



**WORKSHOP GEOPARKS IN VOLCANIC REGIONS
SUSTAINABLE DEVELOPMENT STRATEGIES**

**October 29th to November 1st, 2014
Terceira and Graciosa Islands, Azores Global Geopark**

ABSTRACTS BOOK





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ABSTRACTS BOOK



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October 29th to November 1st, 2014

Terceira and Graciosa Islands, Azores Global Geopark

ORGANIZING COMMITTEE

João Carlos Nunes

Eva Almeida Lima

Manuel Paulino Costa

Marisa Machado

Jorge Ponte

Filipe Gonçalves

GENERAL PROGRAM

Geoparks in volcanic areas: sustainable development strategies Geoparques em regiões vulcânicas: estratégias de desenvolvimento sustentável Programa Geral - General Program									
Horas	27.Oct (Mon-2 ^a)	28.Oct (Thu-3 ^a)	29.Oct (Wed-4 ^a)	30.Oct (Thu-5 ^a)	31.Oct (Fri-6 ^a)	01.Nov (Sat-Sáb)			
08:30-09:00	Partida para/Departure to - S. Maria Is. (06h30)	S. Miguel Island Field Trip (optional) Visita Técnica à ilha S. Miguel (opcional)	Partida para/Departure to - Terceira Is. (07h00)	Terceira Island Field Trip Visita Técnica à ilha Terceira	Terceira Island Field Trip Visita Técnica à ilha Terceira "Pic-Nic" Almoço/Lunch	Graciosa Island Field Trip Visita Técnica à ilha Graciosa			
09:00-09:30	S. Maria Island Field Trip (optional) Visita Técnica à ilha S. Maria (opcional)		Livre/Free						
09:30-10:00			Sessão de Abertura Openning Session						
10:00-10:30			KEYNOTE SPEAKER Jonathan Tourtellot (USA)						
10:30-11:00			Apresentação/Introducing Geoparque Azores Geopark						
11:00-11:30			Almoço/Lunch (Livre/Free)				Almoço/Lunch (Livre/Free)	Almoço/Lunch (Livre/Free)	
11:30-12:00			S. Maria Island Field Trip (optional) Visita Técnica à ilha S. Maria (opcional)				INVITED SPEAKER Patricia Erfurt-Cooper (Australia)	INVITED SPEAKERS Andreas Schueller (Germany) & Barnabás Korbély (Hungary)	Partida para/Departure to - Graciosa Is. (14h20)
12:00-12:30							Apresentações Livres Oral presentations	coffee/tea	coffee/tea
12:30-13:00	INVITED SPEAKER Matteo Garofano (Italy)	NATIONAL GEOGRAPHIC "Geotourism Stewardship Council" by J. Tourtellot (USA)		Graciosa Island Field Trip					
13:00-14:30	Apresentações Livres Oral presentations	Mesa Redonda Round Table GEOTOURISM		Visita Técnica à ilha Graciosa					
14:30-15:00	Partida para/Departure to - S. Miguel Is. (19h55)	Chegada-Lisboa-Arriaval (20h15)		Jantar/Dinner Cortesia/Cortesy Câmara Municipal de Angra do Heroísmo Visita/Visit "Angra UNESCO WHS"	Cocktail Cortesia/Cortesy Geoparque Açores & Associação "Os Montanheiros"	Museu da Graciosa	Partida-Lisboa-Departure (21h05)		
15:00-15:30	Jantar/Dinner (Livre/Free)	Jantar/Dinner (Livre/Free)		Jantar/Dinner (Livre/Free)	Jantar/Dinner Cortesia/Cortesy Câmara Municipal de Santa Cruz da Graciosa				
15:30-16:00	S. Miguel Island Field Trip (optional) Visita Técnica à ilha S. Miguel (opcional)	S. Maria Island Field Trip (optional) Visita Técnica à ilha S. Maria (opcional)		S. Miguel Island Field Trip (optional) Visita Técnica à ilha S. Miguel (opcional)	S. Maria Island Field Trip (optional) Visita Técnica à ilha S. Maria (opcional)	S. Miguel Island Field Trip (optional) Visita Técnica à ilha S. Miguel (opcional)	S. Maria Island Field Trip (optional) Visita Técnica à ilha S. Maria (opcional)		
16:00-16:30			Partida para/Departure to - S. Maria Is. (13h30)						
16:30-17:00			Terceira Island Field Trip (op.)						
17:00-17:30			Visita Técnica à ilha Terceira (op.)						
17:30-18:00			Partida para/Departure to - S. Miguel Is. (13h30)						
18:00-18:30			Terceira Island Field Trip (op.)						
18:30-19:00			Visita Técnica à ilha Terceira (op.)						
19:00-20:00	Partida para/Departure to - S. Miguel Is. (13h30)	Terceira Island Field Trip (op.)	Visita Técnica à ilha Terceira (op.)	Partida para/Departure to - S. Miguel Is. (13h30)	Terceira Island Field Trip (op.)	Visita Técnica à ilha Terceira (op.)			
20:00-	Jantar/Dinner (Livre/Free)	Jantar/Dinner (Livre/Free)	Jantar/Dinner (Livre/Free)	Jantar/Dinner (Livre/Free)	Jantar/Dinner (Livre/Free)	Jantar/Dinner (Livre/Free)			

PUBLIC SESSIONS PROGRAM

 Geoparks in volcanic areas: sustainable development strategies Geoparques em regiões vulcânicas: estratégias de desenvolvimento sustentável Public Sessions Program - Programa das Sessões		
Horas	29.Oct (Wed-4ª)	30.Oct (Thu-5ª)
08:30-09:00	<p>Livre/Free</p> <p>Sessão de Abertura Opening Session</p> <p>KEYNOTE SPEAKER Jonathan Tourtellot (USA) Geotourism for Maximum Benefit: The National Geographic Approach for a Sustainable Destination</p> <p>J. C. Nunes <i>Azores Geopark volcanoes and volcanic landforms. Valuing the Azorean geodiversity and geosites through the geotourism</i></p> <p>M. Machado & E.A. Lima <i>Geotourism and sustainable development partnerships in the Azores Geopark</i></p> <p>J. Toste <i>The contribution of geotourism for the reinforcement of The Azores Islands as a Nature Tourism destination</i></p>	<p>Terceira Island Field Trip including "Algar do Carvão" volcanic pit</p> <p>Visita Técnica à ilha Terceira incluindo cavidade vulcânica do Algar do Carvão</p>
09:00-09:30		
09:30-10:00		
10:00-10:30		
10:30-11:00		
11:00-11:30		
11:30-12:00	<p>Almoço/Lunch (Livre/Free)</p> <p>INVITED SPEAKER Patricia Erfurt-Cooper (Australia) Volcanic Geo-heritage, Sustainable Tourism Development in Volcanic Regions: Geoparks, National Parks and World Heritage Sites</p>	<p>Almoço/Lunch (Livre/Free)</p>
12:00-12:20	<p>V. Montero <i>El Hierro Geopark...volcanoes, sports & adventure!</i></p>	<p>INVITED SPEAKERS</p> <p>Andreas Schueller (Germany) Geology and Tourism – From the First Attempts up to a Functioning Geopark. The Vulkaneifel Geopark as Case Study</p> <p>&</p> <p>Barnabás Korbély (Hungary) Diverse Volcanic Features as Dominant Landscape Elements and Pillars of Geotourism in the Bakony-Balaton Geopark, Hungary</p>
12:20-12:40	<p>F. Rocha & P. Raposo <i>"GeoAlternativa", a project focused in geotourism</i></p>	
12:40-13:00	<p>V. Santos et alia <i>Communicating natural history through art collections. An example of non formal geoscience education and geoheritage public awareness through an Azorean painting</i></p>	
13:00-14:30	<p>P. Aguiar et alia <i>Valuing the uses of the Azores regional thermal resources: a matter of criteria selection on the strategic management plan development</i></p>	
14:30-15:00	<p>coffee/tea</p>	<p>coffee/tea</p>
15:00-15:30	<p>INVITED SPEAKER Matteo Garofano (Italy) Geotourism in the Azores: Considerations About a Decade Experience</p>	<p>NATIONAL GEOGRAPHIC "Geotourism Stewardship Council" <i>by J. Tourtellot (USA)</i></p>
15:30-15:45	<p>F. Souza et alia <i>Transformation of Saco do Inferninho volcano in geotouristic park: example of the Picuj town and region, Paraíba State, Brazil - a preliminary approach</i></p>	<p>Mesa Redonda Round Table GEOTOURISM: CHALLENGES AND OPPORTUNITIES</p>
15:45-16:00	<p>M. Agostinho et alia <i>Luz Beach magmatism: a geosite regarded as a local and regional factor in the heritage, economic and touristic development</i></p>	
16:00-16:15	<p>J. Leite et alia <i>Volcanoes that died or did not managed to come to be: remnants of volcanism in Portugal's Mainland</i></p>	
16:15-16:30	<p>C. Silva et alia <i>Educational and awareness tools in the Azores Geopark as an approach to enhance the population and local stakeholder's engagement</i></p>	
16:30-17:00	<p>Visita/Visit "Angra UNESCO WHS"</p>	
17:00-17:30	<p>Jantar/Dinner Cortesia/Cortesy Câmara Municipal de Angra do Heroísmo</p>	<p>Cocktail in Terceira Is. Delegation of the Azores Geopark</p> <p>Cortesia/Cortesy Geoparque Açores & Associação "Os Montanheiros"</p>
17:30-18:00		
18:00-18:15		
18:15-18:30		
18:30-18:45		
18:45-19:00		
19:00-19:30		
19:30-22:30		

INVITED SPEAKERS

BRIEF BIOGRAPHY

Jonathan B. Tourtellot

Geotourism Editor, *National Geographic Traveler*.

Portal Editor, *DestinationCenter.org*.

Founding Director, National Geographic Center for Sustainable Destinations.

President, Focus on Places LLC.

National Geographic Fellow Emeritus; contributor, National Geographic NewsWatch.

Journalist, editor, and consultant, now specializing in sustainable tourism and destination stewardship.

Articles published on topics such as green tourism, resort sprawl, climate change, nature tourism, heritage travel, and tourism's relation to places, including the cover survey article, "Tourism: Part Threat, Part Hope", for UNESCO's *World Heritage* magazine. While at National Geographic Books, project editor and contributor for a large-format book on plate tectonics, *Exploring Our Living Planet*, with Dr. Robert Ballard.

Motivated by his desire to encourage protection of distinctive places, J. Tourtellot originated in 1997 the concept of geotourism as defined by National Geographic: "tourism that sustains or enhances the geographical character of a place - its environment, culture, aesthetics, heritage, and the well-being of its residents". (In accordance with the Arouca Declaration of 2011, that definition can also specify geology). The 2013 "My Place, My Brand" World Summit in Kuala Lumpur named him "Father of Geotourism".

While directing National Geographic's Center for Sustainable Destinations, he launched the Geotourism MapGuide program, unique in that it invites full participation by destination residents. He instituted the landmark Destination Stewardship surveys published in *National Geographic Traveler*, 2004-2010.

Patricia Erfurt-Cooper

Doctoral dissertation focussed on “*The Role of Natural Hot Springs in Health, Wellness and Recreational Tourism*”.

Adjunct Professor – James Cook University, Cairns, Australia.

Lecturer – University of Southern Queensland, Fraser Coast, Australia.

Visiting Professor – Ritsumeikan Asia Pacific University, Japan.

Principal Research Scientist and Consultant @ GEOTOURISM Australia.

Advisor – Protection of Natural & Cultural Resources; Sustainable Tourism & Destination Development; Health & Wellness Tourism; Thermal Spa Tourism; Assessment of Geotourism Potential; Risk Management & Safety Strategies.

Author and co-author of books, book chapters and research articles about Volcano & Geothermal Tourism, Geotourism, River Tourism, Island Tourism and Thermal Spa Tourism.

University courses in Sustainable Tourism Management, Natural Resource Management, Health & Wellness Tourism as well as Community Development.

With degrees in geography, geology, environmental science and tourism, P. Erfurt-Cooper main research interests are focussing on the sustainability of geoheritage, both geologic as well as geographic. She strongly believes that the overall geodiversity based on natural and cultural resources is a priceless foundation for sustainable geotourism development in (volcanic) National Parks, Geoparks, World Heritage Areas and other protected sites, which require safeguarding for future generations. She advocates the educational aspects of tourism based on geodiversity as a way to promote the concept of conservation of endangered sites, species and cultures.

Researching potential risks and hazards at volcanic tourist destinations for over a decade, she is currently working with an internationally based team of colleagues on guidelines for visitor safety in active volcanic environments.

Books and Book chapters:

2014. *Volcanic Tourist Destinations* (Ed). Geoheritage, Geoparks and Geotourism Series. Berlin, Heidelberg: Springer.

2013. Health and Wellness Tourism – An Integrated Approach. In C. Pforr and C. Voigt (Eds). *Wellness Tourism – A Destination Perspective*. London: Routledge.

2010. *Volcano and Geothermal Tourism – Sustainable Geo-resources for Leisure and Recreation* (Eds). London: Earthscan (with M. Cooper).

2010. Geotourism – Active Geothermal and Volcanic Environments as Tourist Destinations. In R. Dowling and D. Newsome (Eds). *Global Geotourism Perspectives*. Oxford, UK: Goodfellow.

2009. European Waterways as a Source of Leisure and Recreation. In B. Prideaux and M. Cooper (Eds). *River Tourism*. Wallingford: CABI.

Matteo Garofano

Geologist and founder of the Italian Geotourism Association (2000).

Geological tour guide for some Italian tour operators and tour leader in some of the most fascinating geological and touristic spots: Iceland, Azores, Morocco, Italy, Canary Islands, Madeira, Cape Verde, Indonesia.

Author of the first Italian book about geotourism (2003) and author of articles and papers about geotourism.

Organizer of the annual Italian geotourism course for the training of specialized operator since 2004 and of activity for schools and exhibitions about geology.

Consultant in geological tourism and participated in many Italian projects about the development of geotourism and geoparks.

Andreas Schüller

Managing director of the Natur- und Geopark Vulkaneifel GmbH (Ltd.), Daun, Rhenania-Palatinate, Germany.

Member of the Advisory Committee of the European Geoparks Network.

Member of geoparks expert group at UNESCO for conducting evaluations and revalidations of geoparks.

Member of the LEADER Action Group Vulkaneifel.

Vice mayor of the village of Mehren, Rhenania Palatinate, Germany.

Consultant for environmental affairs County Administration of Daun, Rhenania-Palatinate, Germany.

Research fellow project “MORAN – Morphological Analysis North Sea Coast”.

DSc Thesis, Technical University Berlin, Institut for Geography.

Diploma Thesis: Groundwater conditions in Westeifel volcanic field.

Universität Trier, Applied Physical Geography / Geosciences.

The abiotic nature is the determinant of the biotic nature on the earth surface, both are inseparably connected and define the character of regions. Geoparks take up these two aspects of our planet and make them available to the public – to the resident people as well as to visitors and tourists. Since its foundation in 2003 Andreas Schüller worked for the geopark company in pivotal position, being since 2009 the managing director of the Natur- und Geopark Vulkaneifel GmbH.

Barnabás Korbély

MSc in Geography, Eötvös University, Faculty of Science, Budapest, Hungary (Thesis title: “Volcanic evolution of Szigliget Hills”); MSc Supervisors: Dr. Dávid Karátson, Dr. Károly Németh.

Certified Teacher of Geography, Eötvös University, Faculty of Science, Budapest, Hungary.

DAAD (Deutscher Akademischer Austausch Dienst/German Academic Exchange Service) scholarship at Eberhard Karls University (Tübingen, Baden-Württemberg, Germany), Institute of Geosciences.

DAAD–DLR German-Hungarian exchange program scholarship at University of Freiberg (Technische Universität Bergakademie Freiberg, Saxony, Germany) – PhD course “Pyroclastic rocks in thin section”.

Science and Technology Cooperation between Argentina and Hungary: “Vent and crater structures, erosion history and geochemical evolution of monogenetic volcanoes in intracontinental volcanic fields in Patagonia and in the Pannonian Basin: a comparison study”, with Dr. Károly Németh and Prof. Dr. Miguel Haller.

Presently: Head of the Bakony–Balaton Geopark Group & Earth Science Officer at the Balaton Uplands National Park Directorate, as the leading organization of the Bakony–Balaton Geopark, Hungary. Work at the Balaton Uplands National Park Directorate (since July 2003) includes:

- Launching and coordination of the Bakony–Balaton Geopark project, since the beginning (2005);
- Launching and coordination geotourism programmes (adventure cave tours, geological interpretive sites, geological/volcanological trails, etc.);
- Organizing and lecturing in training courses for geotour-guides (7 regions within the geopark territory until now);
- Various tasks for the European Geoparks Network, as a member of the Coordination Committee (since 2012);
- Coordination of the project “Conservation of abiotic natural assets within the operational area of the Balaton Uplands National Park Directorate”, supported by the EU (2008–2013);
- Geological nature conservation activity (protecting geological key sections and other types of geosites, creating management plans, preparing of designation for preservation of geological and morphological assets, etc.);
- Creating and updating a GIS database on geosites.

**INVITED SPEAKERS
ABSTRACTS**

Geotourism for Maximum Benefit: The National Geographic Approach for a Sustainable Destination

Jonathan B. Tourtellot

Geotourism Editor, *National Geographic Traveler*, USA, jbtourtellot@gmail.com

The presentation addresses tourism trends in the 21st century, implications for the Azores, and a geotourism strategy that can maximize tourism benefits while minimizing negative impacts. Specifically, we survey tourism threats and opportunities; how different styles of tourism relate to the locale; research on differing tastes of U.S. travelers; and the most rewarding types of tourists for targeting in a marketing plan. We review the evolution of the term “geotourism,” the National Geographic rationale for it, and the Arouca Declaration of 2011.

The presentation then examines the Geotourism Strategy and Principles with a regard to how they might apply in the Azores, including the geotourism virtuous circle and its challenges, the need for community engagement, measures of success, and creative geological interpretation. The preferred way to implement these principles is to convene a Geotourism Stewardship Council for the Azores. We look at its recommended composition, roles, and options for taking action.

A second workshop session is planned to take the first steps toward forming such a council and selecting an initial catalytic project.

Speaker: **Jonathan B. Tourtellot**

Geotourism Editor, *National Geographic Traveler*, USA, jbtourtellot@gmail.com



Mission Programs

Center for Sustainable Destinations

About Geotourism Stewardship Councils

A Geotourism Stewardship Council is a nongovernmental or public/private entity. A Council may be national, regional, or local. It may go by any name, or coalesce around an existing group, but has the characteristics described below.

The Council's task is to oversee and advise on the four activities of a geotourism strategy:

- identifying,
- sustaining,
- developing, and
- marketing the geotourism assets of a place.

Council advice and activity should be in keeping with the interests of the communities, with good conservation and preservation practices, and with responsible economic development. The Council encourages appropriate tourism in appropriate places, and discourages inappropriate tourism in unsuitable places. The Council should subscribe to the principles embodied in the Geotourism Charter and in the geotourism definition:

Tourism that sustains or enhances the geographical character of a place—its environment, geology, heritage, aesthetics, culture, and the well-being of its residents.

Council activities are intended not only to promote geotourism assets to tourists but also to be a catalyst for local communities—to help them discover their own distinctive tourism assets and provide economic benefits and an incentive for protecting them. The Council should monitor sustainability and ensure that tourist capacity is appropriately managed, while still encouraging maximum benefit per visitor (local spending, etc.) Catalyst activities might include:

- Hosting an annual festival to build local pride and awareness, while garnishing tourism spending in the destination
- Creating a Geotourism MapGuide with National Geographic or a local university, and extensive local participation
- Reviewing and providing recommendations on tourism developments and proposals
- Serving as ongoing gatekeeper and clearinghouse for community-generated geotourism information that is then issued electronically, via the Internet and handheld devices

Council members should represent the following interests:

- historic and archaeological preservation
- natural conservation, including habitats and geological sites
- communities
- indigenous peoples and other cultural minorities
- traditional arts (craft, music, dance, theater, storytelling, reenactments, etc.)
- destination management and marketing organizations
- farm/restaurant programs, agritourism, Slow Food
- beautification programs (signage, architecture, and scenic landscape concerns)
- other stakeholder groups emblematic of the locale
- government (tourism, planning, environment, culture, and economic development)
- private businesses compatible with geotourism

Local collaborators and advisors potentially include:

- Geotourism innovators — guides, innkeepers, restaurateurs, tour operators, etc.
- Local arts, craft co-ops, music groups, or other heritage groups
- Agricultural cooperatives, historic preservation groups, conservation organizations (including ecotourism leaders)
- Community leaders or individuals with deep knowledge of the area's heritage, especially older individuals
- Church groups, school associations, universities, volunteer/charity organizations
- Local geographical, historical, or travel author
- Historians, naturalists, librarians
- Local minority or heritage groups and experts
- Specialists in locally based food and drink

Proactive people from this list may also be appropriate members for the Council.

Procedures. Each destination must tailor an approach appropriate to local circumstances, so there is no formal, prescribed method for choosing council members and sustainable funding of council activities. Generally, a robust council will draw from government, civil society, and the private sector. Until the Council becomes self-supporting, one or more member organizations can serve as its fiscal agent. To ensure continuity, government should not control the Council, although it should have a significant role.

Operationally, the Council can work in a continual cycle:

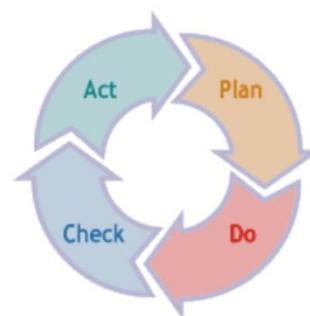
Plan—Planning, including identifying stewardship aspects and establishing goals

Do—Implementing, including training and information dissemination

Check—Monitoring and progress reviews

Act—Taking corrective action as indicated

The Council best functions through a collaborative website, possibly hosted, but not controlled, by one of its members.



For more information, contact the Destination Stewardship Center, info@destinationcenter.org, or National Geographic Fellow Emeritus Jonathan Tourtellot at 1 202 329-2372.

Volcanic Geo-heritage. Sustainable Tourism Development in Volcanic Regions: Geoparks, National Parks and World Heritage Sites

Patricia Erfurt-Cooper

James Cook University, Australia, Research Scientist, Consultant, Lecturer, Author; patricia.erfurt@my.jcu.edu.au

Protected sites such as National Parks, World Heritage sites and more recently European and Global Geoparks, have increasingly gained in popularity over the last few decades. The Global Geoparks Network (GGN) is now in its 11th year with growing numbers of candidate sites awaiting UNESCO recognition as a GGN member.

The main elements of the Geoparks concept are *Geotourism*, *Geoheritage*, *Geosites* and the overall *Geodiversity* of a region including natural, cultural and human resources. Geoparks are usually not confined by boundaries of a particular landscape or countryside, but can incorporate existing national parks, other protected sites, agricultural areas, forests and beaches as well as towns and villages and private properties. Existing infrastructure can be utilised to access all destinations within the Geopark.

Because of their abundant natural and cultural resources Geoparks present an effective method to promote the geological heritage as well as the overall geodiversity of a region. In addition Geoparks and World Heritage areas encourage sustainable and responsible geotourism, which has a lower impact on the environment and at the same time raises awareness about the importance of conservation.

Apart from their unusual landforms these remarkable geosites contain a wealth of attractions such as interpretive centres, various types of museums, guided tours and hiking trails, educational seminars and workshops, plus a vast array of regional specialities. Growing visitor numbers lead to improvements of local infrastructure and further (sustainable) destination development.

Global Geoparks are frequently based on volcanic heritage, both active and dormant. One of the latest official GGN members is the Japanese Mt Aso Geopark, which will be discussed in one of the case studies of this presentation as an example for capacity building within the local community and the concept this is based on.

Further examples of local stakeholder involvement from a number of Geoparks and World Heritage areas (WHA) will be used to emphasize the unique opportunities to improve their economy that are available to host communities. Volcanic Geoparks in Japan, Indonesia, Germany and Australia will be examined to compare different regional settings and their geodiversity. The below table presents a few volcanic Geoparks, both national and global.

The examples and case studies will also explain why some Geoparks either lost their global recognition or why they are not accepted into the GGN as members, despite generally being in line with the criteria and guidelines as defined by UNESCO.

To be part of and accepting ownership of their Geopark is an important step for all stakeholders that is not taken lightly by some communities or by their local government representatives. To achieve a beneficial outcome for the host communities the Geoparks concept is encouraging local stakeholders to get involved in all aspects of sustainable development. The secret to progress and to enhancing the local or regional economy is to be pro-active and creative in the development of “geo-products” that reflect the local flavour and culture.

VOLCANIC GEOPARKS	
Kanawinka Geopark, Australia	Penghu Geopark, Taiwan
Hong Kong Global Geopark, China	Batur Global Geopark, Bali, Indonesia
Leiqiong Global Geopark, Guangdong, China	Jeju Island Global Geopark, Korea
Wudalianchi Global Geopark, Heilongjiang, China	Vulkaneifel European & Global Geopark, Germany
Itoigawa Global Geopark, Japan	Magma European & Global Geopark, Norway
Aso Global Geopark, Japan	Shetland European & Global Geopark, Scotland, UK
Toya Usu Global Geopark, Japan	Katla European & Global Geopark, Iceland
Unzen Global Geopark, Japan	Azores European & Global Geopark, Portugal

The OVOP Movement (One Village – One Product), which originated in Japan, could be a factor in regional vitalisation through discovering special geo-products that best represent individual towns or villages. The concept of OVOP together with geotourism encourages and supports the creation of a cottage industry and local enterprises to manufacture these geo-products. Geoparks consequently stimulate local socio-economic development, empowerment and capacity building by developing and promoting individual local brand names of quality products related to the natural and cultural heritage of the region. Relevant examples from volcanic Geoparks will be used to showcase successful geo-destinations.

While geotourism is predominantly based on the natural heritage such as local geology, the cultural diversity of a region and the geography often overlap with the natural resources. In fact, the geological diversity and the geographical diversity are quite closely linked and sometimes hard to separate. For the purpose of defining geotourism taking into consideration both sides seems to be a reasonable approach, especially as geotourists have many different interests. The framework in Figure 1 illustrates the differences and the similarities and puts the concept of Geotourism into perspective.

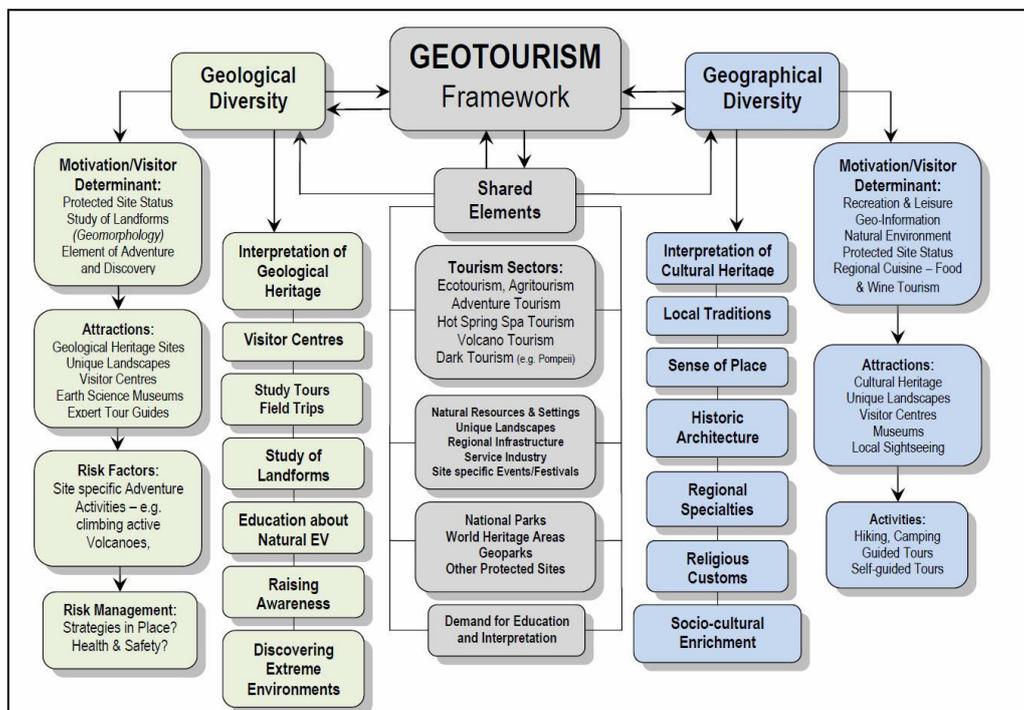


Figure 1. This Geotourism framework can be used for a preliminary assessment of the geotourism potential of a region. © P. Erfurt-Cooper

Volcanic Geoparks, both active and dormant, are attractive destinations for geotourists and offer an element of adventure. Volcano tourism or volcanic geotourism is becoming increasingly popular as people are interested in exploring unique natural areas and learn more about them. Volcanic Geotourism can already be classed as mass tourism in countries including Iceland, Japan, Costa Rica, New Zealand, Spain and Italy.

Geotourism in the Azores: Considerations About a Decade Experience

Matteo Garofano

Geotourism Association, Genoa - Italy, garofano@geoturismo.it

Geotourism, in its “geological tourism” meaning, is a niche of the natural area tourism. Nevertheless it could be a strong leverage to encourage people to make a trip to a destination. Geotourism present common problems that limit its development. Some of those problems are less relevant in some special places of the planet such as the Azores Islands. The Azores island, in fact, present interesting aspect that make it a valuable bench to the test the geotourism potential.

In this paper the author presents considerations about a decade of experiences of geotourism in the Azores archipelago with Italian groups. The focus is on the positive and negative aspects evidenced during the geotouristic activity in the Azores and the potential area of further development and improvement.

The geotourist profile

It is possible to outline a profile of the Italian tourist that decided to travel in a geotouristic trip to the Azores. The information about their motivation, social and cultural status are useful to understand and better address the communication during the informational stage and also to select suited services and better organize the trip.

The Italian tourist that make geotourism in the Azores is a frequent traveller but also participate people in their first geotourism experience. Many of them declared their desired to visit an environment from a different point of view. Traveller mean age is 40 years, it increased in the last 5 years. They are mostly self-employed and anyway with medium-high income level (lawyer, teacher, doctor). They also have a medium / high cultural level, both couples as well as singles (especially women).

The profile is similar to that outlined for other geotouristic trip organized for Italian to other geotouristic destination (Iceland, Canary Island, Madeira, Bolivia, Marocco, etc.).

The “islands effect”, why are the islands attractive to tourists?

The islands: the identity of a territory marked. Each season thousands of tourists embark and leave for an island where to spend their holidays. In modern times due to the wide availability of fast transportation, distances are compressed in time. The islands, with their natural geographical boundaries clearly defined, resist such space compression and well identifies the “distant place” where is possible to realized the escape from modernity and urbanization. For this reason, the islands, in modern popular consciousness, appear to be the place where nature is preserved and traditions remain unchanged. This modern stereotype is accompanied now since fifteen years, by the production of tourism advertising industry that has adopted the island as the representative image of the ideal holiday location. Thus, today the island is for many people a symbol of the ideal holiday. The insularity, as marked identity of a territory and as idealized place of escape, is regarded by some marketing researchers as one of the greatest asset of the islands from the point of view of tourism.

On common problems found in the development of geotourism.

Geotourism is a relative new resource for the tourism business but it also present some problems in its development. Some of them are related to the relation to the nature of science and Earth science. The specific language of science is a barrier between the people's everyday experience and the understanding of natural phenomena. Earth sciences has peculiar aspects that make arduous its comprehension. One of the major problem is represented by the scales involved in geological phenomena that are often not perceived through the senses by the observers. The time scale in the majority of geological phenomena is of millions of years, it is therefore not suitable for human perception.

The spatial scale of geological objects is often out of our ability to observe with naked eyes, it ranges from extensions of thousands of miles in plate tectonics and geological structures to microscopic objects typical of the mineralogy and micropaleontology.

To make it even more difficult the task of popularize geological sciences it should be added that geology is a deductive science and therefore geological phenomena are, in most cases, not reproducible. Problems of interaction between tourism and geology are also common. Geology is a scientific discipline that uses objective criteria, meanwhile tourism is a recreational activity that takes subjective and aesthetic criteria. Geology and tourism are, therefore, very different disciplines that can co-exist and be practiced in a synthesis called geotourism. For good efficiency should not overlook key aspects of each one aspect. The scientific aspect is essential to maintain the rigor and not trivialize the subjects. Geotourism is addressed to a non-expert audience so is a priority to pursue the ludic aspect of the tourism by mean of active participation and direct perception.

From these observations (Figure 1) arise that not all areas of research investigated by geology, in its broadest sense, are suitable to be the subject of geotourism.

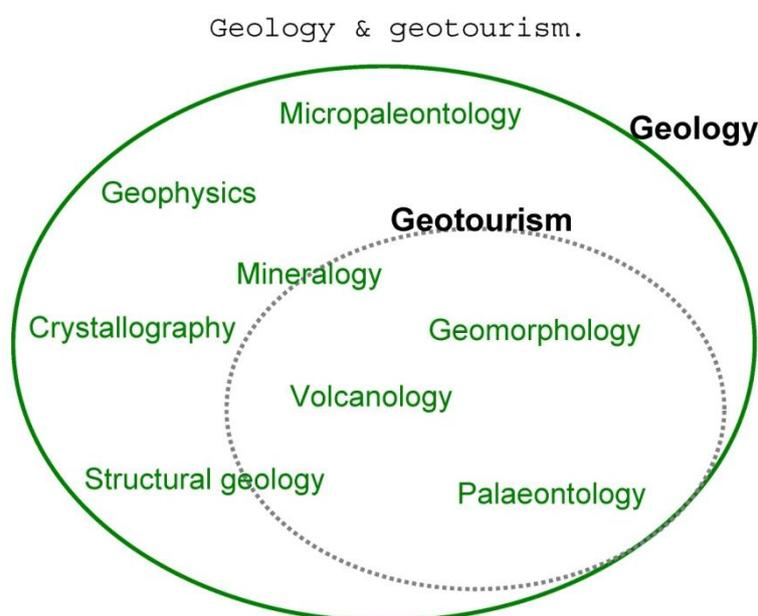


Figure 1. Area of interest of geology and geotourism.

Best geological subjects and places for geotourism

As consultant in geotourism and working with tourism company, the author choice of the localities where to play geotourism is made following a few basic criteria such as the high visual

impact (aesthetics geotourism) of the places where the geological phenomena occur, the potential to arouse attention and curiosity and the "geological clearness" (visibility and comprehensibility).

Another key criterion is the adoption of the pertinent language in all forms of geotourism communication, as much as possible appropriate to the audience without sacrificing scientific accuracy.

The method adopted as often as possible is by means of "direct contact" meaning to proceed in the observation of geological phenomena in the place where it is situated or "*in situ*".

Also the entire perception sphere should be involved to produce a positive experience in the tourist. The volcanic area are by far the more suitable subject that fulfil those requirements.

- sight, not only, landscape but also movement in human-scale time;
- hearing, the volcanic activity such as eruptions and hydrothermal activity produce sound;
- taste, only in special occasion it could be involved in the geotourism experience;
- smell, the volcanic activity often, is accompanied by the emission of odorous gases;
- touch, not only the volcanic rocks could produce the sensorial experience but also the high temperature of the terrain and gases of the geothermal areas.

Positive aspect of the Azores as geotourism destination

The positive aspect evidenced by the geotourists during their trips to the Azores Islands are many.

The first consideration is related, as partially described above, to the people desire to reach remote and less known destination such as the islands. The Azores have the advantage to be in the middle of the Atlantic Ocean and to be an archipelago. In the tourists perception the Azores are far from the rest of the world but they give the opportunity to visit more than one single place (9 islands).

The natural and geological heritage is rich and well preserved and tourists have the clear perception of it. Geotourists consider this aspect of paramount importance in their travel experience.

The Azores Islands present sceneries that are mainly due to relevant geological processes which can be easily explained to people, also to one with no geology background (Figure 2).

The geological processes are still going on, so the geotourist can do a 5-senses experience in the Azores. From the visible shapes of the volcanic cones and calderas to the touch of hot water and steam of the various geothermal areas, to the taste of the traditional food "cozido nas caldeiras" (Figure 2).

The climate is also a positive aspect offered to tourists in the Azores, since is temperate almost all year long and could offer a very long touristic season. Nevertheless some aspect of the climate are not liked by people such as the high humidity and often rains.

Another important positive factor shown by the Azores is the **price level** for most of the services. Even if, in the last 3-4 years, the price raised closer to the European mean, they are still cheap for important services such as restoration and transport.

Negative aspects of the Azores as geotourism destination

One of the singular aspect working with the Azores as a tourist destination for Italian is that only a small number of Italian know the exact location of the archipelago. Also little is known about their nature, tradition and culture.

If this lack of knowledge could stimulate curiosity on the other hand it largely limit the number of potential visitors.

The geotourist during his trip to the Azores, looking for preserved environment, tend to prefer as location small structure managed by family. In some islands of the Azorean archipelago only few of them are available. Even taking into account all the different typology of accommodation during some period of the year the availability of rooms tend to be problematic.

If the remote location of the Azores is attractive to tourist as drawback there is, at least coming from Italy, the absence of direct flights that connect Italy to the Azores. This is one of the most important limiting factor to the development of the Italian tourism to the Azores.



Figure 2. Experiences in the Azores.

Conclusions and areas of development

The observation during the last decade shows that in the Azorean archipelago the tourism is getting more attention and more services are available. A much wide documentation is available and easily accessible. Also the decision to target the tourist offer to the specific natural tourism audience is clear and have positive effects.

The strategies adopted in the last years seems to have positive effect and also the geotourism is giving its contribute to the whole Azorean tourism industry. Anyway the infrastructure support could be improved and better organized to support tourism.

Also the communication is an aspect that can be improved and can offer an higher level of interest about the Azores.

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Geology and tourism – from the first attempts up to a functioning geopark. The Vulkaneifel Geopark as case study

Andreas Schüller

Managing Director of the Natur- und Geopark Vulkaneifel GmbH (Ltd.), Daun, Rhenania-Palatinate, Germany, andreas.schueller@vulkaneifel.de

During the 1990ies the idea of geoparks, to link the non-living earth heritage with the living natural heritage, arose and widened the view on the natural processes to a much more holistic approach. Furthermore the geopark idea looks on the effects the geologic nature has on human activities and includes the influences of natural landscapes on the cultural and historical, even economic development of regions. Through increasing public awareness the earth sciences convey their valuable contributions for society and opened new ways to support economical development in rural areas, especially through offering the geological asset of a region to be used for touristic marketing. From now on geotourism received a much more wider perception.

In Vulkaneifel, the change in agricultural production triggered negative demographic and economic effects. Local politics and communities were induced to think about new ways to vivify local economy. To promote Vulkaneifel as a tourism destination was one of those ways. Long before the first geoparks were inaugurated officially (in 2000), in Vulkaneifel the geological and in particular the volcanic formation of the landscape has been used as an important regional feature for tourism promotion since the late 1970ies. With thematic pathways and auto-routes interpreting the regional geologic assets the region contributes to the popularization of geosciences and thus transfers the scientific relevance into an instrument for tourism marketing. In the 1990ies a decentralized concept of info-centres was established, the so called geo-museums. In that context the “Vulkaneifel Magazine” issued by the geopark has consolidated its position as the most useful and accepted print media for tourism marketing in Vulkaneifel today.

Through the years, the style of science popularization and geotourism marketing has made progress as can be seen in the new design of visitor information panels, co-operations with business, qualification of geopark-guides and bringing back the local geography and history (Heimatkunde) to kindergardens and primary schools. Recently in Vulkaneifel the first steps were taken to vitalize landscape experience for visitors by implementing the concept of “story telling”. Without neglecting the scientific facts and correctness, visitors and also residents should make their individual experiences in understanding and valuing the landscape of Vulkaneifel with all facets: Along newly established hiking trails geology, geomorphology, culture, history etc. etc. are thematic contend and/or act as narrator of a story.

A plan to the future development of the Geopark: After more than three decades of dealing with “Geo...” in Vulkaneifel a new masterplan for the future targets was compiled in an extensive participatory process. Three pillars of activity were elaborated in accordance with the pillars of sustainability. The basic idea is, to strengthen the esteem of their homeland by increasing the knowledge on the non-living and living nature in the local population through environmental

education. With a high extend of regional identity a region will be able to represent itself with a higher level of authenticity which is a core requisite of rural tourism marketing.

Diverse volcanic features as dominant landscape elements and pillars of geotourism in the Bakony–Balaton Geopark, Hungary

Barnabás Korbély

Head of Bakony–Balaton Geopark Group, Earth Science Officer, Balaton Uplands National Park Directorate; korbely@geopark.hu

Bakony–Balaton Geopark was accepted into the European and Global Geoparks Networks in September 2012. The 3,244 km² Geopark is located in western Hungary, near Lake Balaton, the largest lake in Central Europe, at the boundary between four major geographic regions. Therefore it is characterized by a variety of geological, topographic, climatic and hydrological features and by its extensive biodiversity. Altogether 24 of the 45 geosites are located within protected natural areas of national interest (Balaton Uplands National Park, Protected Landscape Areas, Nature Conservation Areas) and/or the geosite is itself protected by law (e.g. caves, sinkholes). The Geopark territory comprises administrative areas containing 151 settlements with 330,000 inhabitants. There are 90 villages where less than 1,000 people live.

Bakony–Balaton Geopark, with its long tradition of geological research is one of the places on Earth where the outstanding geodiversity is not only described in scientific papers but is also beautifully reflected in the landscape. More than four-hundred-million-year-old metamorphic rocks, fossil-rich Alpine Triassic limestone sequences, dinosaur-bearing Cretaceous rocks and tropical tower karst (Bakony Mountains), sediments of the former Lake Pannon containing diverse endemic species of molluscs, gorges and karst plateaux featuring 700 caves, hundreds of sinkholes, a 9-km-long thermal-water maze under a town and more than 1,600 clear-water springs can be found in the Geopark. Here you can see the emblematic volcanic remnant hills of Tapolca Basin (details below) and ‘seas of stones’ around Káli Basin areal so geological-geomorphological curiosities.

Added to this geological wonderland is the legacy of five thousand years of human occupation: the rich archaeological heritage of the prehistoric and Roman times, ruins of medieval castles, old monasteries, the two-millennium-old but still existing viticulture and beautiful examples of traditional folk architecture.

Basaltic volcanic activity in the Mio-/Pliocene

At the beginning of the late Miocene (approximately 11.3 million years ago) an inland sea came into being, which was separated from the other basins of the Paratethys Sea. It became diluted by the rivers running into it and, by the end of the Miocene, it was filled up with sediments transported by streams. Lake Pannon of a huge areal extent occupied the predominant part of the Carpathian Basin, and throughout 4–4.5 million years it covered the prevailing part of the Transdanubian Range and encircled its higher areas which rose above the water surface.

During the last phase of the Alpine orogeny – in connection with the up warping of the mantle, along faults within the crust – basaltic magma rose up to the surface and one of the densest volcanic fields was formed in Europe: approximately 50 volcanoes erupted in the Bakony–Balaton Volcanic Field (due to the volcanic complexes and nested volcanoes, the number of vents may be far more than 50) – Figure 1. The initial phase of the intense basaltic volcanism provided a small amount of pyroclastics and lava during the late Miocene. Phreatomagmatic explosions started approximately 8 million years ago in the area of the Tihany Peninsula. The explosive nature was

due to the interactions between the hot alkali basaltic magma and water or water-saturated sediments. Subsequently, the predominant part of the volcanoes in the Balaton Uplands were characterised by a calmer activity producing lava fountains and cinder cones, nevertheless, the activity that produced lava flows was the most common one.

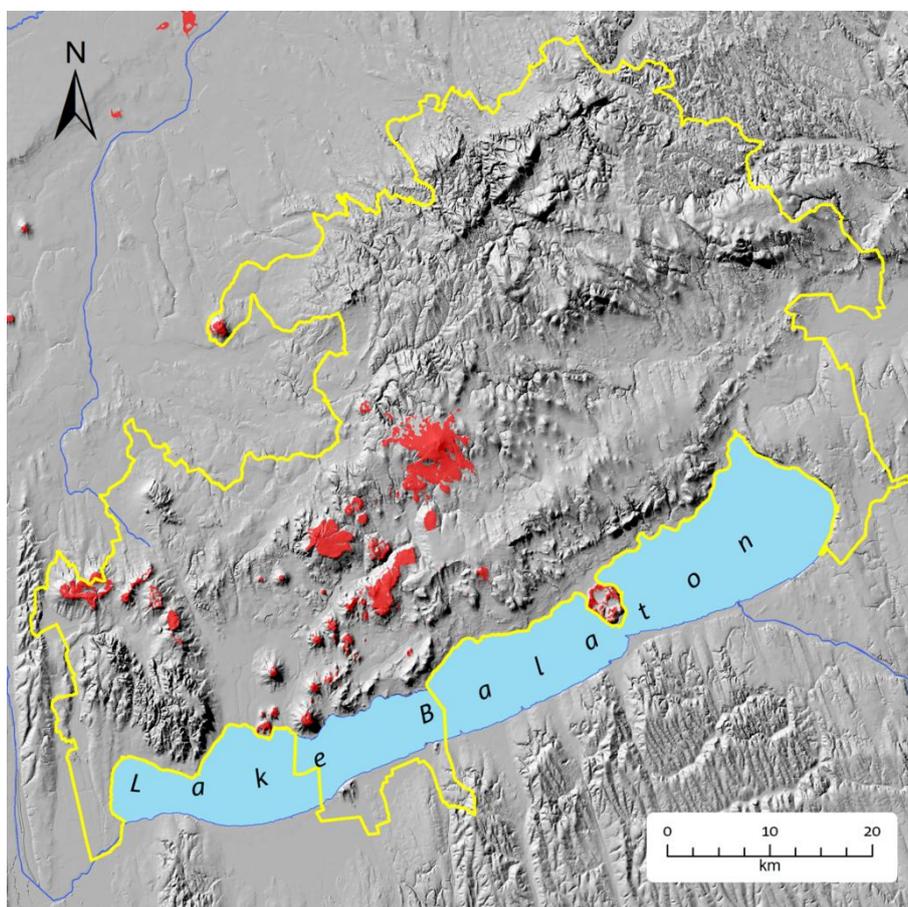


Figure 1: Distribution of Tapolca Basalt Formation within the Bakony–Balaton Geopark.

Phreatomagmatic explosive volcanic activity started in the Tapolca Basin and Káli Basin over the Pliocene erosional surface but in other places extensive lava fields were developed. In the lakes which came into being inside the tuff rings of the volcanoes, volcanoclastic deposits accumulated, or – under favourable conditions – thick, lacustrine successions were formed. Meanwhile denudation processes took place, thus erosional surfaces and different levels of the Pannonian sedimentary sequence have been overlain by the volcanic formations. In the northern areas of the Keszthely Mountains a significant part of the magma was trapped at shallow depths under the surface in the Pannonian strata (as sill and dyke systems).

Post-volcanic activity resulted in the formation of the so-called geyserites in Tihany. Actually, this rock type is not related to ‘classical’ geysers: in this case thermal springs reached the surface along volcano-tectonic fractures. Carbonates and dolomitic sediments were precipitated from their water, which was rich in dissolved substances and the subsequently precipitating silica saturated the lacustrine sediments.

Strong climatic fluctuations during the Pleistocene created variable landforms and peculiar sediments. Due to frost disintegration, mainly slope debris accumulated on retrograding hillsides

in the dry and cold periods (periglacial). During interglacial periods water courses – fed by the abundant rainfall – carried a significant amount of loose sediments away. This led to the formation of the basalt-capped volcanic remnant hills in the Geopark (the Hungarian word for these volcanic landforms is ‘tanúhegy’ which means ‘witness hill’ because they represent the quasi-level of the Pliocene palaeo-surface).

Extinct volcanoes, active geotourism

This area has one of the richest geological heritages in Hungary and the tradition of activities concerning geological nature conservation and interpretation has been present for many decades. The tourism service network of the region, the high number of accommodation providers (regarding guest nights, the Balaton Region is the second most popular destination of Hungary), the interpretive sites and visitor centres, the several-hundred-kilometre-long marked hiking paths, the nature trails provide an excellent background for geotourism.

The Balaton Uplands National Park Directorate, as the leading organisation of the Geopark, operates 14 interpretive sites, 7 of which are related to the geological-volcanological heritage. While, during the hot summertime, mass tourism (crowded beaches, etc.) characterizes the shoreline of the Lake Balaton, the beautiful geosites are easily accessible and thus, we can say, more and more people ‘escape’ to the silent and peaceful world of the Geopark.

The Tihany Peninsula, as a recognition of its outstanding geological and volcanological heritage, has been a European Diploma awarded area since 2003. Its almost thousand-year-old Benedictine abbey attracts hundreds of thousands of tourists every year. Many of them wander among the geological values, which can be found along the Lajos Lóczy Nature Trail, named after a famous Hungarian geologist (the first nature trail of Hungary, established in 1984). In the middle of the peninsula, the Lavender House Visitor Centre opened in 2011, which is also the Eastern Gate of the Bakony–Balaton Geopark. There are many installations (e.g. the visitor can take a walk inside a basalt scoria cone) and a full HD movie related to the volcanism in its exhibition.

The abandoned quarry of Hegyestű, located only a few kilometres from the lake, is one of the most important geological demonstration sites of the Bakony–Balaton Geopark. The former quarrying area – developed on the hilltop – is the memory of an early success of the Hungarian nature conservation, as the quarry was not opened on the side that is facing Lake Balaton; therefore the hill – watching from the lake shore – has retained its original, natural shape. The nearly 30-m-high wall of the quarry is made up of basalt (more precisely basanite) characterised by columnar jointing, and this is one of the most beautiful and spectacular occurrences in Hungary.

The geological interpretive sites are run by local entrepreneurs or by local employees of the leading organisation. We aim to sell more and more local products at these sites to provide an even higher quality for geotourists and to promote a sustainable local economy.

Our long-term plan is the development of the Bakony–Balaton Geopark Visitor Centre at Kopasz Hill (in the Káli Basin). This site boasts a 260-metre-long tunnel carved into the volcanic rock, which could be a special element of the future exhibition site.

We can say without any prejudice that the most emblematic landscape of the Bakony–Balaton Geopark is the Tapolca Basin (Figure 2), with its spectacular volcanic remnant hills (note that even the logo of the Geopark represents the outlines of these hills). Badacsony, next to the northern shoreline, definitely is the best-known extinct volcano of Hungary, partially because of the fine wines of the region. Basalt ‘organ pipes’ of the Szentgyörgy Hill and the ruins of medieval castles on some hilltops are also very popular destinations for hikers (four of these remnant hills are along the route of the ‘National Blue Trail’, which crosses Hungary in an E–W direction).



Figure 2: Volcanic remnant hills in the Tapolca Basin.

Apart from the programmes and events of the Geopark (e.g. guided geotours, educational programmes and contests for pupils) there are many geotourism programmes provided by local geotour-guides, who have been trained in our geotour-guide courses (Figure 3). Until now 7 regions of the Geopark have been covered by the trainings and 4 of them (the most popular ones) were related to our volcanological heritage. Currently 98 people have 172 geotour-guide certificates (some really enthusiastic participants attended more than one course) and 15 geotour-guides have signed a cooperative agreement with the Geopark organisation about their geotourism-related activities. Thanks to this mutually beneficial contract, they are allowed to use the ‘Bakony–Balaton Geopark Partner’ term and logo, their geotours are published and promoted via our website (www.geopark.hu), our popular Facebook page and Rajongeo mailing list (the name of the list is a pun: ‘rajongó’ means ‘fanatic’ in Hungarian).



Figure 3: Training for geotour-guides on the top of the SzentGyörgy Hill.

More and more service providers, civil organizations and local governments are seeking to become Geopark Partners to promote the goals of the Geopark and to develop their services, linked to the local geoheritage. Our aim is to intensify the cooperation with Geopark Partner schools operating in the volcanic areas: pupils will help to manage geosites, maintain the volcanological trails, etc.

**ORAL PRESENTATIONS
ABSTRACTS**

Azores Geopark volcanoes and volcanic landforms. Valuing the Azorean geodiversity and geosites through the geotourism

Nunes, J.C.

Azores University Assistant Prof., Azores Geopark Scientific Coordinator, Azores, Portugal, jcnunes@uac.pt

Azores Geopark Volcanoes and Volcanic Landforms

The Azores Archipelago is located in the North Atlantic at the distance of 1815 km from the Mainland Portugal, and is formed by nine islands and several islets, which are dispersed along a strip with 600 km length and with a WNW-ESE trend (Figure 1). The archipelago lies on the triple junction between the North American, Eurasian and African (or Nubian) plates and, in general terms, the intervening plate boundaries are the Mid-Atlantic Rift, separating the American plate from the Eurasian and African plates, and the Azores-Gibraltar Fault Zone, bounding the latter two plates.

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. Earthquakes reaching magnitude 7 and successive pre-historic surface fault ruptures that produced well-developed fault scarps, represent recent seismotectonic and neotectonic activity.

All the Azores islands are of volcanic origin and are all oceanic islands that emerged from the surrounding seafloor due to the progressively piled up of submarine volcanic products, a deep-sea process that should have started about 36 million years ago. Thus, the Azores islands emerges from the Azores Plateau (or Azores Platform) defined by the 2,000 meters bathymetric line and which makes the transitions to the surrounding abyssal seafloor (Figure 1). The oldest terrestrial volcanism (8.12 million years) outcrops in Santa Maria island and Pico is the youngest island of the archipelago, that emerged about 300,000 years ago.

There are 27 main volcanic systems in the Azores Islands, being 16 major central volcanoes (most of them silicic and with summit subsidence calderas) and 11 volcanic ridges associated with fissural basaltic volcanism. Among these, 9 major polygenetic volcanoes and 7 areas of fissural basaltic volcanism are active (even dormant today) and are located on the islands of São Miguel, Terceira, Graciosa, São Jorge, Pico and Faial and the D. João de Castro Bank. Offshore near the islands are located important active submarine volcanic ridges, like the Monaco Bank (south of São Miguel), the Princes Alice Bank (SW of Faial) and the Serreta Ridge (W of Terceira), where took place the 1998-2001 “serretian” type eruption, the last on in the Azores region.

Moreover, there are about 1750 monogenetic volcanoes in the archipelago, either dispersed along the flanks and inside the summit depression of the polygenetic volcanoes, or belonging to the 11 basaltic fissural volcanic systems located in different islands. These monogenetic eruptive centres include domes and *coulées*, tuff rings and tuff cones, *maars*, scoria and spatter cones, and eruptive fissures. Many of those volcanic landforms and landscapes are considered 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 geosites are also worth mentioning, such as the Mid-Atlantic Rift (with the Lucky Strike and Menez Gwen black smokers associated with those deep-sea

hydrothermal fields) and the D. João de Castro Bank seamount volcano that erupted in 1720 A.D. and whose summit (at a depth of 12 m) presents an impressive fumaroles field.

Thus, the Azores can be considered a natural laboratory of international relevance with regard to active volcanism, volcanic and tectonic landforms, global plate tectonics, and neotectonics. 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 was evaluated at the aim of the Azores Geopark project.

Geodiversity, Geosites and Geotourism

The international relevance of the Azorean geodiversity, the high number and quality of its geosites and the undoubted importance of its geological heritage, together with a rich biological and cultural heritage, supported a major effort of the Azores Government to implement Geoconservation and Environmental Education policies. This resulted in the creation of the Azores Geopark and its application to the UNESCO's Global Geopark Network.

The Azores Geopark, the 53rd geopark of the European Geoparks Network, after March 2013, is also supported on strategic decisions of the regional and local authorities to develop Nature Tourism policies based on the most effective tourism icon of Azores: its volcanoes and volcanic landscape.

Despite its small land surface (2,324 km²), the archipelago offers a wide diversity of landforms, together with different types of rocks, structures and features, which derive namely from the type of eruption that originated them, its dynamics, the nature of the magmas, and the subsequent actions of weathering and erosion processes, and thus constitutes a natural laboratory of volcanic geodiversity.

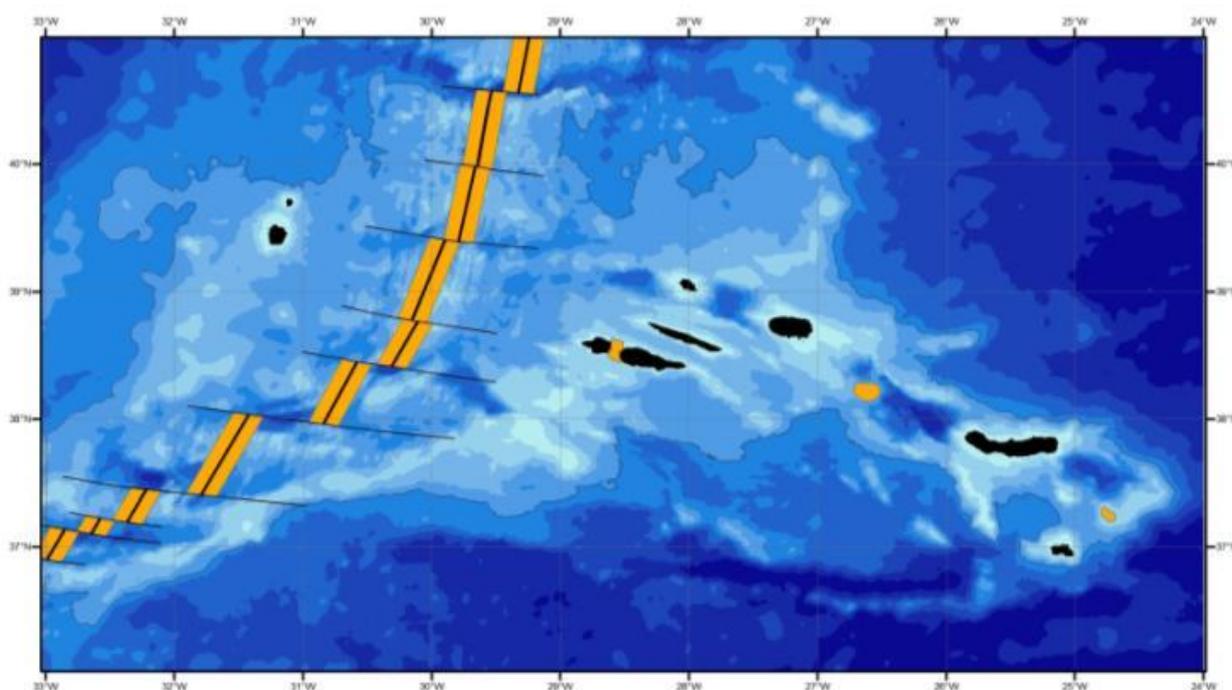


Figure 1. The Azores Geopark (total area of 12,884 km²) includes all the 9 islands of the archipelago (2,324 km² of land surface) and four submarine geosites.

The Azores archipelago includes 121 geosites dispersed by the nine islands and the surrounding seafloor (Figure 1), with relevant scientific, educational and touristic value. Thus, volcanoes, calderas, lakes, lava fields, fumaroles, hot springs and thermal waters, volcanic caves, "fajãs", fault scarps and marine fossil deposits, among many others, belong to this network of geosites.

Among those, 57 are considered as priority geosites for the Azores Geopark, and includes 6 geosites of international relevance: the Mid-Atlantic Rift and associated deep-sea hydrothermal fields, the Furnas Volcano caldera, the Pico Mountain Volcano, the Graciosa Caldeira and Furna do Enxofre volcanic cave, the Capelinhos Volcano and the Algar do Carvão volcanic pit.

Given the insular nature of the region, the Azores Geopark is supported on a geosites network dispersed by the nine islands and the surrounding seafloor, i) that ensures the representativeness of the geodiversity that characterizes the Azorean territory, ii) that reflects its geological and eruptive histories, iii) with common geoconservation and promotion strategies, and iv) based on a decentralized management structure, with support in all the islands.

Besides the geological heritage of the Azores Islands, there are other values of reference in the archipelago, such as its rich biodiversity and the architectural, cultural, ethnographic and immaterial heritage of undeniable value.

The Azorean geo-landscapes are the main *ex-libris* of the archipelago, with huge potential for tourism due to its attributes of great attractiveness and good opportunities for sustainable use. Thus, visitors and tourists are welcomed to do walking trails, visit viewpoints, belvederes and tea plantations, do whale-watching, dive into the blue ocean, do bird-watching, enjoy the regional handicraft, taste the geothermal Furnas stew (cooked in the ground at a fumarolic field), taste the regional sweets and wines or take a bath on warm waters ... while visiting and being part of a fascinating tour on an active volcanic landscape.

“Come to meet the Azorean volcanoes and *enjoy an eruption... of Flavours, Smells and Experiences*”, is the Azores Geopark slogan that says it all!

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Geotourism and sustainable development partnerships in the Azores Geopark

Machado, M.¹ & Lima, E.^{1,2}

¹ Azores Geopark, Azores, Portugal, marisamachado@azoresgeopark.com; evalima@azoresgeopark.com

² Geosciences Department, Azores University, evalima@uac.pt

Azores Geopark

The Azores Archipelago is located on the North Atlantic and is composed by nine islands of volcanic origin that are distributed in geographic terms in three groups.

The Azores geodiversity presents elements closely linked to the dynamics of Planet Earth, in particular, the volcanism and geotectonic of this Atlantic region, with the archipelago as a natural laboratory of volcanic geodiversity. Its morphology is characterized by different types of volcanoes, hydrothermal fields, volcanic ridges, volcanic lakes, black sand beaches and volcanic caves, among others (Lima, 2009) which represent an important basis for the growth of Geotourism in this territory.

The international relevance of the Azorean geodiversity, the high number and quality of its geosites and the undoubted importance of its geological heritage, 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, and the development of the Geotourism strongly justified the creation of the Azores Geopark (Lima et al., 2010).

Geotourism

The geotourism has been recently developed in the Azores archipelago, due to its rich geodiversity, being the volcanic landscape the main ex-libris of the touristic promotion, with a huge geotouristic potential (Nunes et al., 2010).

The nine azorean islands offer a wide range of experiences and emotions that are linked with other values like biodiversity, history and cultural heritage, providing the visitors with unforgettable experiences. All those reasons are the basis for the promotion and the development of geotourism strategies as the aim of the Azores Geopark.

The Azores Geopark has developed several products that promote the geotourism in the territory as:

- Edition of “Geosites Maps” per island, with the areas and information about each geosite and also about some support facilities in the island;
- Edition of “Azores geosites leaflet”, with a simple map, identification and photos of the geosites of the archipelago;
- Creation of several Thematic Circuits, with suggest different itineraries along the island geosites and geolandscapes. The development of these Thematic Circuits in all the islands has the goal to develop rural areas with geological interest and to promote the local sustainable development. This circuits are: i) the Volcanic Caves Circuit; ii) the Belvederes Circuit; iii) the Walking Trails Circuit; iv) the Thermal Circuit; v) the Science and Interpretation Centers Circuit; vi) the Urban Circuit, and vii) the Coastal Circuit;

- Workshops for students of tourism courses and for tourism companies, divided in theoretical and practical sessions to explain to the students some concepts related to geotourism and give them the opportunity to make a field trip to the geosites of its island and take a closer look at the geological aspects, mainly its geotouristic potential and the need to implement geoconservation measures on those geosites;
- Developing a “Azores Geotouristic Guide”, to support travellers and tourists that visit the island, but also to assist the tourism companies to promote their products and services. The guide is composed by selected geosites and geolandscapes in the nine islands and surrounding sea floor, with their description with geotouristic interest and activities that can be done in those sites (e.g. guided tours, walking trails, canyoning, diving, nature photography, among others). This guide pretends to i) provide a better knowledge and new experiences to visitors about the relevant geological heritage and geodiversity of the Azores; ii) improve the involvement of the local population and companies on touristic activities; iii) contribute to the improvement and economic sustainability of existing infrastructures and iv) contribute to the development of new touristic products (e.g. geo-products);
- Creation of “Azores Geopark Passport” to promote the thematic circuits (especially the Volcanic Caves, the Thermal and the Science and Interpretation Centers circuits), to promote the partners of the Azores Geopark and to encourage the visitors to travel between the islands.

To improve the geotourism quality in the territory, and besides the described activities, the Azores Geopark is planning several new actions and initiatives, including the creation and implementation of an Interactive Brochure, based on the Geotourism Guide to be edited in 2014.



Figure 1. Geotouristic products: A- Azores Geopark Passport, B – Geotourism workshop, C – Azores Geotourism Guide

Partnerships for sustainable development

In order to better implement the adequate management of the territory, the Azores Geopark established partnership between different institutions and companies throughout the islands, resulting in a joint work that creates important synergies, brings together common efforts and eliminates some limitations that result from the insular nature of the territory, thus promoting a true sustainable development in the territory.

Thus the geopark management is also ensured through these partnerships, supported in “Memorandum of Cooperation”, signed with several regional stakeholders, which clearly commit

themselves to respect, carry out and fulfill the European Geoparks Network Chart and to take part in and to support the geopark activities. Among these stakeholders and partnerships with relevant work in the domains of the geopark's three pillars are:

- Geoconservation: the Island Natural Parks and the Azores University;
- Environmental Education and Awareness: the Regional Network of “Ecotecas”, the AZORINA S.A. – Environmental Management and Nature Conservation Society (that manages the Regional Network of Environmental Interpretation Centers), the Regional Network of Science Centers (EXPOLAB, OASA, OAA, OMIC and OVGA) and the NGO's associations “Os Montanheiros” and “Amigos dos Açores”;
- Sustainable Regional Development and Geotourism: the Azores Tourism Promotion Board, the Regional Network of Museums, Rural Tourism Houses Association “Casas Açorianas”, Azores Association of Guides, and several tourism companies, including animation, lodging, restaurants, etc.

The Azores as a nature laboratory of geodiversity and a touristic destination should be built up on the experiences and emotions that people live and witness. The feedback from locals and foreigners have been positive, expressing satisfaction with the quality of the geosites or geolandscapes visited and the available variety of activities, products and services available. Also from the stakeholders (companies, environmental interpretation centers, and others) there have been several requests for cooperation, namely for interpretative contents, support in some activities and for staff training, reinforcing or allowing new partnerships and the development of new geotouristic products.



Figure 2. Stakeholders activities: A- Interpretative boat trip with *OceanEye*, B – Interpretative walking trail with *EXPOLAB*, C – Guided visit to Caldeira Velha Environmental Interpretation Center (Ribeira Grande Municipality partner).

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The contribution of geotourism for the reinforcement of The Azores Islands as a Nature Tourism destination

Toste, J.

Azores Tourism, Azores Promotion Board, Angra do Heroísmo, josetoste@visitazores.com

The Azores Global Geopark has a unique geodiversity and geological heritage that is the basis for a strategy of sustained development of the local communities, based on geotourism and on nature tourism, and the promotion of an economic growth of the territory with respect for its environmental values.

In the last decade, Tourism has proved to be an economic activity with great potential in the archipelago, which is strongly focused on providing emotions and experiences to visitors mostly taking profit of the major icon of the Azores: its volcanic landscape.

The mission and goals of the Azores Geopark includes the promotion of Geotourism. This desideratum is being accomplished in close cooperation between the Azores Geopark and the Azores Tourism Promotion Board, which is responsible for promoting the Azores as a tourist destination and for the qualification of the tourism offer in the Region.

As a consequence of this close partnership, Geotourism was included in recent years in the official touristic policies and is one of the Azorean touristic products, together with Scuba Diving, Hiking, Whale and Bird Watching, Meeting Industry, Golf, Health and Well Being, and Canyoning, among others.

For the next years this close partnership is being reinforced, through a joint Action Plan that makes Azores Geopark responsible for the Azorean Geotourism policies and the implementation of several activities such as: i) the Azores Geotourism Guide; ii) the edition of leaflets and brochures promoting the varied geotouristic activities; iii) the development of a geotourism web micro-site, iv) training courses for local stakeholders on the tourism area (e.g. tour operators and travel agencies, guides, animation companies and restaurants), and v) promotion activities such as press trips and fun trips.

This partnership Azores Geopark / Azores Tourism Promotion Board is a relevant tool on the management of tourism in the Azores and the implementation of policies of geoconservation that ensure the promotion of the geotourism as a touristic product of outstanding quality and reputation.

El Hierro Geopark: Volcanoes, Sports and Adventure

Montero Herrera, V.

El Hierro Geopark, Canary Islands, Spain, vmontero@el-hierro.org

The volcanic island of El Hierro, the westernmost and smallest island in the Canary Archipelago, was declared Biosphere Reserve by UNESCO in 2000. El Hierro is the island with major protected surface at the whole archipelago (60%), in proportion to its size. There are seven Protected Natural Areas (PNA) in the island that include: a Rural Park, two Integral Nature Reserves, a Special Nature Reserve, a Natural Monument and two Protected Landscapes. Some of these PNA have been declared by its geological and volcanological singularities, among others, such as: the protected landscape of Ventejis, which is the biggest phreatomagmatic caldera (maar) in the island; or the Natural Monument of Las Playas that constitutes one of the first landslides that it took place in El Hierro.

El Hierro has a population of 11,000 hab., a surface area of 278 km², a maximum height of 1.501 m (Malpaso) and due to its geographic and geology, it is the perfect scenery for practice of adventure's sports.

The variety of landscapes on El Hierro surprises any visitor who is new to the Island. This island only measure 30 kilometers from one end to the other, but offers a broad ranging diversity of scenery and landscapes. The seabeds reveal the beauties produced by a complex system of underwater volcano systems. The coastline is constantly ravaged by the ocean beating against the black basalt rock. The Island is relatively young geologically but its steep cliffs give it a dramatic profile all of its own. The wild juniper trees, petrified beauty, bravely face the wind that crashes against hills and slopes. The laurel forest is permanently green and offers the only humidity that there is on an island with a long history of thirst. The higher reaches offer pine trees that survive, despite the poor minerals in the soil. The variety of micro-climates produced by the heights and orientation of the island give rise to a surprising diversity of habitats in this small island that emerged out of the sea. The underwater gardens and fauna, including the rarely seen Cuvier beaked whale, clear water, visibility until 50 meters depth make El Hierro all of a paradise for scuba-diving, thanks to the enormous environmental protection that has been applied to the underwater treasures, the famous micro-climate is one of the issues considered for practice of hiking, walk in the nature, mountain race and long etc.

El Hierro with more than 200 km network of walks allows geopark visitors to explore around the island, safely and simply. The traditional paths have been made into a network that conforms to international norms, with numbered markers similar to any other part of Europe to make sure you find your way round, safe and sound.

As a part of our geopark marketing and promotion geotouristic plan, every year there is a complete calendar which includes many adventure sports events, being the most relevant:

- **Open Fotosub Isla de El Hierro** (international open submarine photo competition)
18 years old; www.openfotosub.es
- **International meeting of Paraglide El Hierro**
18 years old; <https://www.facebook.com/concentraciondeparapenteelhierro>
- **El Meridiano Marathon**
5 years old; <http://maratondelmeridiano.com/>
- **Magma Bike El Hierro** (mountain bike race)

- 3 years old; <http://www.magmabikemaraton.com/>
- **Regional Hike Encounter**
2 years old; <http://encuentrosenderismo.com/>
- **Travesía Mar de Las Calmas swimming over volcanoes** (open swimming competition)
2 years old; <http://www.travesialascalmas.com/>
- **Photo Trek**
1 year old; <http://www.fototrek.es/>

As result of this promotional strategic, El Hierro Geopark has more visitors per event every year, contributing to the local economy and the maximum visibility on written and digital newspapers, TV, social media network, Twitter, Facebook, YouTube, flick, etc.

GeoAlternativa, a Project focused in Geotourism

Rocha, F. & Raposo, P.

Alternativa – Associação Contra as Dependências, Rua Coronel Chaves, 42, 9500-309 Ponta Delgada, Açores, ass.alternativa@gmail.com

Since the beginning that we are dedicated to environment protection, so, we started a start up, in the area of sea shore cleaning, recycling and the gathering of agricultural bags, which still this day, operates, employs and occupies. Our concern with the environment has been our driving force in the development of the company; therefore, it's no wonder that, when we wanted to start another start up, in the tourism area, in this case, lodging at low cost, the notion of environment is so accentuated.

It rises as, GeoAlternativa, a multyway space, operating in the area of low cost lodging, in GeoTourism.

A brief history about us, in 2001, when we started Ilha Limpa, our first start up, and created from scratch an activity that today is a business by it's own, that was the gathering and recycling of the agricultural bags, and other plastic derivates from agricultural and dairy factories.

They were, from our point of view, extremely polluting elements, and the lack of a management, or, effective management of those elements wasn't adequate. There were a lot of these plastics, hanging on trees, abandoned bags by the side of the road, clandestine deposits of these types of materials in isolated areas in enormous quantities.

So, we started an awareness between the farmers, public organisms and created spots within the dairy industrie where they could deposit those materials, so that we could gather them, transport and recycle. This initiative was an enormous success, to the point that we began to sign contracts with local authorities, to maintain the whole dairy industries roads, streets, and more, cleaned .

We were, trusted with the European Coastwatch program, for 3 years, in wich, we cleaned the whole São Miguel Island perimeter (the one that we can access conventionally, by car and on foot), and monitored and noted information about the different types of contaminants that we've found.

And, since the start of this company, but, in regime of service contract, we maintain the shores of Ponta Delgada, in an excellent state of cleansing and conservation, service that includes, street sweeping, cliff and other dangerous walls in the shore cleaned, and cleaning the beach and rocky surroundings.

It was, because of the large amount of materials found in our daily services, that we've realized we didn't have an ideal object where to put those residues while we were picking, so, we saw the potential of the bags we were gathering from the agricultural service, and started to reuse them in our cleanings. We brought a social awareness to the environment issue, giving lectures in schools, teaching young kids the recycling materials, where to put them in the colored bin, and much more.

But, in this economic uncertainty, we've decided to start a new project in tourism, because is the most growing area of business in the Azores, an also, because we wanted to maintain the environment as our driving force.

With the profit we've made, trough time, we bought a space, in the town of Ginetes, 20km of Ponta Delgada.

We initiated contacts with the local council, and, due to the place and type of tourism we wanted, we initiated contacts with Azores Geopark, with whom, we rapidly signed an cooperation protocol, and with the Ginetes city council, we started a partnership, in order to reactivate (clean and maintain) the Camarinhas Trail.

GeoAlternativa, is the name of the project, that is implemented on the entrance of Ferraria, and it's an tourism endeavor, that we've started in 2013, and will be complete by Summer 2015.

The Camarinhas House (Casa das Camarinhas), nowadays, is totally renewed, and it's ready to lease, we've completed the reception and the camping balneary, and the renewable energies, are at a finishing stage, remaining only to restore one house.

It's a place devoted to adventure tourism, in low cost regime, with camping and common lodging.

Our target costumer, are those people, who love the nature, walking on trails, and discovering the most beautiful and unseen sites to where they go. We are, as mentioned, by the entrance of Ferraria, one of the Geosites of São Miguel, a lava delta formed by basaltic lava flows originated from Pico das Camarinhas scoria cone, about 900 years now, and where we can see a litoral cone, a fossil sea cliff, a natural thermal swimming pool and a trachyte lava dome, these types of places attract backpackers, vulcan a rail lovers, and to whole those tourists who want 'the real deal', to be in a place, not in the center of the city, but close enough, places to rest, and live like the people who in fact, live there.

By the other side, we are, very close, from other Geosites in São Miguel, located in Sete Cidades, places like, Serra Devassa, where you can find the biggest number of lakes with exotic names, such as: "Lagoa do Canário", "Lagoa da Égua", "Lagoa Rasa", and much more...as well, as the Caldeira das Sete Cidades or the "Vista do Rei".All of those, recognized sites, and classificated by Azores Geopark.

We are going to collaborate with other associations, and touristic companies, in order for us to be able to offer promotional packages, that will include, adventure activities, such as diving, whalewatching, horse ridding and much more. In Ferraria, they will be able to go and enjoy the thermal baths, and thermal spa and enjoy, what was called by the Daily Mail, as one of the most beautiful natural swimming pool in the world.

Communicating natural history through art collections. An example of non formal geoscience education and Geoheritage public awareness through an azorean painting

Santos, V.F.^{1,2}, Prudêncio, J.¹, Rodrigues, L.A.³, Costa, A.M.⁴, Cavaco, G.¹, Maduro-Dias, F.⁵ & Jácome, G.⁶

¹ Museu Nacional de História Natural e da Ciência – Universidade de Lisboa, Rua da Escola Politécnica, 58, 1250-102 Lisboa, Portugal. vsantos@museus.ul.pt; jprudencio@museus.ul.pt; gcavaco@museus.ul.pt

² Centro de Investigação da Terra e do Espaço da UC – CITEUC, Avenida Dr. Dias da Silva, 3000-134 Coimbra, Portugal

³ Centro Ciência Viva de Lagos, Rua Dr. Faria e Silva, 8600-734 Lagos, Portugal. Irodrigues@cienciaviva.pt

⁴ ARTIS – Instituto de História da Arte, Faculdade de Letras da Universidade de Lisboa, Alameda da Universidade 1600-214 Lisboa, Portugal. amcosta@campus.ul.pt

⁵ Instituto Histórico da Ilha Terceira, Convento de São Francisco, Ladeira de São Francisco, 9700 Angra do Heroísmo, Portugal

⁶ Escola Secundária Gil Eanes, Lagos, 8600-614 Lagos, Portugal. guadalupejacome@gmail.com

Art objects can be used as a resource for science communication in various domains of Natural History. For instance a rock or metal sculpture can be used to transmit knowledge about Geosciences and a wood sculpture to speak about botanical aspects; a paint with representations of plants and animals can be a start to communicate about Biology issues like biodiversity, extinctions or ecology; a landscape in a painting can be a way to illustrate aspects of shapes of earth's surface which can tell us about the geological processes that originate them. All these aspects can be discovered and understood if we are able to read it. The promotion of these interpretations at the museum's art collections could be used as a method to science communication and Natural History education in a non-formal approach.

Coordinate visits to museums to see landscapes in paintings can be a way to invite visitors to look for local geoheritage. Furthermore, local museums can organize field trips to observe the local geosites after a discussion about geological aspects illustrated in the artwork at the museum. This would be a way to stimulate geoheritage and geoconservation awareness and it can be an incentive to promote the conception of natural heritage's routes, stimulate responsible geotourism activities alongside with visits to local museums. For example, in the Azorean artist António Dacosta (1914-1990) painting "Ilha" (1979-80), it can be possible to communicate volcanism starting with the volcanic rock surrounding the fortress battlement, then talk about the volcanic island formation and finally the marine erosion using this representation of "Ilhéus das Cabras".

Another possibility is to use representations of artworks in the classroom allowing students to use their scientific knowledge to analyse Natural History representations developing their awareness on natural and artistic heritage and simultaneously making them understand that science and art are no more than different products of a universe exploring mind. This might also be a way of bringing young students who have chosen a scientific area to art museums.

Our article intends to draw attention to the possibility of communicating or teaching science through art objects by using a Natural History approach when analysing the artwork collections or it's representations, thus increasing the public knowledge about natural history issues and natural heritage but also to establish a bridge between both science and art that can sometimes seem not so obvious.



Figure 1. "Ilha" (1979-80), artwork by António Dacosta (1914-1990) that belongs to the 111 Gallery - Manuel de Brito collection. Courtesy of Miriam Dacosta.



Figure 2. Ilhéus das Cabras (Terceira, Açores) seen through the battlement of São João Baptista. Foto de Miguel Maduro-Dias.

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Valuing the uses of the Azores Regional thermal resources: a matter of criteria selection on the strategic management plan development

Aguiar, P.¹, Couto, J.P.² & Calado, H.¹

¹ CIBIO-Açores, Departamento de Biologia

² Universidade dos Açores, Departamento de Economia e Gestão

Hydrothermal resources, or just thermal resources as a whole, are a valuable asset to the Azores region. They contribute to the region's local economy where they occur through tourism, energy production (direct use and/or conversion into electricity) and ecosystem services (which include the provision of genetic unique resources and cultural values).

The traditional use of thermal resources by the local population in the Azores is thought to be almost as old as the islands settlement. The first written records of thermal water uses date to the 1760s (Sousa, 2008) and the Azorean hot springs were, as far as we know, the first place for which the existence of life forms at higher temperatures was described (Mosely, 1874; O'Meara, 1874).

The scientific and technological development, coupled to a time of economic depression, have led, among other things, to an increase on the demand of natural resources worldwide. Thermal resources are no exception.

The increasing pressure of multiple usages calls for an efficient management strategy for these natural resources in order to ensure its use in a sustainable manner, at medium and long term. Such concerted usage will minimize conflicts of interest in areas where use may overlap and enhance the regional sustainable development.

The Azores archipelago harbours have a high diversity of thermal resources, within a confined territory, which can grant a competitive advantage in several economical areas such as tourism and energy. These sectors can work as cornerstones for the Azorean economy and have been signaled by the local government as strategic areas of interest to be considered on future development strategies.

The region was pressured by national and international demand for its tourist establishment as a wellness and nature destination (Santos, 2009). Simultaneously, there was a need to decrease oil and coal dependance, partially replacing it by energy production based on renewable energy sources, such as the geothermal energies. Nevertheless, no detailed management strategy for the regions thermal resources was established.

If the energy and tourism are relatively recent uses, others, normally considered within the ecosystem services suite, have been in place for a few centuries. In a small scale, Azores local residents have used the available thermal resources for instance to enhance certain crop yields, for geothermal cooking, for wellness purposes, among others. This cultural historical use's value is of high relevance. Thus should be integrated and accounted as an important imaterial endogenous resource available, that can mark for its uniqueness.

In order to establish a sound management strategic plan, which properly ensures the Azorean thermal resources use, one needs to identify criteria for which such resources should be valued. These criteria will then enable for the design of a strategic management plan. The valuing criteria and its weight needs to be evaluated not only based on experts' views by also having in account the local population reality.

It is necessary not only to identify valuing criteria for the Azorean thermal resources but also to establish priorities for uses and non-uses, having in account the present and future development. Furthermore, it is important to include in this process local stakeholders, namely the residents' opinion.

A strategic management plan developed based on adequate valuing criteria, tailored to the region's reality, will have higher likelihood of being successful. Such strategic plan will maximize uses, minimize conflicts and facilitates the efficient resource management. In any case, it should be a strategic plan that, at medium and long term creates higher economical value for the archipelago.

The project presented here aims for the initial identification of thermal resources valuing criteria by using an experts panel as well as residents in other to determine the value proposition. Initially, the criteria will be selected based on case study areas comparable to the Azores in terms of thermal resources as well as in economical sectors of interest (Italy, Iceland, United States, and New Zealand). The criteria list will then be ranked by both groups using questionnaires. Results will be compiled, analyzed within and among each group as well as contextualized accordingly with the regional reality, having in account the present and future uses and non-uses.

The outcome may be used in order to create a work base to properly design a strategic management plan of thermal resources for the entire archipelago. This strategic management plan has as main purpose the safeguard and the value's enhancement of the Azorean thermal resources for all the autonomous region.

The Azores Geopark can be considered as a major transversal communication vector between local small businesses, residents, and visitors. It can also aid on the plan implementation, once this is established, being a major asset for the region.

Transformation of Saco do Inferninho Volcano in geotouristic park: example of the Picuí town and region, Paraíba state, Brazil – a preliminary approach

Souza, F.A.¹, Sobrinho, A.P.C.L.², Barros, P.S.C.², Araújo, A.² & Souza, N.V.L.³

¹ M&PG/Instituto Federal de Ciência e Tecnologia da Paraíba – campus Campina Grande - franciscosouza.ifpb@gmail.com

² G&M/Instituto Federal de Ciência e Tecnologia da Paraíba – campus Picuí

³ C&T/Universidade Federal do Rio Grande do Norte – campus Natal

The Picuí town is located in Serido microrregion, Paraíba State, Northeast Region of Brazil. Its geotectonic position within the Borborema Metalogenetic Province classifies it as one of the main producers of ore minerals of the region, especially with respect to the exploitation of dikes and sills of pegmatitic intrusives in schists and quartzites of the Seridó Group. Such bodies occur often in structural highs on hinges or flanks of anticlines folds, producing essentially tantalites, tourmaline, beryls, spodumene, quartz and feldspar, which are mined by prospectors in an almost sustainable way, boosting the local economy, but generating environmental degradation by unplanned extraction.

Regional geodynamics diversity became primarily responsible for the deposition of crystalline, metamorphic, sedimentary and volcanic rocks, objective of the present work. We highlight here the SACO DO INFERNINHO VOLCANO (Figures 1 and 2), whose main volcanic edifice dates to the Cenozoic Era, probably formed in a single stage eruptive structured in "lava flow, spread radially and overcome local wind fields to reach small distances upwind" and fumarols (unpublished data), flanked by dykes and intrusive radial ring throughout region.



Figure 1. Entrance on Saco do Inferninho Volcano.



Figure 2. Geotourism on Saco do Inferninho volcano. Inferninho, Picuí, Brazil

The petrographic composition of the volcanic body comprises basalt of aphanitic texture, isotropic and black color, has milimetric to centimetric nodules of peridotite and/or olivine. There are also disjunctions with columnar polygonal cross sections with diameters of the order centimetric to metric, most of which of pentagonal and hexagonal trend.

The Saco do Inferninho Vulcano has a rich and diverse built heritage, being in progress by the Federal Institute of Education, Science and Technology of Paraíba the full inventory of geological

heritage, cultural, ecological and geotouristic of the area, which is preserved with respect to the environment, virtually uninhabited, displaying all the exuberance of its native vegetation. The access to the area from the town of Picui can be made by two main tracks, all on back roads. The first trail follows entirely within the "Picui "graben", inside the Piranhas River watershed through the water reservoir Várzea Grande, until it reaches the volcanic structure, after about 15 kilometers travelled towards South-North. This reservoir is the main responsible for the drinking water supply of metropolitan areas of Pcuí and Frei Martinho, currently in danger of collapsing due to long periods of drought plaguing the paraiban semi-arid. The second track, also in the service road, starts at the Picui "graben" to then hit the Santa Luzia "horst", an important plateau structured geologically by Serra do Martins sediments, with average elevation of 650 metres. This trail is about 30 kilometers long, beginning in the "graben", passing by the "horst" to again descend until "graben" at the time of Serra dos Brandões, up penetrate the volcanic structure (Figures 3 and 4).



Figure 3. Foothills of Saco do Inferninho Volcano body.



Figure 4. Median part of the volcano body showing fungus and native vegetation.

Luz beach magmatism: a geosite regarded as a local and regional factor in the heritage, economic and touristic development

Agostinho, M.¹, Oliveira, B.², Rodrigues L.A.³ & Santos, V.F.⁴

¹ Agrupamento de Escolas Gil Eanes, 8600-614 Lagos, Portugal. muymagnifica@gmail.com

² Agrupamento de Escolas do Concelho de Vila do Bispo, 8650-416 Vila do Bispo, Portugal. btoliveira@gmail.com

³ Centro Ciência Viva de Lagos, 8600-614 Lagos, Portugal. lrodrigues@cienciaviva.pt

⁴ Museu Nacional de História Natural e da Ciência, 1250-102 Lisboa, Portugal; Centro de Investigação da Terra e do Espaço da Universidade de Coimbra – CITEUC, 3000-134 Coimbra, Portugal. vsantos@museus.ul.pt

The Ferrarias site (Luz beach – Algarve) due to its geological interest was identified as a geosite in 2005 by the Laboratório Nacional de Energia e Geologia (former INETI) [1] and in 2010 in the project “Identificação Caracterização e conservação do património geológico: uma estratégia de Geoconservação em Portugal” [2].

At Ferrarias site, between Luz beach and Porto de Mós beach, the Lower Cretaceous stratigraphic sequence was crossed by a Upper Cretaceous (72 Ma \pm 3 Ma) magmatic intrusion. This intrusion with a circular-elliptical shape may be interpreted as a volcanic chimney (with the same age as the Monchique plutonic massif) [3]. This magmatic structure has 80 meters of diameter and is as high as 40 meters (Figure 1). The intrusive body shows a vesicular texture rock with small geoids, as well as some volcanic breccia where is possible to identify xenoliths. In the volcanic apparatus alkaline dykes can also be identified [4]. A submarine outcrop is observable on site, but there are no studies of it yet (e.g.: dimension, biodiversity impact, sea currents impact).



Figure 1. Magmatic outcrop at Ponta das Ferrarias (Praia da Luz, Lagos). Field trip made by Lagos Science Centre 12 September 2010.

Local visits organized by schools and Lagos Ciência Viva Science Centre (CCVL) have promoted a growing interest by general public and touristic business in the region (Figure 2). CCVL has done

field trips and has an important scientific geological and paleontological role in the enhancement and promotion of this heritage and knowledge. These field trips are always guided by teachers, professors or specialists in scientific areas as well as in science communication [5].

The work done by these institutions, in heritage defense, stimulated a more sustainable, creative and innovative approach to this subject.



Figure 2. Field trip made by a local school (Agrupamento de Escolas Gil Eanes – Lagos).

The local community shows interest in these studies because it has already developed the perception that they might serve as a tool to explore different business areas as: Scientific, cultural and heritage divulgation; merchandising production and development; informative field guides, books; training actions; academic studies as support to new ways of sustainable heritage survey.

The submarine outcrop may be seen as a significant local potentiality due to its unusual nearby submarine and ?terrestrial geological structures. These characteristics will allow a huge variety of exploitable niches such as: touristic (diving, scuba, sailing, surf, windsurf), commercial (hotels, inns, shops, restaurants, bazars) and scientific (new scientific knowledge). This Scientific knowledge product is valued by a community that is gradually learning how to make an income out of it.

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Volcanoes that died or did not managed to come to be: remnants of volcanism in Portugal's mainland

Leite, J.¹, Ribeiro, B.¹, Cascalho, J.^{1,2}, Póvoas, L.¹, Barriga, F.³ & Santos, V.F.^{1,4}

¹ Museu Nacional de História Natural e da Ciência, 1250-102 Lisboa, Portugal.

² Centro de Geologia da Faculdade de Ciências da Universidade de Lisboa, 1749-016 Lisboa, Portugal.

³ CREMINER, Centro de Recursos Minerais, Mineralogia e Cristalografia, FCUL and LARSyS Lab Associado, 1749-016 Lisboa, Portugal.

⁴ Centro de Investigação da Terra e do Espaço da Universidade de Coimbra – CITEUC, 3000-134 Coimbra, Portugal.

Although Portugal is a relatively small country it does hold a considerable geodiversity. Even though there were some previous attempts it was only in the last decade that a proper systematic inventory was started following ProGeo methodologies. By now there is a list of three hundred twenty six geosites distributed among twenty-seven frameworks that represent the most relevant features of national geodiversity. That inventory is available at <http://geossitios.progeo.pt/index.php>. This has been a long term and ongoing endeavour so it will never be completely finished.

The Lisbon municipally has also been developing its own geoconservation strategy with the collaboration of several public entities. This was done by selecting a group of outcrops through the city that were classified as Geomonuments and as such are taken into account in Municipal Planning Instruments.

The former Museu Nacional de História Natural (MNHN) had a long tradition of scientific research, as well as in collections management and scientific education. It was also pioneer in geoheritage and geoconservation in Portugal. Nowadays Museu Nacional de História Natural e da Ciência (MUHNAC) is continuing that work. The museum has a vast program dedicated to all the publics that include guided visits to exhibitions, hands-on activities, field trips, lectures and special events. Regarding the school public there are two field trips that are often requested: “Sintra desde há 160 Ma” [Sintra since 160 Ma ago...] and “Com a cidade a nossos pés” [With the city at our feet]. Both are related to the geology of the Lisbon region and are mainly targeted to secondary school students (but are also available to other school groups and to the general public). Every year since the late 90s there are always a few groups from high schools that have been taking those field trips. The first one is a day trip consisting of 6 stops where the students are told about the geological history of the last 160 million years mainly focusing on the Sintra's massif installation. “With the city at our feet” is a 2 to 3 hour tour in downtown Lisbon devoted its geology and how geology has been influencing the history and development of the city through time.

It is known that nowadays there is no active volcanism in the Portugal mainland. However, there is evidence that did occur several times in the geological past - the most recent of which took place during the opening of the north Atlantic. The fracturing triggered by the rifting allowed the installation of three important subvolcanic massifs (Sintra, Sines and Monchique) along with a great network of dykes and other volcanic veins and also a thick sequence of erupted lava and pyroclastic piles - the Lisbon Volcanic Complex (LVC). So, during the Cretaceous there was at least a set of volcanoes related to LVC. There could have been more but the three subvolcanic massifs never reached the surface and so never became volcanoes.

Although less common than in the Azores or Madeira, there are also some volcanic features in the mainland that are worth mentioning (see link in first paragraph). There are three geosites related

with these phenomena that are integrated in the national inventory under the framework Mesozoic tectonic evolution of the west Iberian margin which are: intrusion at Ribeira d'Ilhas beach; sill at Foz da Fonte and the encasing deformation; columnar jointing in the Penedo do Lexim volcanic neck. Some other examples of interesting outcrops that are related with the Mesozoic volcanism are: Sta. Quitéria de Meca; Cabeço de Montachique and Papoa peninsula (all outside Lisbon), and Monsanto's Urban Park, Estufa Fria and an ancient quarry in Rua Aliança Operária (in Lisbon).

The LVC actually occupies a considerable area of Lisbon, almost the whole west half, and it is in fact a major event in the regional geological history. It is possible to observe, all over the city, that basalt was widely used in construction and pavements. This reflects the abundant presence of basalt in the Lisbon area. However, it has been empirically realized that a significant part of the public at large ignores or doubts that there were once volcanoes in the mainland. We know this by just casually talking to people or browsing through the internet in fora such as <http://www.geopor.pt/gne/geocabula/faqs/vulcao.html>.

In order to mitigate the ignorance on mainland volcanism, we began to prepare a new tour directed to the school public and also to the general public, to include in our educational/cultural program an item dedicated to the LVC. This might prove to be very successful as the theme volcanoes is perceived to be quite popular and some people might actually find surprising the fact that there were once volcanoes in Lisbon. So, we are already doing some field work surveying for places that can be integrated in an urban geological tour regarding volcanism in Lisbon. A more comprehensive virtual version that could be available on our website, (that can be much more flexible concerning distance and dispersion among sites) is also being considered. Another idea that we would like to implement is proposing partnerships with companies that are present in areas where the LVC crops out, which could sponsor interpretative panels about the LVC, prepared by the museum. We hope to achieve some of this over the next year.

The tour may end with a brief mention to the current theories concerning the 1755 earthquake, relating it to the initiation of subduction under Iberia, and the next cycle of volcanism in Lisbon, in a few million years. This could be the main topic of yet another museum tour.

Educational and awareness tools in the Azores Geopark as an approach to enhance the population and local stakeholder's engagement

Silva, C.¹, Garcia, P.² & Meneses, S.³

¹ Services for Conservation of Nature and Environmental Awareness, Regional Directorate of Environment / Azores Geopark, Portugal; carla.SG.Silva@azores.gov.pt

² Environmental Management and Nature Conservation Society, Azorina S.A. / Azores Geopark, Portugal; paulo.rm.garcia@azores.gov.pt; salome.c.meneses@azores.gov.pt

The Azorean archipelago is located in a very complex geodynamic area: the junction of three tectonic plates. This context along with other geological settings allowed the formation of nine islands and several islets in the middle of the Atlantic Ocean. During the last 8 million years volcanism, tectonics and erosion process created a unique landscape characterized by a huge geodiversity and an important geological heritage.

Since the settlement (in the middle of the 14th Century) the Azoreans have witnessed about twenty six historical eruptions, but soon they understood that volcanoes were not just destructive, being very important for many human activities, allowing the creation of beautiful landscapes (geolandscapes), soil fertility and providing raw materials. During the last centuries, Azoreans added new contours to this unique landscape and created a close relationship with the natural phenomena that created their islands. This relationship is evident in its gastronomy, religious and cultural manifestations and all other aspects of the way of life of these islanders. The concept “açorianity”, created by the famous Azorean writer Vitorino Nemésio, symbolizes this exceptionality.

The geological and anthropological uniqueness of this archipelago allowed to be created the first truly archipelagic geopark in the world: the Azores Geopark - 9 Islands, 1 Geopark. As in other geoparks, the action plan is supported by three main pillars – geoconservation, environmental education and sustainable regional development.

Being an ultra-peripheral archipelagic region, a territory with a non-continuous nature and with a wide dispersion of population among the islands, this may cause limitations in the application of uniform politics of sustainable development and the implementation of educational and awareness tools that would be effective in the entire territory. The Azores Geopark surpasses this problem and reaches the resident population and visitors through the synergy of different players, by building partnerships and bringing together regional and local stakeholders dispersed through the archipelago, allowing an adapted and effective strategy. This strategy reflects a diversification in actions, organizations and subjects, as well as the optimization of human and financial resources used environmental education and distributed along the 9 islands. In general, our aim is to engage everyone who lives in or visit the Geopark, but also to stimulate local stakeholders to do the same.

The key actors for the Geopark's strategy for environmental education are:

- the Regional Network of “Ecotecas” of the Azores – composed by 9 “Ecotecas”, the public service of environmental education, one in each Island Natural Park.
- the Environmental Interpretation Centres – a diverse group of 16 Centres connected to the Island Natural Parks, plus 4 more managed by Non-Governmental Organizations and 1 by a municipality.

- the Regional Network of Science Centres (with 6 infrastructures), the Regional Network of Museums and several other institutions that also promote natural and cultural heritages among the local population and the tourists.

The educational and awareness tools used by these players, that work alongside the Azores Geopark staff for promoting not only the natural heritage, but also its close connection to the cultural heritage, are differentiated according to different target groups and different practices, covering all the three forms of Environmental Education: formal, non-formal and informal education/learning. Formal education happens in the structured education system (from lower primary school to the university), whenever it happens inside school boundaries or outdoors: it occurs in school framework, accompanied by teachers or educators, in curriculum-linked contexts. Non-formal education is any organized, systematic, educational activity carried on outside the framework of the formal system, to provide selected types of learning to particular subgroups in the population, adults as well as children. Informal education is the lifelong process by which every person acquires knowledge, skills and attitudes from daily experiences and exposure to the environment (at home, at work, at play), from the example and attitudes of family and friends, from travel, reading newspapers and books, or by listening to the radio or viewing films or television. It is broadly recognized that formal educational systems alone cannot respond to the challenges of modern society, and therefore all Environmental Education theories welcomes its reinforcement by non-formal and informal educational practices.

For formal education, the Azores Geopark team produced Educational Programs specific for school framework, including teacher guidelines for several educational levels (from the 1st grade until the high school) that have been tested in the school year 2011/12 and fully implemented since 2012/2013. The main goal of these programs is to empower teachers and other educators, allowing them to have an autonomous and supported intervention, and also including several initiatives of direct interaction with the student population. Such efforts comprise:

- Training activities for teachers: in 2012 the Azores Geopark was present in the X Azores Regional Meeting on Environmental Education and Eco-Schools, with the presentation of its educational programs, and again in 2014 in the XI Azores Regional Meeting on Environmental Education and Eco-Schools, with workshops for teachers.
- Technical workshops were implemented for Islands Natural Park technicians, and other professionals who work with school groups.
- Free online contents (PowerPoint presentations and respective teachers guidelines) available on the website (www.azoresgeopark.com), including topics as "Azorean Volcanoes" and "Azorean Geolandscapes", differentiated by grade level.
- Field trips and outdoor activities in each island, named "Geosites of My Island".
- Lectures in schools, business schools and university, itinerary exhibitions, celebration of environmental dates, thematic school contests, distribution of the children's guidebook "The Volcanoes of the Azores" to all the Azorean school libraries.
- "School Park" – a regional program implemented by the Islands Natural Parks. This program presents two different approaches: "Park goes to School" and "School goes to Park".

The regional approach for non-formal environmental education is more comprehensive, including several resources, programs, actions and specific tools allowing to reach a larger range of target groups. For non-formal education contexts, the Azores Geopark educational staff has produced more recreational-educational resources, such as the board game "The Volcanoes of the Azores", puzzles and children guidebooks. A variety of international, national and regional programs are implemented throughout the islands, of which we highlight the following: "Science Alive –

Geology in the Summer”; “European Geoparks Week”, World Earth Day and Geologic Heritage National Day, and the “Open Park” program (a regional program that is implemented by all the Island Natural Parks). These initiatives involve many different entities, and have a diverse range of events, such as guided tours to land and marine geosites and protected areas, guided walking trails, special visits to the Interpretation Centres (such as sleeping inside the Capelinhos Volcano Interpretative Centre, in “an adventure in the volcano”), thematic fairs with taste of geoproductions, exhibitions, photo contests, geocaching, and more.

The environmental and science centres themselves can be regarded as non-formal educational tools, since their construction and contents are focused on a wide range of natural and cultural heritage subjects, some of them being specifically dedicated to the geological heritage and geodiversity, such as interpretation and visitors centres of volcanic caves, centres dedicated to geosites or volcanic landscapes, and science centers on volcanology and geothermal issues.

Some examples of informal tools are the Geopark Facebook initiatives, the biweekly section “(geo)diversities” in a regional newspaper and even the labels in “geoproductions”.

Finally, some of the Azores Geopark communication practices can even be considered transverse to the three forms of environmental education above presented, depending on the contexts they are used. It is the case of “Geosites Maps”, “Geosites guides”, pamphlets, the Geopark website and newsletters.

In all forms of environmental education the active relationship with partners and local and regional stakeholders is essential, but in the non-formal contexts we consider it to be vital, since many of the programs/actions would be impossible to succeed without their engagement and commitment.

To engage specific target groups, such as journalists, touristic guides, and local businesses, several thematic workshops were promoted, empowering them for an autonomous practice of environmental education themselves. One should not forget that all the cultural, (geo)tourism animation, entrepreneurship and local economic fostering initiatives supported by the Geopark are also and always promoting environmental awareness, by focusing indirectly on the protection, conservation and valorization of the natural heritage, and especially the geological heritage, as a pillar for the sustainable regional development. In fact, the environmental education in general, and the educational and awareness tools in particular, can never be truly dissociated from the other two pillars of the geoparks – geoconservation and sustainable regional development - rather they are complementary and inseparable.

The numerous and important tools mentioned here are only possible due to the synergetic approach that involves general population (from senior citizens to children), visitors and the local and regional organizations, all working for a collective goal.

This gives a meaning to our motto “9 islands, 1 Geopark”!



ABSTRACTS BOOK – WORKSHOP “GEOPARKS IN VOLCANIC REGIONS: SUSTAINABLE DEVELOPMENT STRATEGIES”

J.C. NUNES, E.A. LIMA, M.MACHADO & J. PONTE

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