Project APQ-6671-5.02/07: Patrimônio Geológico e Geoconservação no Quadrilátero Ferrífero: uma proposta para implantação de sítios pilotos); Polo Mineral-SECTES (mineral technology); universities (PUC/MG, UFOP, UFMG); CPRM-Brazilian Geological Service; IEF/SEMAD (environmental agency); IEPHA (cultural heritage); and SETUR (tourism).

2. Overview of Regional Geology

Rock formations in QF date from the Archean to the Paleoproterozoic, covering a bracket from 3.3Ga to 1.7Ga, and are representative of various, diversified geological processes and events, some of them meaningful in the global geological evolution. Briefly, its geodiversity includes 3 extensive complexes of rocks:

1) Metamorphic complexes of Archean crystalline rocks: gneisses, and sudsidiarily granites, granodiorites, amphibolites and ultramafics;

2) Archean greenstone belt-type rocks: Rio das Velhas Supergroup, with phyllites, schists, metagraywackes, mafics/ultramafics, metadolomites, quartzites; the rocks in this supergroup hold the principal gold deposits;

3) Paleo- and Mesoproterozoic metasedimentary sequences: Minas Supergroup, Sabará Group, Itacolomi Group and Espinhaço Supergroup, including phyllites, quartzites, metaconglomerates, dolomites, and metagraywackes. These rocks carry extensive bodies of banded-iron formation (BIF), with alternating millimetric-to-centimetric layers of hematite and silicates, usually quartz or reddish chert (less commonly, dolomitic itabirites occur too). This world-known itabirite (named after the peak originally called Itabira), is the main ore in this area and, along with the quartzites, is responsible for the mountain ranges that surround and characterize the QF. Some of these sequences are cut by Paleoproterozoic basic and metabasic intrusives.

Younger geological units or features do occur, including Tertiary basins, "canga" (local name for a surficial or subsurficial reddish-brown unstratified rock made up of well-cemented

chunks of itabirite, very tough and erosion-resistant, which covers extensive areas and is responsible for many topographical features), and Quaternary alluvial deposits. An interesting aspect is that, by consensus, these units (except, in some cases, the *canga*) are not represented in geological maps and stratigraphic columns.

3.History

This region was initially occupied by the Portuguese in the mid-1600's, who came prospecting for mineral resources, pressed by the economical and financial crisis that affected Portugal caused, among other factors, by the decreasing activity of the sugar industry. Gold found in 1694 triggered a century-long period of extensive mining and the founding of small villages, including Mariana, Ouro Preto, Sabará (present names).

Table 1: Quadrilátero Ferrífero heritage

Geosites of geoecological interest	22 Meta-volcanics	**Archeological sites**
1 Itacolomi quartzites	23 Gandarela Basin	42 Rancharia stone bridges
2 Silvery phyllite	24 Viana waterfall	43 Morro da Queimada
3 Rio das Velhas Supergroup / Minas Supergroup contact	25 Sansa waterfall	44 Morro de Santo Antônio
4 Bação Complex	26 Itabirito peak	45 Morro de Santana
5 Stromatolites	27 Serra de Ouro Branco (mountain range)	46 Bicame de Pedra (stone acqueduct)
6 Engenho fault	SITES ASSOCIATE TO MINING HISTORY active mine inactive mine	47 Gongo Soco ruins
7 Frazão peak	28 Capão do Lana mine	48 "illegal mint"
8 View of the Mariana anticline	29 Chico Rei mine	49 Barão de Eschwege's iron smelting plant
9 Cartuxa peak	30 Old mine	LOCALITIES
10 Sanctuary of Serra do Caraça	31 Fonte do Meu Bem Querer mine	50 São Bartolomeu
11 Carbonatic rocks	32 Passagem mine	51 Glaura
12 Ultramafic rocks	33 Germano's mine	ROADS
13 Santo Antônio waterfall	34 Córrego do Meio mine	52 Royal Road (Caminho Real) in Sabará
14 Serra da Piedade itabirites	35 Cuiabá mine	SITES OF RELIGIOUS-CULTURAL INTEREST
15 Metavolcanoclastic felsic rocks	36 Morro Velho mine	53 Nossa Senhora da Lapa grotto
16 Sabará Group	37 Águas Claras mine	54 Pedra Pintada archaelogical site
17 Belo Horizonte Complex	38 Cata Branca mine	PALEONTOLOGICAL SITES
18 Ibirité schists	MUSEUMS	55 Fonseca's Paleontological Sites
19 Canga, Serra do Rola Moça	39 UFOP's Museum of Science and Technology	Sources: Alkmin (1987), Barbosa (1967), CPRM, Dorr (1969), Ladeira (1988), Noce (2005), Renger (1994), Rosière (2005), Ruchkys (2007), Schobbenhaus (2002), SIGEP (Map and compilation by Rose Lane Guimarães)
20 Quartzites and basal conglomerates	40 Gold Museum	
21 Meta-sandstones	41 Mineralogy Museum Prof. Djalma Guimarães	

Throughout the 1800's, Portugal virtually sustained itself from these riches. Besides the official shipments of gold, smuggling activities were strong, making it difficult to compile trustworthy statistics. Carrara (2009, p. 21), estimates that about 800 metric tons arrived in Portugal. Gomes (2009) raises that number to 3 thousand tons. The region had so many mines that it came to be known as "Minas Gerais", "general mines". Gold was also used to practically line the walls of many local churches, which were the hub of the luxurious life in the new villages. Beautiful homes were built, as well as impressive buildings that, besides housing administrative offices, also had the purpose of outwardly affirming the presence of the Portuguese Crown's power and control. Arts flourished, from music and poetry to painting, sculpture and stonemasonry, making the 18th century a landmark in Brazilian cultural history. The Historic Town of Ouro Preto and the Sanctuary of Bom Jesus do Congonhas (Baroque church and sculptures) are UNESCO's World Heritage Sites.

Barbosa & Rodrigues (1967) describe 4 phases of gold mining in QF, the first 3 in the colonial period, the last one in the imperial period (1822-1889). During the 1st phase, extraction was done directly from the river bed. As the gold dwindled, prospectors started going uphill, reaching terraces 30/40m above the river, which is characterized as the 2nd phase. In some places a 3rd phase occurred in terraces at 60/80m. The gold content eventually decreased, and as the technical resources were primitive, the bonanza ended in the 1790's. Industrial scale mining, the 4th phase, was started by British companies in the early 1800's (see below, Sites Related to Mining). Brazilian gold, directed to Britain on account of Portugal's debts to that country, was an important factor in leveraging the Industrial Revolution, thus contributing towards worldwide development.
According to Rosière *et al* (2005), iron mining in small scale in QF started during the gold cycle. Although very little information has been found so far, Landgraf *et al* (1994) refer that the knowledge of metallurgy brought by African slaves was a meaningful contribution. The development of iron mining and related activities came with the founding, in 1875, of the Escola de Minas (School of Mines) in Ouro Preto, whose graduates acted both regionally and throughout the country. An important side effect of the establishment of this Escola de Minas was the production of extensive technical literature published both locally and abroad. Today Minas Gerais is one of the wealthiest states in the country, and a world leader in iron ore production.
During the 1900's, iron, gold, and precious stones were the main stakes of the mining industry, central to in Minas Gerais' economy. More recently, tourism activities related in various ways to that industry have grown significantly, and this is one of the factors that will contribute to the creation of the proposed Geopark.

4. The Royal Road (Estrada Real) and Gold Trail (Caminho do Ouro) through QF
Initially Paraty, and later on Rio de Janeiro, were the ports which connected that part of Brazil to Portugal. Of course, there was a need to transport the gold (and, later, the diamonds discovered further North) safely to the coast. The extensive set of roads/trails developed for that purpose came to be called The Royal Road (Estrada Real), with some local names: Gold Trail (Caminho do Ouro), New Road (Estrada Nova), Diamond Trail (Caminho dos Diamantes). In the 18th century, the Estrada Real became the main communication artery in Brazil, and many other roads were built connecting important areas to it. In its heyday it collected diamonds from as far away as Bahia's hinterland, which was much closer to the coast - but those diamonds had to travel through Minas Gerais to be accounted for and submitted to the heavy taxes levied by the Portuguese Crown.
A well-established tourist route, highly prized by Brazilian and foreign tourists, the Estrada Real crosses the very heart of QF, in a N-S direction, for about 180 km (including branch-outs), and is integrated to the QF Geopark project as a very important asset.

There are a series of unique geological features of QF that can be classified as geosites. As examples, these are some that contain elements that help in understanding the geoecological history of the Earth:
– Basement: Gneisses of the tonalite-trondhjemite-granodiorite (TTG) suites, along with greenstone belt-type sequences, are characteristic components of Archean cratons. The first continental crusts and protocratonic nuclei that started to take shape 4Ga ago were made up of this kind of gneisses. Various representative outcrops of such rocks can be found in the QF; for example, a good exposure exists in an inactive quarry in Brumadinho, near the Instituto Inhotim (an institution dedicated to environmental and heritage education).
– Rio das Velhas Supergroup: a greenstone belt-type sequence, characterized by vulcano-sedimentary cycles, including komatiites, which are considered as characteristically Archean, and an important source of information about the geodynamic and physico-chemical conditions of magma generation for that eon. Good outcrops can be seen near Crucilândia, in

the Morro do Onça. An interesting site, in the Serra do Andaime, presents meta-sandstones which indicate a coastal environment, with ripple-marks and cross-stratification.
– Minas Supergroup: good outcrops of metasedimentary occur in the Serra da Moeda, a well-known scenic area. The Cauê Formation is characterized by the presence of the above-mentioned itabirite BIF's. Besides helping in the understanding of the atmosphere, oceans and phenomena that led to the evolution of life in the Precambrian, the itabirites have an important economic role, as the main ore mined in the QF. Meaningful outcrops occur in many places, being noteworthy the Serra da Piedade (Piety Hill), a natural monument with strong religious and tourist appeal. In some areas, the presence of carbonate rocks indicates a paleoenvironment in which the dissolution of atmospheric gases in the bodies of water led to the formation of carbonic acid, which eventually, after evaporation, caused the precipitation of carbonates. In some places these carbonates include stromatolites, fossil structures produced by the activity of ancient cyanobacteria.
– Itacolomi Group: essentially made up of quartzites, which form the crests of important hills which are referential landmarks in the QF, particularly the Serra de Ouro Preto and Serra de Ouro Branco. These two ranges are protected by law, classified as "conservation units" ("unidades de conservação").
– Rola Moça Mountain Range: meaningful *canga* outcrops. The *canga*, a sort of ferruginous laterite, originates from weathering of the itabirite, a process which in tropical areas can lead, mostly by dissolution of the silica by rainwater, to a concentration of up to 95% of limonite, a complex mixture of hydrated iron oxides.
The QF is also a producer of various gems of high economic, social and cultural importance, associated to pegmatitic intrusions and/or hydrothermal processes. Some are very rare, like the imperial topaz (not yet found anywhere else on Earth) and the alexandrite (a variety of chrysoberyl); other gems include beryl (emerald, aquamarine, heliodor, morganite), euclase, quartz, etc. Visits to inactive gold mines and gem-producing sites are a well established tourist activity, and many geosites can be established in these environments.

5. Sites Related to Mining
With QF's long mining history, many of the tourism and cultural sites are related to this activity, such as:
• Ruins of the "illegal mint" in the city of Moeda ("Coin", literally!!): in the early 1700's, as an attempt to dodge the 20% tax on gold, which was levied when raw gold was taken to the official mints to be turned into coins, some people started turning gold into coins, thus establishing a sort of "illegal mint". This site, one of the few where it has been proven that such a "mint" operated, is extremely important for the history of mining and for economic history as well, constituting a unique testimonial to the "alternative" routes of our Colonial economy.
• Fábrica Patriótica, in Congonhas: opened in 1812, classified as a historical heritage site as the first industrial iron smelting facility in Brazil.
• Passagem Mine: a good example of the use of old mines for geotourism. Visitors learn about the mine's history, see some pieces of mining equipment, and can even try some panning for gold, in a tank with water, gravel, sand, and some gold powder. They also go down the inclined tunnel in a cable trolley, visit some large man-made caves and see a beautiful underground lake. The site also offers the possibility of underground diving into the galleries and tunnels which are flooded as a result of being below the water table level.
• Cata Branca Mine: close to Itabirito Peak, this gold mine was opened in the early 1800's, and at its peak productivity had a workforce of 450 slaves. After its shaft collapsed in 1844, it was re-opened and closed a number of times; presently inactive, it still exhibits many features of its previous history, such as shafts, tunnels, galleries, plus equipment, documents, etc., with great educational and geotourist potential.

• Morro Velho Mine: with its origins in 1725, and since the early 1800's one of the fundamental examples of the British presence in Minas Gerais, this mine has experienced the evolution of gold mining technology more than any other in the QF; it was the world's deepest mine (over 2700m), and the most productive in Brazil, for many years. In the history of gold mining, it is a world-renowned landmark.

6. Interface between Geoconservation, Geotourism and the Mining Community

Considered the heart of the QF, Itabira is one of the world's largest iron ore mines. It's a unique man-made landscape, carved for decades out of large mountains, without any concern for (geo)conservation - which is a recent social concept and concern -, and it has an important socio-economic and cultural meaning.

In this context, it is important to discuss the relative importance of the mining industry and that of the efforts to protect the environment and the scenic beauty of the landscape. In the opinion of the Authors, given the economic realities of the region, simply to establish a dichotomy between "mining vs. no-mining" is not the best option; what should be discussed, instead, is the possibility of applying the concept of sustainability. This is a new social concept, which may be used here to try to bring an urgently needed solution to a hitherto undervalued, but now strongly felt, contradiction in modern society. A possible alternative would be to create a certain "range" of landscape classification, containing several values representing different options within a continuum. Opponents may classify it as unfeasible, others may see it as unnatural or even immoral, but modern society has to create new ways of handling new - or apparently new - challenges. There are already some drafts of projects attempting to create new options, including this "scale of landscape importance".

7. Historical, Architectural, and Cultural Attractions, and Conservation Units

A general overview of other attractions in the QF area can be helpful for the general picture.

Historical tourism has been a common practice in QF for a long time: old towns with colonial-time houses and churches, art to be seen in museums but also in the open air, traditional cuisine, local handicraft, frequent religious events, 18th century Brazilian music played in 18th-century organs, and an overall feeling of tranquility form a perfect tourist cluster.

Stonemasonry, a technique brought by the Portuguese, flourished during the rich times. The variety of available rocks allowed their use for all kinds of purposes: from structural support of the buildings, to decoration of church entrances, to religious sculptures, and clear down to household items, like pots and pans. This traditional craft was almost extinct, but now some projects are under way, to recover, register, preserve and transmit it as an Intangible Cultural Heritage.

Conservation units of various kinds, some reaching various municipalities, include: Itacolomi State Park (Ouro Preto, Mariana); Serra do Rola Moça State Park (Belo Horizonte, Brumadinho, Ibirité, Nova Lima); Tripuí Ecological Station (Ouro Preto); Mangabeiras Park (Belo Horizonte); Fechos Ecological Station (Nova Lima); Environmental Protection Area (APA) Seminário Menor de Mariana (Mariana); APA Cachoeira das Andorinhas (Ouro Preto); APA Sul (Belo Horizonte, Brumadinho, Caeté, Ibirité, Itabirito, Nova Lima, Rio Acima, Santa Bárbara, Raposos, Mário Campos, Sarzedo).

8. Final remarks

QF is a region with many attractions, suitable, and already used, for many types of tourism, to which the concepts and activities of geotourism may be applied to perfection. By making good use of its rich geodiversity, and caring for its geoconservation, a world-class Geopark can be created there, providing visitors with natural scenery of exceptional beauty and a variety of natural, historical, and cultural contents, fully capable of enriching humanity's heritage, while at the same time promoting the region's sustainable development.

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ROKUA – HERITAGE OF THE ICE AGE

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Finnish heritage of the ice age, Rokua is a unique combination of geology, nature and culture on the Northern hemisphere not far away from the Arctic Circle. The characteristic features of the area are the landforms shaped by the ice age: glacial ridges, pine and lichen-clad heaths, kettle holes and small ponds filled with crystal clear water. In addition to the incomparable environment, the area tells the story of a prehistoric settlement of the human being and of the ever since flourishing culture.

For the European Geoparks Network Rokua offers a new northern dimension and an interesting geology of the island that the glacial sea once abandoned. Area's special arctic character, long winter and Finnish traditions make it interesting for diverse visitors to experience. During the winter months, in the middle of a snowy landscape and frozen lakes, you are able to get a touch of a way of life and scenery of the ice age.

The proposed Rokua Geopark covers an area of 1326 km^2. The area includes three scenic areas, Rokua esker and dune formation, the Oulujoki river valley and Lake Oulujärvi. These areas have a common geological, natural and human history starting from the last ice age, about 10000 years ago.

Rokua area hosted an advisory visit by the European Geoparks Network on October 2008. The visit was made by Mr Richard Watson from the Marble Arch Geopark. The results of the visit were positive, in his report Mr Watson stated that: "In many respects the Rokua region could almost be regarded as de facto Geopark" The report also noted some points that needed strengthening, for example producing more geological interpretation, expanding the existing education program, preparing a Geopark management structure and marketing and business plans.

After the visit several actions have been taken in order to improve the preconditions of a Geopark area. A new business plan has been made for Humanpolis Rokua, a restoration work of the old fire watchers tower and routes has started, including the making of several new geological and cultural information panels. Marketing has been strengthened by planning a Geopark logo and theme. Geopark project website has been opened at address: www.rokuageopark.fi. New information has also been gained of the esker formation and the surrounding areas by starting a mapping project with the Geological survey of Finland and by starting a geological research project with the University of Oulu.

Rokua's application is going to be submitted on November 2009 by a partnership of Humanpolis Rokua and Metsähallitus. Humanpolis Rokua is a developing organisation financed by the municipalities and companies of the Rokua area. Metsähallitus is an organisation governing the state owned forests and national parks. Besides Metsähallitus and Humanpolis also the Geological Survey of Finland is actively involved in the preparation of the application and the actual Geopark site. The National UNESCO committee has also given its approval to the Geopark project.

ROKUA ESKER – A GEOLOGICAL PUZZLE

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Finland has excellent possibilities for geoparks in different geological main themes such as bedrock, quaternary deposits or peat landscape. Rokua esker ridge and the surrounding area is a very good candidate for quaternary based geopark.
The esker landscape of Rokua is a combination of landforms produced by geological processes which are linked to one another in a puzzle-like manner. From the pieces a complete, unique natural feature has been formed, which records in its details, the stages of development from the compression of the glacier ice-sheet until the present day.
Rokua is part of a chain of esker ridges deposited during the last period of glacial melting 12,000 to 10,000 years ago. The chain stretches all the way from the island of Hailuoto near Oulu to Ilomantsi in eastern Finland. To the North-West of Rokua, the ridge runs through an area where the bedrock consists of young sandstone and claystone. The glaciers and melt waters loosened homogenous material from the easily crumbling and weathered surface of the bedrock, which the glaciers carried away towards the South-East. This explains the preponderance of sand in the Rokua ridge formation.
The esker core, which consists of gravel, and overlying delta sand form together the first piece of the Rokua landscape puzzle. The esker core and delta sand were formed in glacial tunnels from rock and sand material transported by flowing melt waters 11000–10400 years ago.
A formation developed from the melting of ice from the coarse esker core and the overlying delta sand flowed onto the bottom of the ancient Ancylus lake. The pieces of ice buried by the sand mass began to melt. Due to the melting of the sand formations the level surface subsided forming multishaped kettle holes and hummocky terrain. It forms the second piece of the Rokua landscape puzzle.
Land uplift was rapid. In a few centuries the summit of the hill rose to form a bank in the open sea of the Ancylus lake. During the following 1000 years, from the exposure of the summit, wave-action worked systematically through the sandy ridges of Rokua forming them into a series of beach ridges. They form the third piece of the landscape puzzle.

The waves followed the wind. It transported material of even quality from sandy beaches lacking in vegetation that had been freed from the water, heaping it into dunes elongated parallel to the shoreline and curved parabolic dunes. Finally, the vegetation bound to the sand and from the dunes was fossilised. The dunes form the fourth piece of the puzzle.

Peat lands form the last piece of the Rokua landscape puzzle. Peat began to form in the damp depressions of the lower ridges immediately these were raised above the water surface.
The original esker plain, kettles and esker mounds, shore features, wind deposits and bogs form together the landscape puzzle of Rokua, and at the same time the framework of the landscape.
Rokua esker area is surrounded by basal and superficial till areas with typical moraine features like drumlins, end moraines and hummocky moraines. These, together with the parts of Rokua puzzle, make the suggested geopark area even more interesting.

OPERATION OF THE TRANSBOUNDARY NOVOHRAD-NOGRAD GEOPARK INITIATIVE

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1. Brief summary of the Geopark

The territory of the transborder Novohrad – Nógrád Geopark initiative is a part of the Pannonian basin in Central Europe. The area spans from the southern edge of the Western Carpathians to the North Hungarian Mountains (Fig.1). It is landlocked and dominated by hills, divided by valleys and basins. The area's varied history is reflected in a unique landscape comprising rolling hills, volcanic plateaus and lowlands overshadowed by volcanic peaks.

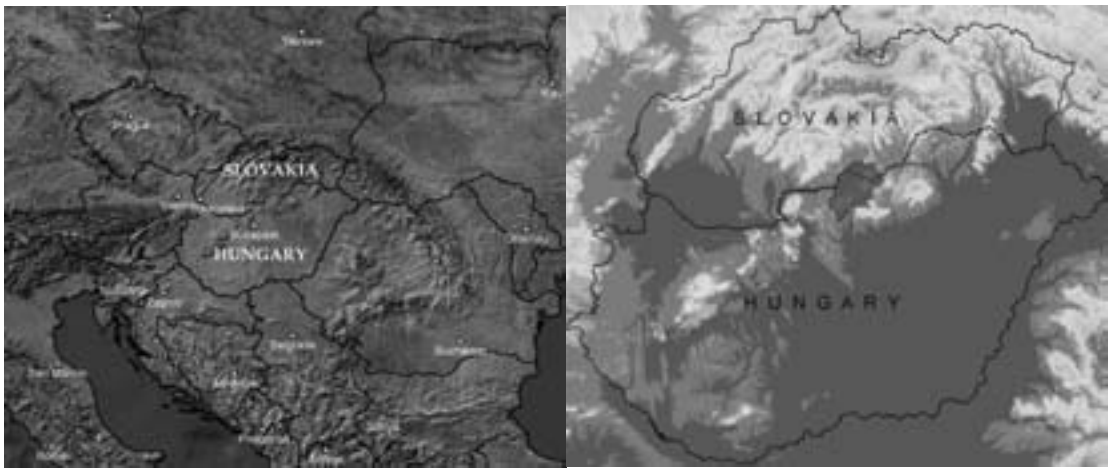

Figure 1: Maps of the locality.

Small villages typify the Geopark's settlement structure and in most of the dwellings, the population is below 1000. Due to high unemployment rates the number of population is stagnant. Approximately 150000 people live within the whole area of the Geopark.

It comprises the administrative area of 63 settlements in Hungary (including urban county Salgótarján) and 28 settlements in Slovakia. The Southern part of the Geopark can be reached by car in an hour from the Hungarian capital Budapest. Lučenec is the biggest Slovak city close to the Geopark.

Figure 2: Map of the NNG_mikroregions.

The total administrative area of the Geopark is 1587 km^2 (1251 km^2 in Hungary and 336 km^2 in Slovakia). Novohrad-Nógrád Geopark comprises every settlement of two micro-regions in Hungary (Salgótarján and Szécsény) plus some settlements from the micro-regions of Balassagyarmat, Bátonyterenye, and Pásztó. In Slovakia the proposed Geopark incorporates the southern parts of the districts Rimavská Sobota, Lučenec and Veľký Krtíš, the settlements of Velických jazerách, Obručná, Pod Bučeňom and Medveš micro-regions (Fig.2).

Being a transnational Geopark, the name comes from the Slovak and Hungarian names of the County, where the proposed Geopark is located. The emblem of the Geopark depicts the Somoska/Somoskő Castle. At the very foot of the castle marked the border line between Slovakia and Hungary after the First World War, separating communities from each other and artificially the landscape for 85 years. The castle stands on a basalt outcrop which represents beautifully the human interaction with the geological past (Fig.3).

FIGURE 3: NNG logo

The region is famous for its archaeological finds, important type localities preserve traces of Bronze-Age cultures on both sides of the border. Slovak and Hungarian citizens, partly as minorities live on both sides of the border and gypsy population stands high in some villages.
The counties' unemployment rate is one of the highest in both countries, economic depression reached records in 2009. The Palóc are an ethnic group inhabiting the area and they maintain multicoloured traditions despite long-term changes in life-style. The area is an important centre for Palóc folk art. Hollókő with its unique Palóc architecture and environment is on UNESCO's World Cultural Heritage List, but other settlements also maintain their own special folklore which is recognized world-wide.

The geological heritage of the Novohrad - Nógrád Geopark has a special significance. The area's stratigraphy represents deposition over the last 30 million years commencing with the initial opening of the Pannonian basin. The geology of the region is the product of a series dynamic of Earth processes. These processes include the collision of accreted terrains resulted in highly complex volcanism spanning 20 million years, the destruction and reactivation of marine basins, burial and the conservation of palaeohabitats.
The outstanding geological heritage of the region is a treasure to both the inhabitants and visitors It's value was recognised even by earth scientists who started to reveal its secrets three centuries ago, when the geological research first began in the area .

The huge variety of volcanic processes preserved in the rock record of the area is outstanding. These include pumice flows, rhyolitic ignimbrites, dacite and andesite stratovolcanoes formed both in submarine and terrestrial environment under the sea and on land, dyke swarms and laccoliths, a basalt plateau which is noted amongst the largest uninterrupted examples in Europe, deeply eroded vents of andesite and basalt volcanoes, maar diatremes and not only columnar basalt but also rare examples of slow cooled columnar andesite.

The rich fossil assets of the Geopark span the last 30 million years of the Carpathian basin. Most of the non volcanic geosites represent fossil resources in abundance as well. Beside in situ fossil localities, important collections exist in museums and depositories found within the Geopark. For example, at Rákóczibánya, a building complex stores - beside eventual fossils - the North Hungarian deep drilling core samples of the last 40 years.
The most famous fossil site of the Geopark is the Ipolytarnóc Fossils (http://ipolytarnoc.kvvm.hu), which is a world-recognised "Prehistoric Pompeii" due to a volcanic catastrophe, which destroyed and at the same time conserved a terrestrial paleohabitat (Fig.4).

FIGURE 4: Picture of ITT logo.

The 510-hectare large area is managed by the Bükk National Park Directorate. The site received national protection in 1944, and in 1995 it officially became a part of the Pan-European Natural Heritage, when it was awarded the European Diploma by the Council of Europe. Its inner core -- under the name of The Palaeohabitat of Tarnóc -- is on the Tentative List of the World Heritage sites.

The Bone Ravine – SE of the Hajnáčka village - is the most important fossil locality on the Slovakian side. Animals got trapped in a Pliocene maar-lake and their skeletons got fossilised. Predominantly mastodons, rhinoceroses and tapirs, but rare finds of the panda bear, remnants of monkey, hyena bones were also excavated. First mentioned in 1861, the locality was reiteratively investigated by renowned palaeontologists. It is a type locality for NM 16 zone of the European Neogene Biostratigraphic Scale.

2. The management of the Novohrad-Nógrád Geopark

The Geopark is managed by a cross-border partnership between two national organisations registered in each of the partner countrie (Fig.5). Each of the organizations acts on their own national territory and can apply for financing in their country. In addition, each organisation represents the Geopark with respect to their own national representatives, institutions and organisations.

During the first two years of its operation, until 2011, the Geopark's activities will concentrate around the headquarters, slowly extending its functionality to the whole territory of the Geopark.

FIGURE 5: Picture of the NNG structure

3. Description of the Novohrad-Nógrád Geopark organization (crossborder)

This cross-border partnership represents the Novohrad – Nógrád Geopark at the international level. It ensures continued development of the Geopark, co-ordination and implementation of all international relations and activities, including other international projects. Each side delegates 4 members for the term of 4 years to the Committee, which is presided over by a president and will employ a voting system requiring a two third majority. There are experts working for the Committee, who may represent the Geopark during local and international consultations.

4. Description of the Nógrád Geopark organization (Hungarian side)
The **Nógrád Geopark Nonprofit kft** was founded by the micro-regions, representing the 63 municipalities on the Hungarian side and by private investors to lead the administrative work of the Geopark. Its headquarters is in Salgótarján. The director of the organization is delegated to the Committee of the transborder geopark with one of the founders.
The **Nógrád Geopark Association** represents NGOs, universities, the Bükk National Park Directorate, tourism organizations, experts and different stakeholders who are willing to co-operate on Geopark issues. The Association delegates two members to the Committee.
The Association maintains close ties with the Slovakian partner and leads widespread consultation among governmental and private entities.

5. Description of the Novohrad Geopark organization (Slovakian side)
The **Novohrad Tourist Information Centre** is the main Geopark office and the visitor centre at the same time. It is located in Fiľakovo and run by the municipality.
The office delegates one member to the Committee of the trans-boundary Geopark due to the fact, that it represents the 28 municipalities of the Slovakian side.
The **Geopark Novohrad-Nógrád Association** is an autonomous corporate body, independent of the political and state institutions. It delegates 3 members to the international Geopark's committee. Its mission and aims are co-operation among all of the partners with the aim of sustainable development of the whole territory in the field of tourism (geotourism) together with the preservation of natural and cultural values.

6. Activity of the Geopark organizations
The geopark project started in 2005 and the database of the area was accomplished on both sides by the end of 2007. The headquarters of the Slovakian part was established in Filakovo in early 2008. In January 2009 the Novohrad-Nógrád Geopark applied for the EGN membership.
Even before the official formation of the joint organization, the partners took an active role in promoting the geopark idea by introducing the Novohrad-Nógrád Geopark to the widest audience during the PlanetEarth events, later held geopark days and organized competitions for schools.
Since the creation of the Geopark its organizations have brought the different stakeholders together on several occasions for workshops and have given presentations to the public. The Novohrad-Nógrád Geopark will have and exhibition and stand during the GEOEXPO event held in the Hungarian Natural History Museum, Budapest between 1st-4th October.

This grassroots movement, inspired by enthusiastic locals, has been building on the rich geological, natural and cultural heritage of the area.
By linking these attractions in an effective network, harmonious living can be achieved. The Novohrad – Nógrád Geopark initiative (http://nogradgeopark.eu/) wants to build on this recognition, to reunite people and landscape again.

ISLAND OF SAAREMAA (ESTONIA) – A PROSPECTIVE GEOPARK

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The island of Saaremaa (Ösel in German and Swedish) is one of the largest Baltic Sea islands, covering an area of 2,673 km^2. It belongs to the West Estonian Archipelago. The capital of Saaremaa is Kuressaare with about 15,000 inhabitants, while the whole island has about 40,000 inhabitants. Saaremaa has a wide variety of rare wildlife species and geosites. The island is made up by Silurian limestones and dolostones. More than 10,000 years ago the first land areas of Saaremaa emerged from the Baltic Ice Lake. The land uplift here is continuing even today, some 2 mm per year.

The nature of Saaremaa is rich and diverse. It offers the most delightful geological sights in the Baltic Sea islands. The island's rugged coastline is characterized by either sandy, gravelly, morainic or rocky shores, whereas coastal cliffs may rise up to 21 m in height. This series of Silurian carbonate rock cliffs, rich in fossils, extend from Saaremaa to Gotland island in Sweden as a well-developed undersea escarpment. Typical landscape elements in Saaremaa are alvars – limestone plateaus covered with thin soil and specific plant assemblages. Here can be seen a wide variety of both ice-shaped landforms as well as ancient coastal landscapes designated by boulder accumulations, scarps and bluffs, spits and raised beach ridges. Especially impressive coastal features were generated during the transgressions of the Ancylus Lake and Litorina Sea. The most unique geological monuments on the island are Kaali meteorite craters, formed by nine meteorite impacts. The main crater measures 110 meters in diameter with an inner small lake (Lake Kaali). The meteorite impact that caused the craters is estimated to have occurred about 7500 years ago. There are also numerous folk legends related to the craters.

Figure 1: Ninase seashore cliff, NW Saaremaa

Saaremaa has a rich flora – here are represented 80% of the plant species found in Estonia. Altogether 1200 species of vascular plants are known in Saaremaa, whereas about 120 species are rare ones which are under protection. The island lies on the main east-Atlantic

bird migration route to Arctic breeding grounds. There are also a great number of cultural heritage sites and architectural monuments, including medieval churches and the Kuressaare Castle on Saaremaa. All those natural and cultural heritage sites make the Saaremaa island a prospective place for a new geopark.

FIGURE 2: Kaali meteorite crater, Saaremaa

GEOPARK INITIATIVES IN VENEZUELA

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Geoparks are well defined areas with particular geological features and a strong management structure that supports the communitarian organization with two specific goals: geoconservation and geotourism development. Geoparks are not only for geologists but an Earthpark, where the geoscientific knowledge about the area may be used to attract local people, schools and tourists in a persuasive symbiosis between education and leisure.

Venezuela has countless areas of geological interest which are apt for the development of Geoparks, due to the possibility of creating investment which will secure itself financially for generations. The objective will include geologists who promote the necessity of securing a future for the geological beauty of Venezuela. The methodology developed by the Fundación Geoparques de Venezuela in each one of the current projects will be explained.

The methodology consists of three stages:
1. Geological context: inventorying of geological interest sites and a the design of a geotourist map (Fig. 1);

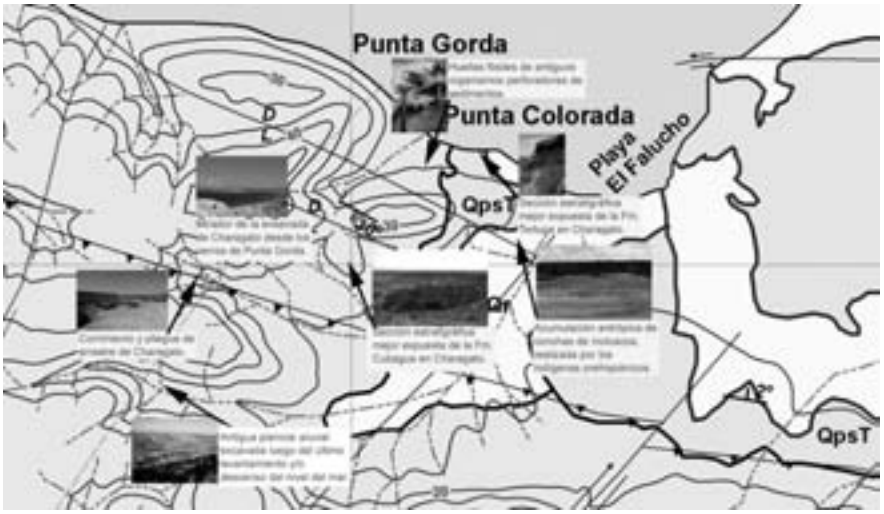

Figure 1: Fragment of the Cubagua Island's geotourist map (Kum & López, 2007).

2. Social context: to determine the main necessities of the communities of the area, with the help of social psychologists, sociologists and anthropologists. Also diagnosis of socio-environmental problems has been made with the support of the Universidad Bolivariana de Venezuela;

3. Management: formation of the geotourism guides, creation of the geological interpretation trails, support to the local communities to develop cooperatives related to the services needed by the tourism market and promotion of the geopark.

Three years of research in this field of study has indicated a series of conclusions; all of which led to the urgent need of creating foundations that will protect the future of sustainable development of the geological treasures in our country. Education is the essential tool in establishing an open discussion between the interested parties who in turn have the power to initiate such a project.

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SUGGESTED GEOPARKS IN TURKEY: VOLCANIC MOUNTAINS

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1. Introduction

Geoparks were defined as a geographical area where geological and geomorphological heritage sites are part of a holistic concept involving conservation of all natural and cultural heritages, where socio-economic development, education, sustainable tourism and sites of ecological, archaeological, historical and/or cultural value are included.

At first, geopark concept was explained during the First International Geology Heritage's Protect Symposium in France in 1991. It was from this background that the idea of Geoparks developed in 1996. At the 30th International Geological Congress in Beijing, discussions between Nickolas Zouros (Greece) and Guy Martini (France) on ways to simultaneously protect and promote European geological heritage and sustainable local economic development led to the creation of the new geopark concept in which the needs of the communities living in areas of rich geological heritage would be addressed (Martini & Zouros, 2001 referred by McKeever & Zouros, 2005). By June 2000 representatives of four European territories, which had separately been promoting geological conservation and sustainable development, came together in Greece to discuss their common socio-economic problems (stagnant economic development, high unemployment, rural depopulation and ageing of the remaining population) and how to address these problems through the protection of geological heritage and the promotion of geological tourism. The result was the signing of a convention declaring the creation of the European Geoparks Network. The purpose of this new designation was to provide a network within which to share information and expertise, and to define common tools in addressing the above objectives (Zouros & Martini, 2003 in McKeever & Zouros, 2005). In November 2000, the four members of the new network, Réserve Géologique de Haute-Provence (France), Lesvos Petrified Forest (Greece), Maestrazgo Cultural Park (Spain), and Vulkaneifel (Germany) invited interested regions and organisations from across Europe to join them in learning more about geoparks and to apply for membership of the new network. From its formal beginnings in June 2000, the European Geoparks Network has now expanded from consisting of four member territories to thirty four members in thirteen countries. In 2000, when a special zone includes more than one particularly rare or beautiful and geologically significant feature, it is also referred to as a ''geopark'' by UNESCO (Wartiti, 2007). But what actually is a Geopark? A Geopark is not just a collection of geological sites, but it is a territory with a particular geological heritage and with a sustainable territorial development strategy. It must have clearly defined boundaries and a sufficient area to allow for true territorial economic development, primarily through tourism (McKeever & Zouros, 2005).

There are many criteria for classifying geoparks as outstanding. More than a single criterion may be required for a geopark to be declared worthy of being considered part of our heritage. A combination of criteria is usually considered (Aguirre, 2000 in Wartiti, 2007). Here is list of selection criteria for geoparks (Aguirre, 2000 in Wartiti, 2007):

- scientific value,
- geotourism appeal,
- educational value,
- historic value,
- cultural, spiritual, and social value,
- international significance,

- link to biodiversity,
- sanctuary for rare or endangered species,
- aesthetic value,
- accessibility.

The goals of the geoparks must always be kept in mind. Geoparks are part of the UNESCO-assisted "Global Network of National Geoparks" that was launched in 2004 to provide a landscape approach which strives to:

- preserve their geoheritage for present and future generations;
- educate the general public about issues in geological sciences and their relation to environmental matters;
- ensure sustainable socio-economic and cultural development;
- foster multi-cultural cooperation for heritage and conservation and the maintenance of geological and cultural diversity, using participatory schemes and co-partnerships;
- stimulate research when appropriate;
- contribute actively to the life of the Network through joint initiatives (e.g. communication, publications, exchange of information, twinning, participation in meetings) (Zouros, 2004; Wartiti, 2007; Grosbois, A.N & Eder, W., 2008).

Today geoparks are a part of the geotourism which is rapidly being recognized as an exciting new direction for tourism involving geological and geomorphology attractions and destinations, to be concerned with sustaining or enhancing a destination's geographic character (Wartiti et al., 2007). In particularly, it uses through tourism, education and sustainable development of a territory in Europe. Many tourists visit geoparks every year. The types of this tourist who are visiting these places are also different.

Turkey is a Eurasian country that stretches across the Anatolian peninsula in western Asia and Thrace in the Balkan region of south-eastern Europe. Turkey is a peninsula which is bordered the Black Sea, the Mediterranean and the Aegean. It has a total coastline of 8,333 km including the Marmara Sea. Turkey also shares borders of 269 km with Bulgaria and 203 km with Greece to the northwest; 276 km with Georgia, 325 km with Armenia, 18 km with Azerbaijan (Nahjivan) to the northeast; 529 km with Iran to the east; 378 km with Iraq to the southeast and 877 km with Syria to the south. Turkey is a big country with the area of 814,578 km^2 and has a population of over 70 million people. The highest mountain in Turkey is Ağrı Mountain with 5,137 m followed by Buzul Mountain (4,116 m), Uludoruk (4,135 m), Süphan Mountain (4,058 m), Erciyes Mountain (3,917 m) and Small Mount Ararat (3,896 m). Its biggest lake is Lake Van with 3,712 km^2. This is followed by Lake Tuz with 1,500 km^2. Its longest river is Kızılırmak with 1,355 km. and after its 1,263 km of the Euphrates River and 523 km of the Tigris, both of which originate in Turkey, are located within the country's borders (Doğanay, 1994, Akbulut, 2009).

Turkey, which is located in the Alpine-Himalayan orogenic belt, has a very rugged and high topographic structure. The geological structure in Turkey is complex. Main causes of these situations are related to orogenic movements that occurred during the Cenozoic Era and epirogenic and volcanic activities that took place between the Tertiary and Quaternary times (Atalay, 2002), so Turkey has an important richness from geological and geomorphology heritage resources points of view, so it has an important potential for geoparks, but geopark concept still hasn't developed in Turkey and it has not been defined in National Parks. This paper tries to present general information about Turkey's volcanic mountains and places where they occur, as well as some examples of geoparks products. However, it is clear that the future development of geoparks requires a comprehensive inventory and detailed planning.

2. Suggested Geoparks in Turkey: Volcanic Mountains

The mountains in Turkey can be divided into three groups in terms of their formation: orogenic, volcanic and horst mountains. Orogenic mountains extend both in the northern and southern section of Anatolia. The northern ranges are called Northern Anatolia Mountains and the southern ranges are named the Taurus Mountains. Horsts, which occurred as uplifted blocks along the normal faults, are common in the western part of Anatolia. Volcanic mountains in Anatolia have formed with the accumulation of lavas and fine and coarse materials such as tuffs, volcanic sands, ash and gravels. Between the highest volcanic mountains in Turkey are the Ağrı Mountain, Süphan and Erciyes (Atalay, 2002). Mountain areas in Turkey lead to the altitude ecological belts and have very big potential from endemic or relic animal and plants points of view. At the same time, these areas provide irrigation of the agricultural lands and drinking water of the urban centres. Mountains covering above half of Turkey are also important resources for geotourism because of nature structures, local architecture, culture features and mountain sports such as mountain biking and parachute of slope (Akbulut, 2009). For example, Ağrı Mountain (Ararat) which is a young stratovolcano that formed in the Pliocene, is the highest mountain of Turkey with its peak of 5,137 m and above the height of 4,200 m has many geopark characteristics such as Cehennem Valley, Lawrence Cave, the Fountain of Prophet and Cow Valley (Güner, 2000). Ağrı Mountain, which is called Kuh-i Nus by Iranians, is still known as "Ararat" in the Western world. Ararat is not a concept from Armenian language, it is the name given to Urartu Country by Asurians. It is highly probable that the name "Ağrı" came from Turkish of Shamanizm period. For in the Dictionary of Yakut Language written by Pekarsky, "Ağr" or "Ağrı" means "Huge" or "God" (Güner , 2000). Furthermore Ağrı Mountain is important for both national and international dimensions. The mountain is sacred for three important religions, so many people has been believed that there is Noah's ark, which was a large wooden ship built by Noah in order to save his family and one male and one female of every type of animal when the world was covered by a flood, in the Ağrı Mountain. Some researchers have come to examine about this subject to Ağrı Mountain (Arınç & Kaya, 2004). In addition to these attractions, there are also touristic attractive such as Fish Lake, Ice Cave, a meteor depression, İshak Paşa Palace and Bayezit Mosque in the near of Ağrı Mountain (Arınç & Kaya, 2004).

From the mountain areas of Anatolia, Nemrut Volcanic Mountain is the other example. Nemrut Volcanic Mountain, which was called after King Nimrod who lived in this area about 2100 BC, is on the west coast of Van Lake, a soda lake covering a surface of 3574 km2, in the East Anatolia Region of Turkey. This mountain is a stratovolcano and continued to be active until 1597 A.D (Aydar et al., 2003). There is caldera, lakes, mineral spring and trees such as oak and birch in the Nemrut Mountain. The Nemrut Caldera is one of the largest calderas in the world. The caldera was formed by the collapse of the peak of the cone of the volcano. It can be seen that emissions from several outlets took place in the caldera. There is still one outlet from where emission of gas continues. The depth of the caldera is approximately 450-500 m. There are two lakes in the caldera. One of them is located the western part of the caldera. The other is also a small hot lake which temperature reaches 60°C (Gürbüz, 1995). This temperature shows that the volcanic activity continues The Nemrut Caldera (Fig.1) is very interesting with its natural and beautiful look. This situation makes it very important from the touristic point of view. In addition to these heritage areas, there are many volcanic mountains such as Süphan, Tendürek and Small Ağrı in the East Anatolia Region of Turkey (Akbulut, 2009).

There are also many volcanic mountains such as Erciyes, Hasan, Karacadağ and Karadağ in the Inner Anatolia Region of Turkey. Erciyes Mountain which is a young stratovolcano is the highest mountain of this region with its summit at 3616 m. There are many small volcanoes cones around this mountain. Erciyes mountain has varied biogeographical features and it is near to Kayseri city. Hasan Mountain (Fig.2) is the second highest mountain in the Inner

Anatolia of Turkey with its peak of 3268 m and its area is about 982 km^2 . Besides Hasan and Erciyes mountains in the Inner Anatolia, there are about 20 volcano cones (Kopar, 2007). In this geography, there are also different geological structures of volcanic origin and geomorphological features including the "fairy chimneys". Fairy Chimneys are quite a rare landform all over the world. The geological history of the region is based on volcanic events from Oligocene times, approximately 38 million years ago (Bowen, 1990: 35, Tosun, 1998). Göreme, Zelve, Kızıl, Güllüdere, Bağlıdere, Killik, Görkün creek, Zemi creek, Pancarlık and Halac creek valleys between Göreme, Ürgüp and Avonos and in their near surrounding are mostly attractive points for tourism (Doğaner, 1995: 25). This area has some problems related to environment.

Figure 1: Nemrud Mountain and Caldera (http://www.fotokritik.com/157224 Abdurrahman Aksoy).

Figure 2: The view of Hasan Mountain (Akbulut,2005).

A further example is Kula volcanics which can be an area of interest for a geopark with its volcanic formations and structures that meet the expectations of people with its cultural values, potentially important for tourism of Turkey (Koçman & Koçman, 2006, Inaner et al.,

2004). The area between Kula and Karataş settlement and Demirköprü dam-lake has been formed by extensional tectonics and represents a landscape with volcanic elements, such as volcanic cones, explosive craters, lava flows and tuff covers which have the footprints of the prehistoric man. All these features are dominant on the landscape and structural surface. The features have attracted scientific attention since the beginning of the Christian era. The well-known historian Strabon visited the area about the time of the birth of Christ and in his book *Geographica*, named the land "Katakekaumene" (Koçman, 2004). In addition to these areas, there are different volcano features in Turkey such as maar and caldera lakes (Somuncu, et al., 2004).

3. Conclusions

Nowadays Turkey has important resources concerning geological and geomorphology heritage. These resources are not used for tourism, so it should be determine main aims for geoparks.

First, Turkey has to determine geopark policies, where it can establish geopark resources and protect their geoheritage for present and future generations.

Second, geoparks ensure sustainable socio-economic and cultural development for local people. Geological heritage sites, when properly managed, can generate employment and new economic activities, especially in regions in need of new or additional sources of income (Tosun, 1998). Local people need to be educated about subjects such as geography, geological sciences and their relation to environmental matters. They also serve a sustainable development and for illustrating methods of site conservation as well as remembering that rocks, minerals, fossils, soils, landforms form an integral part of the natural world. Education and training courses should be open. Children must be given environmental education (Akbulut, 2009).

Third, while geoparks provide business for local people, it also brings negative environmental consequences, so they should be organised for this and investments must be considered in the long term for tourism locations.

Fourth, local government must advertise these heritages in Turkey. They can use modern information technology such as Internet and documentaries. Cultural ambassadors must provide information to other countries.

Finally, if Turkey can use its potential geotourism sites and the geological and geomorphology attractions can be protected, it can contribute successfully for a sustainable Turkish tourism.

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PROTECTED AREAS IN ANGOLA AND GEOPARKS

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The National Parks, Integral Nature Reserves and Protected Areas of Angola are: Bicuar, Búfalo, Cameia, Cangandala, Cimalavera, Ilhéu dos Pássaros, Iona, Luando, Luiana, Mavinga, Mupa, Namibe and Quissama (Fig. 1).

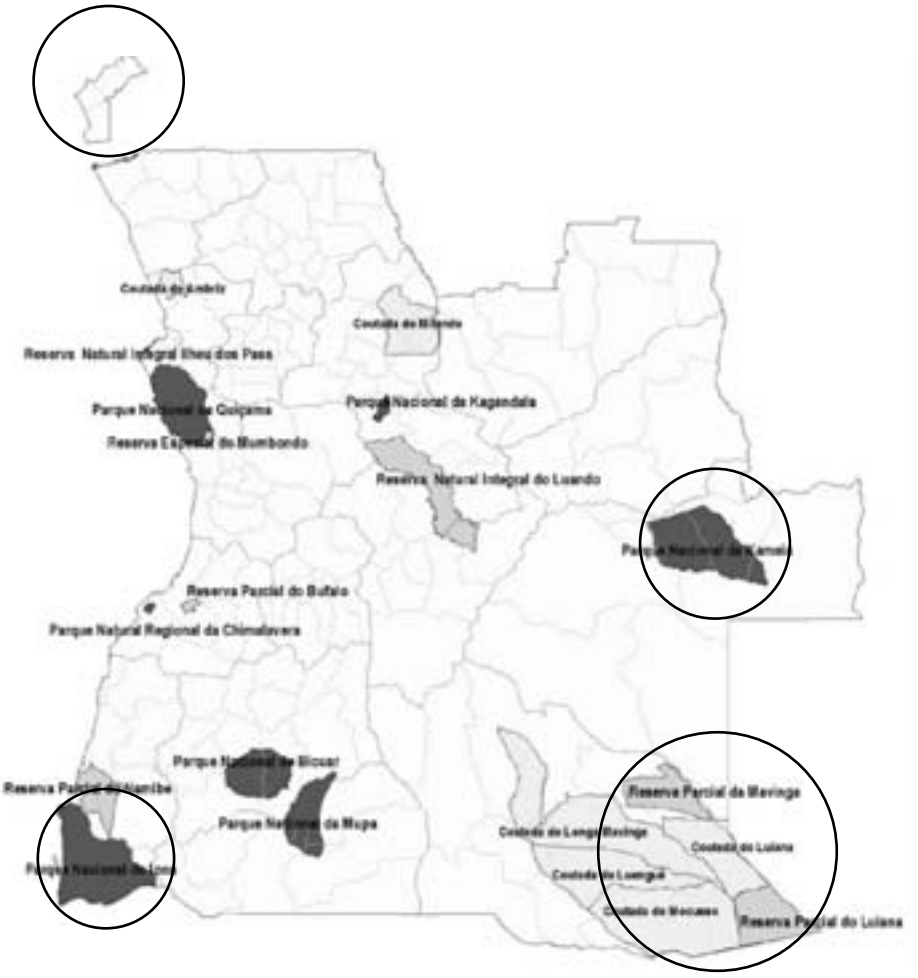

Figure 1: Distribution of Protected Areas in Angola. Circles refer to proposed Geoparks

The National Parks being protected areas may be at the same time GEOPARKS. The proposals of Angola to candidate National and Nature Parks to the Global Geoparks Network whose conditions fit in the principles established by UNESCO are Iona and Kangandala national parks, Luando Reserve, Tundavala Protected Area in Lubango and The Great Forest of Mayombe, the second in the world and the first in Africa.

1 – Iona National Park

Origin - This protected area was established as Hunting Reserve in 02-10-1937. Classification - National Park, II, since 26-12-1964. Location - Iona National Park is located in the South of Angola, in the Province of Namibe, between the Atlantic Ocean and Cunene and Curoca

rivers. Area - 15.150 km^2. Geographic limits - 15 44' to 17 16' Latitude South and 11 44' to 13 14' Longitude East. Natural boundaries - The National Park is limited at North by Curoca River, at South by Cunene River, at West by the Atlantic Ocean and at East, by Elefantes River. Description - The Iona National Park (Fig. 2) spreads out from sand dunes close to the sea to the mountains of Tchamalinde, to East. The core of the Park is open planes. The average annual precipitation varies between 100 mm and 500 mm, increasing to the hinterland. There are 31 natural springs included in the Park. There are three types of vegetation: "anharas", dunes with bushes and savannah planes with small bushes. *Welvitschia mirabilis* abounds, a plant that can grow for more than one thousand years. There are mammals like the elephant, olongo (*Strepsiceros strepsiceros - kudu*), lion, black rhino, onça, hyena, ostrich (*Struthio camelus*), guelengue (*Oryx gazella blainei*) and several species of zebra. Visitors - The National Park started to receive visitors in 2001, in organized tours coming from Namibia.

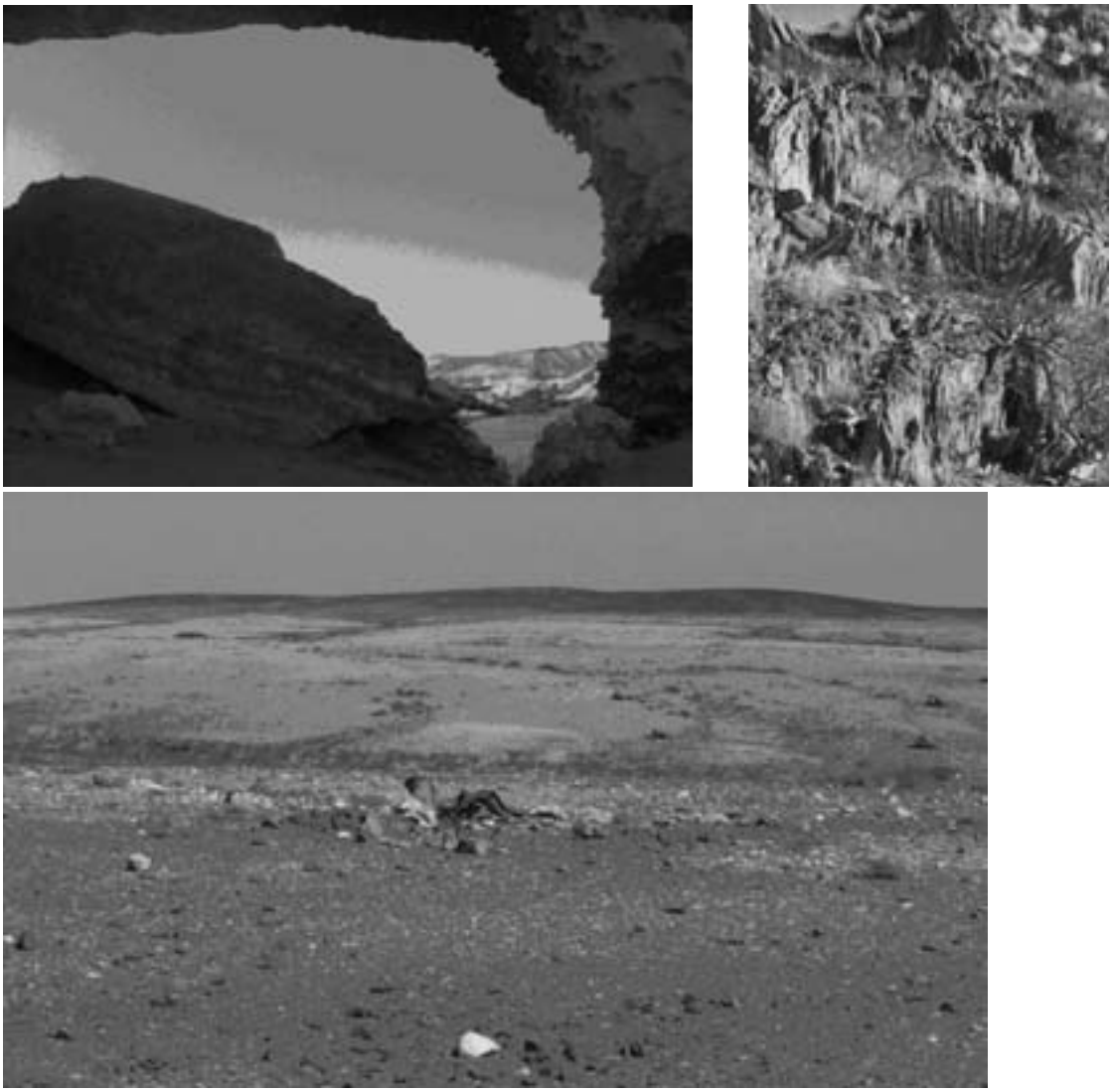

FIGURE 2: Iona National Park.

2 – Kangandala National Park and Luando Reserve

Origin - Established and Integral Natural Reserve in 25-05-1963. **Classification -** National Park, II, since 25-06-1970. **Location -** The National Park is located at the Province of Malanje.

Area - 630 km^2. **Geographic Limits -** 09 09'to 10 02' Latitude South and 16 34' to 16 52' Longitude East. **Natural boundaries -** At North and NE the Park is delimited by Camifundi, Cuije and Caculo rivers. At South by Maubi, Candua and Camifundi rivers. To East and SW by Caculo and Cuije rivers, Dumba Kicala, Picada Calamungia, Maubi Calongo to Cuque and Lussa rivers. **Description -** The average annual precipitation is 1350 mm and the temperature 21,5°C. There are no big water courses and life flourishes in ponds and lakes formed during the rain season. Vegetation is open forest and dry savannah. In 1963 the discovery of Palanca Negra Gigante (*Hippotragus niger*) lead to the protection of Kangandala National Park (Fig. 3). Nowadays, the numbers of this species are unknown. There is a project to save Palanca Negra Gigante from extinction and its protection in a specific protected area that is being developed by an international team of researchers (from Angola and South Africa).

Figure 3: Palanca Negra Gigante

3 – Tundavala Protected Area in Lubango

Located 8 Km close to the city of Lubango in a tourist area, the Tundavala Crack is estimated to be 2.500 m deep (to the present date there are no precise information about someone that reach the bottom of this rare geological crack; Fig. 4). The protected area connects with Leba mountain.

Figure 4: 4 Tundavala Crack

4 - Strategies and Actions to recover National and Nature Parks and Protected Areas
The strategies and actions planned to recover National and Nature Parks and Protected Areas in Angola are:

• Development of a Socio-Economic Viability Plan and models of sharing management of National Parks and the redefinition of strategies and politics about Protected Areas and/or Conservation areas;
• Elaboration of plans and actions of recovering/rehabilitation of National Parks with attractive projects and adequate infrastructures, in order to transform/elevate Angola as tourism destination, with strategies for Nature Tourism, Ecotourism, Tourism activities, Lodging Brand and other tourist activities that result in revenues for the State and Communities;
• Politics involving local communities from the Parks and surroundings - involving them in the Parks' management (shared management), and to foster Biological Agriculture, regulated Sport and Local Chasing, "Porta" handicraft, etc..

5 – Conclusions and recommendations
• Angola is certain about the world-class of its Parks, Nature Reserves and remaining Protected Areas and for environmental protection and conservation (geological, geographic and biological outstanding diversity of Parks and Integral Reserves);
• Several Parks in Angola fulfill necessary criteria to be included in the Global Geoparks Network of UNESCO and to contribute significantly for the establishment of a African Network of Geoparks;
• Angola needs support from European Geoparks Network and Global Geoparks Network to develop 4 Parks and Protected Areas as Geoparks and the applications to UNESCO Geoparks;
• Support can be achieved by financial, material and human donations for rehabilitation and recovering of infrastructures to contribute and develop necessary conditions to internationalize Sustainable and Harmonious Development through Geoparks.

BASQUE COAST GEOPARK: AN ASPIRING GEOPARK

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1. Natural heritage for all to enjoy

The central part of the Basque coastline and surrounding inland areas in the north-west of the province of Gipuzkoa (Autonomous Region of the Basque Country, Spain; Fig. 1) is an area of great geological interest. The land is known for its diverse stratigraphic and palaeontological record, with sedimentary rocks deposited under the sea, dating from between the Jurassic period (150 million years ago) and the Middle Eocene epoch (45 million years ago). The region in question plays a key role in our understanding of the processes which marked the evolution of the western part of the Pyrenean orogen. We can identify two main areas within the region: the southern area, where a series of hills and mountains is characterised by carbonate rocks dating from the Jurassic and Early Cretaceous periods; and the northern area, characterised by a more gentle relief on flysch rocks dating from the Late Cretaceous and Early Palaeogene (Fig. 2).

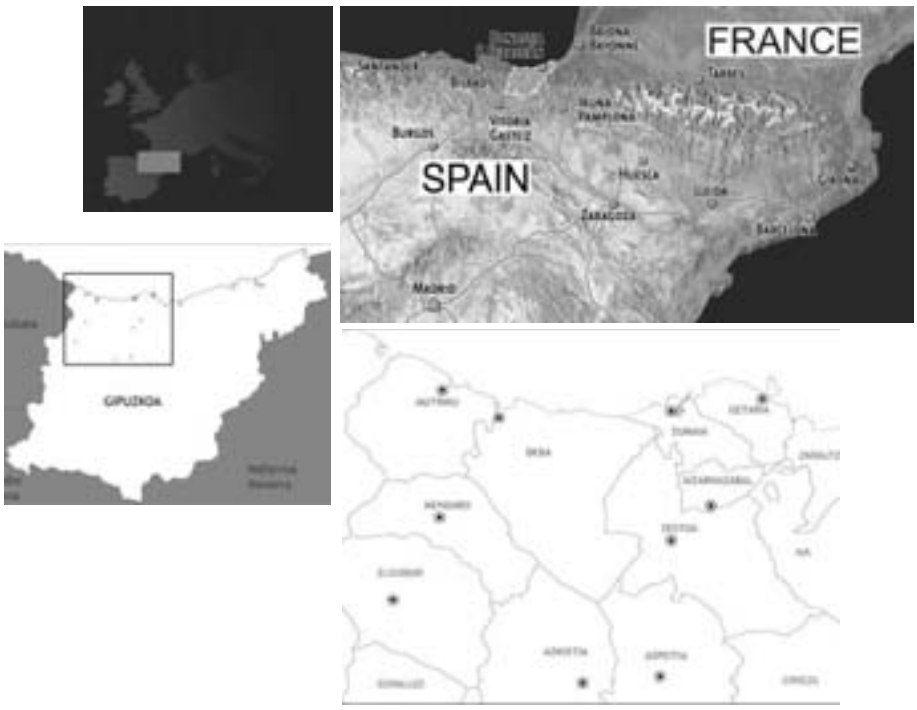

Figure 1: Location maps of the Geopark in Gipuzcoa Province of Spain with the included municipalities.

Most of the studies carried out in the area have looked at the flysch sequences visible on the surface around the coastline between the towns of Deba and Getaria. The focus on this particular area is due to the excellent quality of the coastal outcrops, and the fact that it is possible to study an almost unbroken sequence more than 5000 m thick, where we can see a practically continuous record, layer by layer, outlining 60 million years of the history of our planet and some of the physical and biological episodes which have marked its development. The international scientific community has known about all of this for

several decades, and geology specialists from around the world continue to visit and study the area today. Specifically, the research carried out here has played an important role in backing up the catastrophist hypothesis proposed by Alvarez *et al*., which suggests that the mass extinction at the end of the Mesozoic Era was caused by Earth being hit by an asteroid or comet shower (Fig. 2).

Figure 2: Zumaia outcrop with the Cretaceous-Palaeogene boundary.

As such, from a stratigraphic point of view, the section of flysch at Zumaia, which contains an excellent, complete record of the important boundaries between different geological periods (e.g. the Cretaceous-Tertiary and the Palaeocene-Eocene), as well as the official stratotypes of the two boundaries within the Palaeocene (Danian-Selandian and Selandian-Thanetian), is particularly relevant. This area is home to one of the outcrops with the greatest concentration of analysable chronostratigraphic boundaries in the world. Another highly relevant feature of this region is its geomorphology, which, generallyspeaking, is made up of two key elements: firstly, the coastal relief (Fig. 3), with flysch sequences where horizontal or intertidal abrasion platforms form, as well as numerous promontories, coves, etc…; and secondly, the various karst landforms of the Early Cretaceous inland limestone massifs, both endokarstic (caves, chasms, springs, etc…) and exokarstic (limestone pavements, poljes, etc…). The area is also home to a great many caves of high palaeontological value, one of which, the Ekain Cave in Deba, which contains one of the best sets of painted horses in all Quaternary art, has been declared a World Heritage Site. In addition, the region is known for its many places of geocultural interest, and a large number of myths, legends and sacred elements are related to its geological features. Furthermore, there are a number of thermal springs in the area, which have been used for more than two centuries and were some of the first tourist attractions in the Basque Country, as well as numerous natural spaces included in the Natura 2000 network.

Figure 3: Coastal relief.

Moreover, the area's geological and natural value led to the stretch of coastline between Deba and Zumaia being declared a Protected Biotope by the Basque Government this year. The University of the Basque Country recently carried out a study on this part of the coastline, cataloguing its geological features, and creating an inventory of around one hundred geosites.

Fortunately, over the last decade, knowledge and awareness of the geological features of the area have ceased to be the exclusive preserve of academic or scientific spheres, and have reached the public domain. This successful public exposure is due, in great part, to the interest of most of the area's media, which have written about the importance of the region's characteristic geological elements. And it seems that the media and the general public's interest in this geological heritage are set to continue to grow. Furthermore, a documentary film is currently being made which examines the area's geology and its global context, and a number of scientists of national and international renown are contributing to its production.

The educational value and potential of this environment are also very important, as shown by the success currently being enjoyed by initiatives like the Algorri Interpretation Centre in Zumaia or the Nautilus Fossil Museum in Mutriku. The area's features offer up a wide range of different possibilities, and hold two advantages which make it easier to attract the general public; firstly, the themes that can be examined here are universal and affect us all; and secondly, the area's geology can provide us with information about the past which continues to be important for us today in a modern context. In short, the ability to draw comparisons between past extinctions and climate changes and the problems we are facing today is a powerful tool which can be used to promote awareness amongst the general public.

The region also provides an example of successful geotourism, a sector which first began to develop in the area some eight years ago. In 2002, geological walking tours began to be run from Zumaia, taking in nearby points of interest such as the K-T boundary (or, more specifically, the K-Pg boundary), as well as guided tours exploring the main coastal outcrop (Fig. 4). Since then, and given the increasing success of these initiatives, the programme has been extended and new tours have been offered each year. In addition, since 2006, guided boat tours have been run so that visitors can take in the views of the coastal outcrop from the sea. Gradually, Zumaia's neighbouring municipalities, such as Deba and Mutriku, have joined the initiative and begun developing and promoting their natural resources, such as fossils, etc…

FIGURE 4: Geotourism activities in the area.

A further milestone was reached in 2008, when the municipalities of Zumaia, Deba and Mutriku signed a collaborative agreement to set up a joint geotourism route, known as the Coastal Flysch Route (www.flysch.com), with a view to bringing together and promoting all of the area's geological, natural and cultural attractions (Fig. 5). One of the main activities carried out to develop and promote the area's geological heritage and inject new energy into the region has been the running of scheduled guided tours by tourist offices. There is now a complete annual programme of scheduled geotourism activities, most of which go beyond mere sightseeing and actually examine the origins and significance of the area's features. In addition, support has been given to "a la carte" group tours run by private initiatives. Results so far have been very positive, with 11,500 people taking part in these geotourism activities in 2008. Finally, a full calendar of 150 geotourism and nature activities has been drawn up for 2009, and an online booking and payment system for geotourism tours was set up in spring 2009, making it much easier for visitors to sign up for the activities on offer.

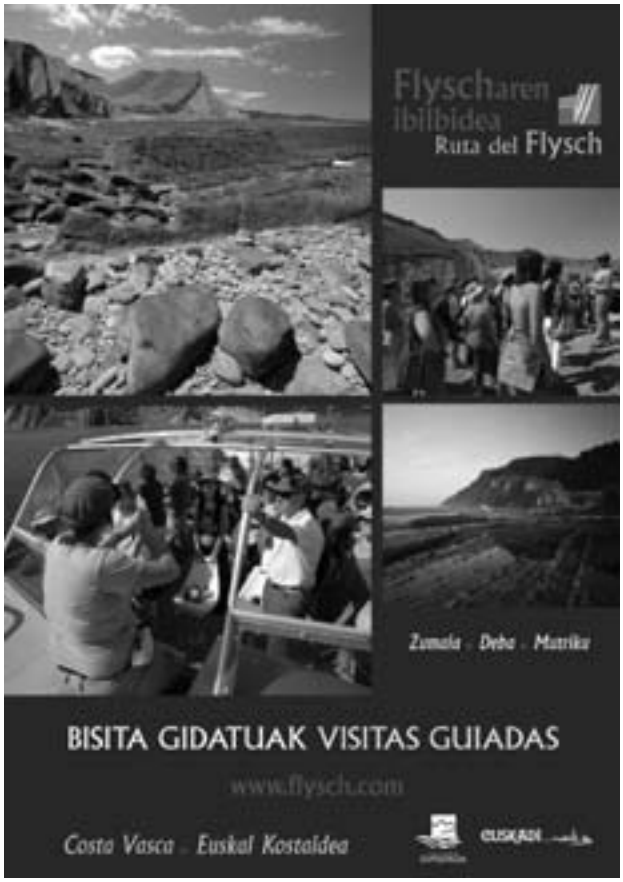

FIGURE 5: Coastal Flysch Route brochure.

2. The Geopark proposal

The importance of the area's geological resources and the work carried out over the last few years have led to some reflection and debate about the strategy that should be implemented in the region in the immediate future, and examples from around the world which could support that strategy have been sought. Having studied a number of different possible labels, we have reached the conclusion that the Geopark concept is the best one for the area for two reasons: firstly, because our knowledge of the place tells us that the area is in a good position to meet the criteria for becoming an EGN Geopark; and secondly, because the innovative philosophy behind the Geopark concept, amongst other factors, means that this may be the most appropriate way to promote and develop the region. In conclusion, creating a geopark on the Basque Coast could not only boost the sustainable socioeconomic development of the area, it could also teach new, important lessons to the people who live in the region and those that visit it.

THE FRACTAL DIMENSION OF GEOPARKS: UPSIZING AND DOWNSIZING ITS SCOPE

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1.Introduction

Is geopark a fractal? It may well have an underlying nonlinear dynamics since it integrates economy and social sciences. Probably it is not a true fractal. Its degree of complexity may change from local to national, to European or to the Global scale. It may be a multifractal entity if its perspective differs somehow when applied to different continents, Europe, Asia, Americas or Africa. The importance of this theoretical analogy is that if geopark is a fractal, i.e. scale invariant, it can be downsized to the local scale or upsized to the entire planet without losing its fundamental properties.

2. Downsizing

Portugal has embraced the concept of geopark to promote a sustainable management of its geological heritage. First Naturtejo and this year Arouca are two Portuguese European geopark members. Others (Azores, Porto Santo) are in the horizon. For Portuguese aspiring geoparks to become a European geopark is an all-or-nothing process. In some countries, like Portugal there are no intermediate categories to consolidate the geopark institution at local and national levels, as happened to the first fourth founding geoparks of the European Geopark Network. Before establishing this European network, the *Reserve Geologique de Haute-Provence* (France), the *Natural History Museum of the Lesvos Petrified Forest* (Greece), the *Geopark Gerolstein/Vulkaneifel* (Germany) and the *Maestrazgo Cultural Park* (Spain) had first to become a reality at a local scale and then to the scale of their respective countries. This is a sustainable bottom-up strategy for implementing a geopark.

Naturtejo and Arouca benefited from favourable political and management local conditions that immediately understood the scope and benefits of a geopark and immediately promoted and consolidated the idea among the local populations, following a top-down strategy: it has been recognized at an European and Global scale, so must be important and useful for the local populations.

Ten years ago we proposed on a local information journal (Rodrigues, 1999) a geopark for Porto Santo (Autonomous Region of Madeira, Portugal) but only last year it was internationally presented as an aspiring European Geopark (Cachão & Dias, 2008). Arisen difficulties showed us the usefulness of returning to the origins and apply the original and fundamental rule: a geopark must be a local and national reality first, for at least a couple of years, before applying to the international geopark family. In countries such as Germany and Switzerland, for a long time national geoparks are realities. Some evolved to become European and Global Geoparks, others may do it others not. Having European Geoparks without having intermediate stages, e.g. skipping national implementation is like competing for UEFA Euro or FIFA World Cup without national teams and national championships to establish the who's better and before those regional teams to recruit local new talents.

A certain territory can become a geopark at a local scale if the structure (public, private or mixed) that manages it recognizes and promotes its natural geological heritage. It can evolve to a national level if the geopark is recognized as ***the*** (national) strategy for the sustainable development of that territory. Several national geoparks should then exist and cooperate (just like the geopark founders) before some of them achieve being recognized at a European (and Global) scale by the importance of the natural heritage values they possess

but also by the success in implementing its sustainable management policies locally.
Due to a considerable lack of knowledge on Earth subject both natural and cultural heritage managers, some even related to other UNESCO world heritage entities, when dealing with geological entities only consider, at best, simplified versions of the total scope of activities and processes that can be implemented on a geopark. Geological heritage protection is still a strange concept to apply to entities commonly considered as eternal. When present, geological popularization is mostly restricted to a few basic activities: a general landscape description on a leaflet; a sign pointing to a geosite; an information board on the beginning of a track with a short general sentence about the geology of a place. This generally exhausts the total range of initiatives on what concerns geoconservation. For this reason is useful to characterize the degree of involvement in geoconservation of a certain Municipality through a Geological heritage invaluing index (GeoVal) ranging in crescent terms of importance, from I to VII:
I) – Geosite identification and characterization (e.g. ProGEO-Portugal form);
II) – Implementation of trails, signs and information panels about geotourism;
III) – Leaflets and books edition, webpages and downloadable pdf documentation on popularizing geology;
IV) – Recruitment of specialized geo-rangers (with a degree or post-graduation on Earth Sciences) to conduct geotourism activities;
V) – Classification of geosites by local and/or national authorities in environment and natural resources;
VI) – Protection measures of geoconservation on Municipal Management Plans or National Environmental policies;
VII) – Geopark as ***the*** integrated and sustainable development strategy of the region.

3. Upsizing
Upsizing geopark to become the environmental, ecological and conservationist policy of sustainable development of a Nation, a Continent, an Ocean, or the entire World is also conceivable. If this is stretching geoparks to far out, it should be stressed that a Portuguese ecological association, Quercus, already launched a similar idea, the Earth Condominium.
On Article 2 (Object) of their constitutive declaration (GAIA), Earth Condominium is clearly defined it "*aspires to harmonize the internal organization of the human societies with the interdependent and global functioning of* [only] *the Biosphere*". And while Article 3 (General Principle) recognizes that "*The Planet Earth is indivisible*" in Article 9 (On the Common Parts) it only recognizes Atmosphere and Hydrosphere. Not a world for the obvious Geosphere; it fails the big picture.
Individuals, cities or nations have always coveted land. Legislation distinguishes soil from subsoil as a way to specify what can and cannot be owned by privates. But, can an individual or nation own Geological Heritage as has being done with Earth resources? Or should the Geological Heritage belong to the entire Humankind, if not, to the entire vernadskyian *Biosfere*?

We submit that the Geopark is a better concept to manage the world and the geologists (without the mad ruler-of-the-world laugh) are better positioned to do so. Geologists value land without converting it into numbers other than age. Geologists are traditionally trained in multidisciplinary approaches and integration. They are used to be on both sides of the trench. They work in extracting industries (i.e. quarries, oil) but also know how to value their scars on the landscape as windows of geological knowledge. These attributes are fused and re-crystallized as geopark sparkling facets, making it the best tool to manage the entire Planet because, for instance:
i) Completely integrate local populations and value their local traditions, handicraft, gastronomy, etc.;

ii) Value all Natural and Cultural heritages without discrimination, in a complementary and integrated way;
iii) Create new sustainable and environmental friendly development strategies that promote life quality for the populations while preserve ecosystems and geosystems;
iv) Promote geotourism, health practices mostly in counter-cycle with the main seasonal touristic (Sun & beach) activities.

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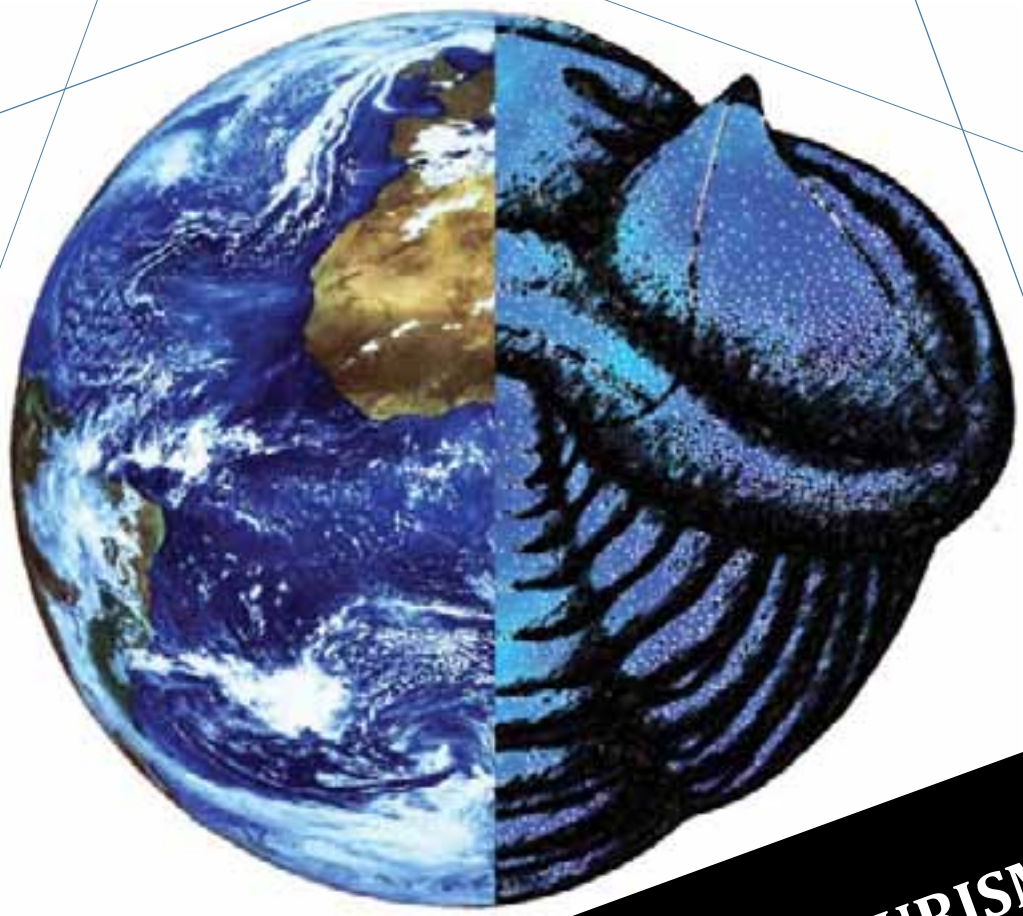

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