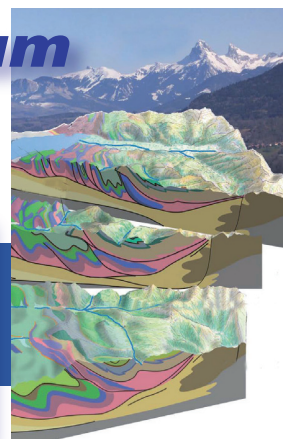


# **International Symposium on Geosite Management**



*Savoie - Mont Blanc*

# **Managing Geosites in Protected Areas**

**Conference 7-9 September 2011**

**ABSTRACT BOOKLET**

*LIVRET DES RÉSUMÉS*





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## QUATERNARY LAKES, AS IRANIAN CIVILIZATION LANDMARKS

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Key words: Archeology, cataglacial, geotop, catastrophism, Geoheritage

The “cirque de Navacelles” repres Civion plays a crucial role as one of the major factors in tourism attractions and, in turn, as a base in rating the condition and capabilities of a region. In this regard, rivers, beaches and sometimes glaciers have mainly been considered as the base of civilization. In Iran, generally speaking, lakes which existed during the Fourth Period had such a role in the formation and growth of the civilized centers. The formation of the core of these centers has been subject to various discussions in social sciences and anthropology. Ancient climate data (Paleoclima) and evidence from climatic change geomorphic not only have made revelations about the past life but also have established new ways in rating the geotops.

The result of climatic changes on morphogenesis systems occurs in several general cases which are:

Governing of the cold and wet period

Governing of the cold and dry period

Governing of the hot and dry period

Governing of the rainy or warm period

The governing of each of the above-mentioned periods has created special morphogenesis systems, the effects of which are detectable and traceable as landscapes and geomorphological evidence, being considered as the main factors in the formation of geotops in Iran. In general, climatic changes caused various changes in the function of the morphogenesis systems, especially in the coastal strips of the open seas, closed local lakes, permanent snow line heights and glacier tongues. Such fluctuations led to the displacement of centers of civilizations and also brought about great changes in the basic livelihood of early human beings and even their technology and tool making. Although the governing of each of these climate patterns all over Iran can impose its own morphogenesis system on the region, the morphic characteristics of the land precluded individual climatic systems to develop a specific morphogenesis. In actual fact, owing to the height of the Plateau and the elevation of the land (28 up to 5600 meters), it has not reacted in the same way to the climatic and environmental changes but has imposed a variety of special effects on the morphogenesis system. Hence, the governing of a particular kind of climate has caused a special kind of morphogenesis system in highlands, whereas the same climate has formed a different morphogenesis in lower lands. All of these features have, in turn, upgraded the geo-tourism in Iran. Generally speaking, the governing of the cold periods has developed in the form of four morphogenesis systems, while the governing of the hot and dry period has been demonstrated in three morphogenesis systems.

The most significant landscapes in the formation of the civilization centers in Iran include:

a- Rivers:

b- Shorelines of open seas in Iran:

c- Local lakes

d- Permanent boundaries of snow and mountain glaciers during cold periods

The present study aims to shed light on the role of the bed of the lakes in the Fourth Period in the formation of population centers and geotops by making use of the geomorphic evidence based on historical, archaeological and geo-tourism findings. It also tries to classify the regions based on the importance of the natural indexes or factors in the development and expansion of civilization centers. The close study of the Iran's most important geotops with regard to their characteristics and complexities indicated that most of Iran's geotops associated with civilization during the Fourth Periods were along the shores of lakes enjoying more water resources as compared to the current period. The changes in the height of the glacier as well as the redirections of the rivers are considered as the other major factors affecting the formation of civilization centers and geotops in Iran. The formation of the civilization centers at the margin of lakes during the Fourth Period caused the cities to physically develop in a star-shaped way and with pointed convergence. This trend appears to be thoroughly different in Europe as compared to Iran because of the different roles of the glaciers, an important point worthy of attention for city planners because if there is a development toward the stable center and the past climatic conditions reoccur, most of the areas will undoubtedly be flooded.

## STAKES IN THE PRESERVATION AND IN THE VALUATION OF THE GEOMORPHOSITE OF NAVACELLES (LARZAC, FRANCE)

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Key words: Geomorphosite, geoconservation, geovalorisation, geotourism

The “cirque de Navacelles” represents the perfect model of cut-off meander at the bottom of a profound gorge. As such, it acquired since a long time a patrimonial status by its exceptional representativeness and so appears as an educational example in numerous school books and books of geomorphology and geology. This exemplary geomorphosite belongs to the wider site of the gorge of the Vist whose sector between Vissec and Madières was classified in two phases. The héraultaise part at the bottom of the circus benefited of a protection status since 1943 and the perimeter has been completed forty years later, in 1983. While the classified site takes into account only the gorge up to the cornice, the inscribed sector comes to protect for its part the border of the limestone plateaus of Larzac and Blandas, testifying of the link between the plateau and the gorges.

This presentation concerns the protected area of the “Cirque de Navacelles”. Our objective is to review the stakes in term of management and valorisation of this geomorphosite. The recent inscription of the territory on UNESCO’s World Heritage List in conformance with cultural, alive and evolutionary landscape (agro-pastoralism) strengthens the current events of the subject.

The first part aims at showing that the central value of this geomorphosite is above all geomorphologic but it is reinforced by the numerous marks of the human activities. The “Cirque de Navacelles” is an original example of cut-off meander, more complex than a simple one. Classic in its shape because finished, it is original in its creation. The karst, causes the accumulation of Holocene tuffs which heightened the talweg and induced the pouring, then the inversion of trend at the origin of the waterfall.

The “Cirque de Navacelles” knows an annual average frequentation of 250 000 visitors today. The quantitative and qualitative studies of frequentation show the misunderstanding of the visitors for the object of their visit and express a strong need of a better understanding of the landscape which they have in front of them.

In order to better control this high touristic frequentation three levels of intervention must be considered. Firstly the meander at the bottom of the gorge must not be considered by the visitors only as a parking. Tourists must appreciate the site in its globality and not only through the eye of he/she’s camera from one of the belvederes. Finally it is necessary to allow him (her) to understand the history of this landscape by different interpretation tools.

The last part of the communication will evoke the strategies developed to answer these different stakes.

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## A CULTURAL APPROACH OF GEOSITES: PREHISTORIC CAVES

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**Key words:** Cave, Prehistory, 3D cave reconstruction, local development

Karst areas are marked by the diversity of their heritage. One of their peculiarities which characterize them is the strong representation of underground geosites.

The first scientific explorations scope is undertaken by J. W. Valvasor during the seventeenth century. Many other scientific studies will follow this first step, the karstology becoming a new research field.

As important witnesses of the history of the Earth, the caves participate in understanding and observation of geological phenomena. Since the late nineteenth century and early twentieth century, with the discovery and recognition of rock art the caves acquire a new cultural dimension. They are home to an ancient heritage: engravings and cave paintings but also traces of transition and human occupation (footprint, movable archaeological) are contributing to knowledge about the history of mankind.

At the beginning caves were fitted out because of their wealth in concretions as Paderac or Orgnac, in France. Then, "prehistoric" caves as Combarelles, Rouffignac, etc., were also fitted out to allow the visit. Henceforth, in these areas, local tourism and economic development is based on this new touristic resource that are the prehistoric caves which can be considered as cultural geosites. Indeed, this cultural dimension is inseparable from the offer of underground geotourism. We will endeavor to define its place and how it can participate in transforming the perception of karst area. This analyse will also help to define the contours of the concept of underground geological site that finally belongs both to the natural and cultural heritage sphere.

Our work will study three examples:

- Niaux Cave and The Prehistory Park (France): these two spaces managed by the same company that introduced the Salon Noir is a chamber whose walls are adorned with hundreds of animal figures. In the cave of Niaux, this chamber is the subject of sightseeing of the cave (the quota size of visiting groups is 20 people), and Prehistory Park, a facsimile of the Salon Noir is presented to visitors.
- The cave of Altamira (Spain): the quota established in the cave (8500 visitors per year) and waiting times involved (over a year), led to the creation of a replica of the part of the original cave within a museum.
- Chauvet Cave (France): the current project of interpretation center is important for the economic development at regional scale and for that is one of the seven "Great Projects Rhone Alps".

Studying these examples will also participate to show the links between natural space, interpretation center and museum where the question of the dissemination of knowledge and the pedagogical approach is central.

# IMPORTANCE OF GEOMORPHOLOGICAL ANALYSIS FOR GEOMORPHOLOGICAL HERITAGE PROMOTION IN PROTECTED AREAS: THE CASE OF CONTAMINES-MONTJOIE NATURAL RESERVE (MONT-BLANC MASSIF, FRANCE)

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**Key words:** Geomorphological landscapes, Geomorphological mapping, Paleogeographical reconstructions, Geosystems

It has been demonstrated that natural protected areas are adequate sites for geoheritage protection and promotion through geotourism. In particular, they are interesting areas for linking geomorphological processes and ecological and cultural heritage. The methods of geoheritage assessment generally focus on the evaluation of the scientific and additional (cultural, ecological, etc.) values of specific sites. In a preliminary work carried out at the University of Lausanne, the assessment of scientific value of geomorphosites was based on criteria such as rarity, representativeness, integrity and palaeogeographical value (Reynard et al., 2007). Nevertheless, the inventory approach of geoheritage presents a weakness due to the fact that the process of site selection does not give sufficient importance to the dynamics of processes in a geosystemic approach and to the temporal development of morphogenesis (a landscape presents always a combination of inherited and active landforms). The objective of this research is to show how a complete geomorphological analysis is a preliminary step for each project of geotourist promotion. This presentation is based on the results of a Master thesis carried out in the Contamines-Montjoie Natural Reserve (Bosson, 2010).

The geomorphological analysis combined three different complementary approaches:

- geomorphological mapping using a morphogenetic legend;
- palaeogeographical reconstitutions of Late- and Postglacial glacier extensions;
- geosystemic analysis carried out at the valley scale using the model of sedimentary cascade.

Each of the three approaches focuses on a specific aspect of geomorphological heritage:

- geomorphological mapping allowed us to represent the spatial distribution of processes and landforms; it gives information on both representativeness and rarity of geomorphosites;
- palaeogeographical reconstitution is focused on the history of landscape morphogenesis; it allows inherited landforms to be mapped and, therefore, the temporal development of geomorphological landscapes (geomorphosites as Earth history heritage) to be approached;
- the geosystemic approach allowed us to point on the current dynamics of processes; coupled with an analysis of human impact on geomorphology, it gives information on the potential evolution of geomorphosites (and, therefore, their integrity).

Based on this complete geomorphological analysis a selection of geomorphosites (with high scientific value and important tourist potential) was made and proposals for geotourist promotion were developed.

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## ASSESSMENT OF GEOLOGICAL HERITAGE: SCIENTIFIC VALUE AND VULNERABILITY OF GEOSITES WITH NATIONAL RELEVANCE IN PORTUGAL

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**Key words:** Geosite assessment; geosite vulnerability; geosite management

The first systematic inventory of the Portuguese geological heritage was concluded in 2010 (Brilha et al. 2010). Based on the previous work of Brilha et al. (2005), this was one of the main results of a national project involving about seventy Earth scientists from different institutions. The inventory was established based on the ProGEO methodology, i.e., definition of geological frameworks followed by the identification of representative geosites with national and international relevance for each framework. Twenty-seven frameworks were defined and 326 geosites selected exclusively based on their scientific value. For each geological framework a leading geoscientist was responsible for the scientific characterisation of the framework, to invite collaborators to identify representative geosites and to compile all information concerning the framework.

In order to facilitate the future management of the geosites, both their scientific value and their vulnerability were assessed. This assessment is very important because when dealing with a large number of geosites it is fundamental to establish priorities in the development of the subsequent steps of a national geoconservation strategy. The assessment method was defined taking into account that the 27 frameworks' leaders and collaborators were responsible for the geosite evaluation. Clear instructions were attached preventing subjective interpretations by researchers with less familiarity with these quite innovative procedures.

The scientific value assessment was based on six criteria, namely: representativeness (30 % of the final score), key-locality (20 %); published scientific literature (10 %); integrity (15 %); geological diversity (10 %); and rareness (15 %), scored with one, two or four points. The vulnerability assessment used five criteria, each score ranging from one to four: fragility of the geological elements (35 %); proximity to potential damaging areas (20 %); present protection status (20 %); accessibility (15 %); and population density of the area (10 %).

The results of the geological heritage inventory and its assessment are now an important raw data to support nature conservation initiatives under the responsibility of the Institute of Nature Conservation and Biodiversity, one of the requisites expected in the Portuguese conservation legislation published in 2008.

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## NEW TECHNOLOGIES APPLIED TO THE MANAGEMENT OF THE GEOSITES : AN OVERVIEW

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Key words: geoheritage interpretation, interactive media, webmapping, 3D imagery, virtual geotrails, augmented reality.

Since a few years the development of Web 2.0 and Cloud computing model conjugated to the growth of smartphones and mobile devices authorizes new practices of inventory, protection and development of natural heritages. We can however regret the lack of practical realizations as regards geoheritages

Far from being reserved to specialists, these open-source software as well as the very numerous freeware give access to powerful tools, henceforth relatively simple of implementation. Geoscientists, teachers, staffs working in protected areas but also amateurs can now realize multimedia and numeric interfaces for the management of the geoheritage.

This presentation will review digital technologies which, from the simplest to the most sophisticated, can be used in the inventory, exploration, knowledge and valorization of the geoheritage.

The panorama will be the widest possible in order to overview a large panel of good practices.

Will be successively presented:

The tools of Webmapping which, from expensive solutions to the API of Google earth or that of Géoportail authorize the construction of interactive maps.

The 3D imagery which, thanks to a wide outfit of tools, allows the reconstitution of real objects for scientific purpose but also for the valorization of the geoheritage.

The various techniques which can be used to develop itineraries using the augmented reality.

This panorama will be followed by a critical analysis of the development of these multimedia practices. Indeed, if the technical tools progress it has to be for the production of quality realization in the service of the various stages of the management of the geoheritage.

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## THE INVENTORY AND CAPITALIZING OF GEOSITES FROM PROTECTED AREAS FROM THE HYDROGRAPHIC BASIN CASIMCEA (ROMANIA) – A PREMISE FOR LOCAL DEVELOPMENT

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Key words: geosite, protected area, Casimcea, Dobrogea, Romania, development project

The present work aims to inventory the geosites which exist in protected areas of different types from the Casimcea basin and to establish the most efficient ways and possibilities to capitalize them, in order to subsequently include them within local development projects.

The hydrographic basin Casimcea is situated in Central Dobrogea, having a complex paleo-morphological evolution which starts from Proterozoic and continues up to Quaternary, and a varied lithology, consisting of limestones, loess and green schist, which are important for the apparition of geo-sites.

Within the analysed area, the following protected areas can be noticed: the Cheia Massif (surface 285 hectares), the caves from the Dogrogea's mouths (15 caves with paleontological, geomorphological and archaeological importance, out of which the most important are: Mireasa Cave, the Cave from Ghilingic, Babei Cave, La Adam Cave, Casian Cave, Liliecilor Cave) and the Casimcea Reservation (surface 137 hectares, with geomorphological and paleontological value). Within these reservations there are varied geo-sites, the most representative of which are: gorges sectors, caves, erosion witnesses, coral reef-like formations which were shaped by erosion under different forms or cliffs which preserve different fossils.

Geosites were inventoried following the consultations of cartographic materials, aerial views as well as the direct mapping on the field, using a theodolite, model Theo 020, clinometer compass, tapes and GPS. After the inventory, the evaluation was done (by using two different methods with the aim of their correct classification) and their mapping, resulting maps of geo-sites from this area.

As the presented area is weakly capitalized from the touristic point of view, the main direction of action must regard the introduction of geo-sites in geotouristic circuits; touristic activities which take place here must be based on geo-tourism principles. Within this paper we will propose a series of thematic routes inside protected areas. Their elaboration is based on the following principles:

- thematic paths can become active instruments of education for environment and of appreciation for the values of a protected area;
- an interactive and carefully elaborated thematic path can influence and sensitize the visitor's behaviour as regards the discussed themes and the status of protected area, in general;
- getting through a thematic path is a pleasant and educative (informal) way of free time spending;
- thematic paths can become small "laboratories" in open air for sustaining some educative activities.

## CLAY HANDCRAFT: AN INTRODUCING KEY TO GEOMORPHOLOGY IN WESTERN FRANCE

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Key words: geomorphic heritage, clay handcraft, alteration, basement, Armorican massif

In a low-energy relief country like Western France, material handcraft is an introducing key to local geomorphic pattern for tourists as well as for inhabitants. This may be a material heritage like old farms, mills, rural ovens, whose building is made from the Armorican massif basement granite and schist, or limestone in the nearby sedimentary basins. In other parts, local clays were used to make pottery, tiles and bricks – an out of fashion activity, which is now preserved for tourism exhibitions, and originated red-dominating colour building still visible, creating a singular social pattern whose local memory is still living among inhabitants, as in the Mauges southern Armorican region.

This clay material is originating from basement alteration as well as from sedimentary processes. Alteration clays were commonly worked in a great number of places in Brittany, Vendée or Mauges as testified by many locality names like La Poterie, La Tuilerie, whose evidence is often the only way to reconstruct such pre-industrial activity. On the other hand, tile producing from basement alteration clays is a still active small-scale industry in Southern Mauges (Cholet) and Southern Vendée (Aizenay) – as well as from sedimentary clays (Les Rairies near Angers). In some other places, like Nesmy (Vendée), alteration clay is worked to make crockery.

Such geological evidence is the start point to explain local geomorphology, as a heritage to be preserved and transferred. In the Armorican massif it is possible to explain the origin of this clay material, pointing out alteration processes as a step to pedimentation. In the adjacent sedimentary regions, some landforms can be explained by the hardness differential between clay and limestone. Visitors or local inhabitants generally form receptive audiences, having singular points of view on local environment. The first ones often see landscape through ecological criteria, because of a large popularization of ecology for all kinds of publics. The second ones have a different environment knowing and using, mostly based on work. In both cases, a presentation of present or past handcraft activities allows to show that landscape can be seen through other criteria, among them geomorphology. This demonstrates that geomorphology can be regarded as a heritage, in connection with territories and with material and cultural facts, as pointed out by several authors.

## GEOHERITAGE IN NORWAY- NEW LIGHT THROUGH OLD WINDOWS

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Key words: Database, geological heritage

Norway attracts several million tourists annually. The main reason for visiting Norway is the spectacular landscape. Several areas, including some of the most spectacular fjord landscapes in the world, is declared as World Heritage sites. Fjord landscapes have a significant geological history, so, in a way most tourists visiting the fjord areas can be regarded as geo-tourists. In addition, two areas in Norway are also declared as Geoparks.

Nevertheless, the perception of the geological processes that created the landscape is relatively little appreciated. The description of tourist areas is mainly focused on biodiversity and cultural heritage. Røros, an old mining town, is designated as world heritage site by UNESCO. Surprisingly, however, it is regarded as a cultural heritage site, whereas the natural resources that provide the basis for the town, is neglected in the presentation of the area. Also in environmental management, the geological aspect of nature diversity is almost completely forgotten. There is for instance no official and comprehensive Geosite registrations available for Norway.

In order to inform on geology, or create geological adventures for the tourist, the tourist industry, as well as environmental managers, national park employees etc. need a clear notion of geological diversity and geological attractions. A new initiative may thus be of relevance. The Geological Survey of Norway is compiling a database on geological heritage. The main aim of the base will be to provide relevant information to environmental managers and policy makers in questions regarding nature diversity and geological heritage. Data is systematically gathered from former geological heritage assessments. Our aim is to present the material in a database and Web Map Service (WMS), useful for government agencies, land-use planners and nature managers. In addition, the base will serve as a tool for identifying potential locations for nature-based tourism, recreation and education.

Still, much work needs to be done before an operable, consistent and systematic database of geological heritage is available. There are large inconsistencies in the various assessments and classification systems, and a new framework for identifying the most valuable sites still needs to be made. The current status of the work with the base will be presented in the lecture.

## THE FIRST GEOFESTIVAL® IN BEAUFORTAIN (FRENCH ALPS)

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Key words: Beaufortain Massif, Geofestival, Roselend, Dam

The Beaufortain Alpine Massif is a well defined geological, geomorphological and human entity situated in Savoy between Mont-Blanc and Vanoise Massifs. It exhibits through fantastic landscapes a very complete geological cross-section across the Western Alps through old Hercynian basement rocks, Alpine sea deposit and Valais small ocean and basin fill deposits.

For a few years already, local geologists have worked with passion to simplify the geological story of this massif and to make it accessible to all local and visiting public, through Conferences and article first, then through 6 editions of a one day fieldtrip where the story of the massif is simplified and told through 10 selected rock samples and most magnificent landscapes are explained. These fieldtrips, including one dedicated to local guides, found a big success and interest among the population.

In 2011, The Beaufortain community celebrates the 50 years anniversary of the Famous Roselend – La Bathie hydro-electric complex. On that occasion, and in addition to many festivities organised this year on Roselend site, local geologists have proposed to organise the first edition of a Geofestival® with the aim to explain to a wide public the geology and geomorphology around the Roselend glacial depression and to focus on the applied geology of its dam. Such proposal was immediately and warmly welcomed by local authorities (Beaufort Mayor), organising committee and EDF Company. It will take place on 17-18 September 2011, and has been selected as the unique activity in Beaufortain on the occasion of the "Journées Européennes du Patrimoine" that weekend. On Saturday will be organised 7 short talks from geology setting to local Roselend geomorphological setting, to dam geology, dam selection and design, and dam maintenance, plus a festive evening. On Sunday will be organised 2 half-day fieldtrips, one explaining on site the Roselend depression geology and geomorphology and one focussing more closely on the Roselend dam geology.

The first Geofestival®, a new concept, took place in Brittany first in 2009 and was proposed by the non-lucrative association Géomnis in collaboration with the Ecole des Mines ParisTech. It was created

- to share with the public simplified but correct scientific knowledge
- to discover with new eyes the environment we leave in or we visit and to embellish it as a natural, historical AND cultural heritage site via all aspects
- to state clearly the close links between geology, biodiversity and human activities.

The Geofestival® is now in the process of developing internationally through a cross-cultural environmental approach.

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## GEOHERITAGE IN FRANCE: FROM INVENTORY TO GEOTOURISM

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Key words: Geoheritage, inventory, France, data base, public access

In France for many years the protection of nature was understood as the protection of living nature (flowers, birds, bats, beetles ...). During the past quarter century, the efforts of the geologists associated with *Réserve Naturelle de France*, a non governmental association, are largely to be credited with progressively gaining this recognition. Several geological reserves were promulgated. From these activities resulted the "International declaration of the rights of the memory of the Earth" written during an international meeting 20 years ago.

A law enacted in 2002 grants formal recognition to the notion of geological heritage.

The term "geological heritage" needs defining as does the notion of "remarkable geological object": the later is one that stands out due to its scientific, educational and historical value, its rareness, its exemplarity, its representativeness, its exceptional state of conservation and its aesthetic quality. Such remarkable geological objects of whatever size must benefit from *in situ* or *ex situ* protection and conservation. An inventory is required by the law enacted in 2002. In April 2007, the ministry launched the inventory of the nation's geological heritage. But it is up to the geologist's community to mobilize, just as naturalists preoccupied with living things have succeeded in doing to good effect over the past 50 years.

The data are collected at regional scale. They are gathered and homogenised then transferred to the National Museum of Natural History where they are examined. The ratified sites are stored at regional and national levels and will be transferred on a public website: <http://geologie.naturefrance.fr> for expert public and <http://inpn.mnhn.fr> for a large public) on the same base as those dealing with other data on nature (with flora, fauna, ecosystems, habitats ....).

These data will be used to feed a database devoted to education, mainly used by teachers to help them to conduct fields trips with their students, and available on Google Earth.

On an other hand, IUGS set up a Geoheritage Task Group. One of its goals would be to feed a database with geosites. The French geosites of national or international relevance will be transferred to this international database. This would avoid doubling the work (or tripled if national, European and international database are established).

Protection of geoheritage needs money and a wish of conservation. This can be obtained only if a proper knowledge is achieved. In order to popularise geoheritage several ways are used :

Conferences, books, field trips, collections of booklets, exhibitions

Besides some "spare" books dealing with geoheritage or geoeducation which were published by several editors with various formats, three collections of books were recently launched : *Patrimoine géologique. Stratotypes, Balades géologiques et Géologie & tourisme*.

## GEOSITES MAPPING FOR LAND PLANNING IN PROTECTED AREAS. A CASE OF STUDY IN THE REGIONAL PARK OF PICOS DE EUROPA (LEÓN, SPAIN)

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Key words: Geoheritage management, protected areas, mapping, Picos de Europa, Spain

Concern for geoheritage (conceived in a wide sense, which includes geological and geomorphological heritage) has increased in the world during the last three decades. However there is still much work to be done. From the author point of view, one important goal to achieve is enforcing and standardizing some methodological principles in geoheritage mapping for management. Protected areas are suitable territories to develop this aim, as they usually have a high geodiversity and they are oriented for nature conservation and appreciation.

In this contribution a methodology for studying and mapping geological heritage is proposed. The test area is the Picos de Europa Regional Park, in the province of León (Spain). In this context, the purpose will be to provide a method for developing cartography to be used by professionals involved in the management and conservation of the Regional Park. Geosite mapping in a protected area should carry out a double function: on the one hand, it must be the basis for geoheritage management in the territory; on the other hand, it should be added to other thematic maps (e.g. vegetation value or fauna value) for establishing the zoning and different uses in the area (i.e.: reserve zones, traditional uses zones, tourist zones, etc.). In this paper the elaboration of maps for planning is based on the concept of typology of geosites defined by Fuertes-Gutiérrez y Fernández-Martínez (2010). Typology is conceived as a parameter for summarizing basic characteristics of every geosite, such as size, object shape and disposition, but also fragility and vulnerability. These characteristics are essential for determining how conservation and popularization of geoheritage in a protected area should be oriented.

Typology mapping must be derived from geological and geomorphological maps, extracting relevant information from these while at the same time adding other new information. There are three reasons as to why specific geoheritage maps, different from the geological and geomorphological maps, are needed. Firstly, geosite mapping has different aims from geological and/or geomorphological cartography. The second reason is that this cartography must be interpreted by a wider group of specialists, which take part in management. Finally, in spite of the wide range of sites which constitute geoheritage, some common management principles can be found. In this communication, typology is presented as a comprehensive and synthetic tool, that could resume these similarities and also be evaluated for comparing different geosites and therefore. That is why it is judged as appropriate to be displayed in maps for land planning.

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## DIGITAL TOOLS FOR COLLECTION AND VISUALIZATION OF GEOSCIENTIFIC DATA

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Key words: geomatics, inventory card, *Google Maps*

During the last years we have witnessed a revolution in the information technology applied to Earth Sciences, in particular in the fields of geological and geomorphological landscape's studies. The most innovative aspect concerns the integration of data coming from different sources. The paper presents the methodology used and developed by Torino Natural Sciences Museum (Italy), Department of Earth Sciences of Torino University (Italy) with the contribution of the Institute of Geography of Lausanne University (Switzerland), which allow to collect, store and display geoscientific data.

With regard to the terrain data collection, classical methods are based on the use of relatively simple tools and many types of maps. So far, data collected on the field had to be interpreted, summarized and redrawn (1). In order to improve and speed up this kind of process, a palm PC equipped with GIS software and GPS (Ground Position System) has been used. This allows bringing on the terrain any type of georeferenced raster or vector files, and the opportunity to get in the real time the "exact" position on the map allowing a precise and immediate survey. The GIS software includes extensions purposely set-up in Visual Basic. They add several capabilities that enable the digital representation of the features observed during field activities. Depending on the operational needs, different toolbars have been created, allowing to select predefined layers in shapefile format. Each of them is associated with a specific database allowing to perform a complete detailed description of the site. All the data collected could be directly transferred into a relational database in order to carry out an evaluation processes for determining the intrinsic value of geosites: the sum of the scientific value and several aspects such as educational, aesthetic, ecological, cultural, historical and accessibility. In agreement with other authors (2) was also prepared a section to enter values for geological hazards, vulnerability and anthropic impacts. The reason to include these aspects is based on the fact that in recent years the geotourism has attracted an increasing number of fans. In addition to the aesthetic and cultural aspects of landscape, there is need for a better understanding of geological and geomorphological phenomena especially in environments characterized by high degree of dynamism. At the end of the evaluation process each geosite gets a score from each of the aspects considered. Depending on the final purpose of the evaluation process, geosites with higher score will be taken into account.

The projects of valorization developed could be valuable and comprehensive instruments to represent results of research to the general public. In order to promote the knowledge and the usage of the geosites, to a large number of people, a Web-GIS application, based on Google maps has been developed in cooperation with the Institute of Geography of the University of Lausanne.

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## GEOTOPE, GEOFACIES AND GEOSYSTEM: HOW TO INTRODUCE PEOPLE TO GEOMORPHOLOGICAL LANDSCAPES THROUGH GEOMORPHOSITES? THE AIGUILLES ROUGES NATIONAL NATURE RESERVE, CHAMONIX – MONT-BLANC (HAUTE-SAVOIE, FRANCE)

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Key words: Geomorphosites, Landforms, Landscape, Scenery, Geosystem

The National Nature Reserve of Aiguilles Rouges, established in 1974, covers 3,279 hectares located in the two communes of Vallorcine and Chamonix – Mont Blanc with status IV according to the IUCN, i.e. Habitat/Species Management Area. The protected area extends northward from Brévent to the pass of Salenton and Bérard Valley, the Belvedere Aiguille forming its highest point at 2,965 m. Crossed by the D 1506 at the Col des Montets (1,461 m), the Aiguilles Rouges NNR is adjacent to those of Passy to the west (1,800 ha, established in 1980), Carlaveyron to the south (598 ha, Les Houches, 1991) and Bérard Valley to the north (539 ha, Vallorcine, 1992). In grand total, including the Nature Reserve of Sixt-Passy (9,200 ha, Sixt – Fer-à-Cheval and Passy, 1977), this part of Haute-Savoie offers 15,417 ha of "natural" protected areas (Depraz, 2008).

The National Nature Reserve of Aiguilles Rouges has approximately 40 km of trails experienced by 137,000 hikers between June 1st and September 30th (RNNAR, Activity Report, 2009). Half of the flow focuses on the period of mid-July to mid-August (2,200 persons/day). The motivations of visitors are fourfold: to contemplate the scenery (84%), to perform a sport activity (61%), to visit a "natural" protected area (26%), to observe wild life (14%). Lac Blanc is by far the main destination, either from Flégère cable car station or Montets pass. An initial reconnaissance concerning geomorphosites was conducted during Summer 2010 along the route Flégère – Lac Blanc – Chéserys lakes – Montets pass, which partly follows the Tour du Mont Blanc trail and the stage R-113 of the Via Alpina "Red Trail".

The concept of "landscape" has proven a definition in the French language with its connotations of "scenery" since the late 16th century: "a tract of land offering an overview to his observer" (Neuray, 1982). This definition is clearly due to the influence of Dutch painters when referring to paintings of inland natural or rural scenery. But because of different perception processes and filters of every observer, there is no more polysemous concept as those of "landscape": neither the botanist nor the geologist, the entomologist, the glaciologist, the painter, the novelist, the economist, the developer, the architect, the archaeologist, the historian, the geographer, the geomorphologist, the hiker, the tourist... have the same perception of the scenery.

However, because they run across reliefs, hiking trails may serve as material support to various visual or multi-media equipments such as relays for smartphones and kiosks for personal digital assistants (PDA). The information delivered will allow all the varied groups of landforms and dynamics not to be perceived as an ordinary background, a tract of land that one simply browse or pass through, but as a "geomorphological landscape", i.e. a complex system of spatial and chronological significance, that any observer will be able to capture and understand (Panizza & Piacente, 2003. Reynard & Pralong, 2004. Giusti & Calvet, 2010). More precisely, as noted by E. Reynard (2009), if "relief" is the objective geomorphological part of the landscape, the "geomorphological landscape ... may be regarded as a part of the Earth relief viewed, perceived and sometimes used by Man". Four panoramic views, each located along the trail between the Flégère cable car station and the Montets pass can serve as an introduction to the discovery of geomorphological landscapes of the Chamonix – Mont Blanc Valley.

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## GEOMORPHOSITES, A USEFUL TOOL FOR ENVIRONMENTAL MANAGEMENT IN NATURAL PROTECTED AREAS: VALDEREJO NATURAL PARK (ÁLAVA, THE BASQUE COUNTRY, SPAIN)

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Key words: Geomorphosites, Assessment, Valderejo Natural Park

The aim of this work is to incorporate the assessment of geomorphosites in environmental management documents of land studies.

Geomorphologic framework provides the basis of territorial organization in the Natural Protected Areas and often are the geomorphologic characteristics the reason of their attractive/appeal; the good condition/conservation of these areas are related with their relative peripheral position to the main axes of economic development due many times of their geomorphology (high altitudes and slopes, topography...) which causes both this socio-economic marginality and also its high natural value.

Geomorphologic knowledge is necessary by itself and because directs the distribution of other environmental factors: climatic, vegetation and land uses: usually geodiversity underlies their location. Moreover there are some elements with special geomorphologic value that is necessary consider for carry out proper land management: the geomorphosites. They show as suitable tools that allow achieve/implement a quite scientific, cultural and socioeconomic assessment employing a methodology that can be understood in different levels: scientific, from land assessment and by the public in general.

We focus our work in Valderejo Natural Park, located in Álava (Basque Country, Spain) in the Arcena Range, in a spatial and socioeconomic peripheral area. Its surface is around 3500 ha and occupies a karst area where the geomorphologic elements have a major role in the landscape, in this way we have defined 11 geomorphosites. They have been defined during the last ten years in the context of the studies realized by the research team. This eleven geomorphosites shows illustrates different structural aspects (monoclinal peaks of Vallegrull and Arrayuelas), various karstic processes (limestone pavement, sinkholes and caves of Campullido and Arrayuelas), tufa deposits (Purón and Polledo valleys), slope deposits (Portillo-Lerón) and different fluvial morphologies and glacis (Lahoz-Lalastra), most of them with high geomorphological value.

Tourism is a major resource in this area, in fact Valderejo is the Natural Park that has received the most high number of visitors of the natural protected area of The Basque Country (60.000 visitors in 2009). In this sense is important to note that some geomorphosites alone in Valderejo have the potential for becoming “tourist sites” and they can be considered tools for local development. In fact Geodiversity is one of research priorities promoted by the documents of Natural Park (III PRUG, 2009), that organize different events related with geomorphology and its value together with the municipalities of the area; they are all aware of the value of geomorphology as a landscape resource. However, as resources, is necessary to achieve a balance between conservation and use from the perspective of sustainability. With this aim a proper methodology has been employed defining specific proposal for each of the eleven geomorphosites defined in Valderejo Natural Park to guide environmental management. Finally, a document with information about each geomorphosite will be submitted to the management responsible of the Natural Park; this document includes an assessment that contains three valuables items: intrinsic values (involve geomorphologic information), added values (historic, cultural, touristic, landscape...) and use and management values.

\*This study is included in the research Project: “GEODIVERSIDAD, LUGARES DE INTERÉS GEOMORFOLÓGICO Y GESTIÓN AMBIENTAL EN EL PARQUE NATURAL DE VALDEREJO Y SIERRA DE ARKAMO”, UNESCO09/05, funded by the Unesco Chair of Sustainable Development.

## EARTH HERITAGE SITES AND SUSTAINABLE LOCAL DEVELOPMENT: FOSSIL FOREST – TURKEY AND LESVOS PETRIFIED FOREST - GREECE

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Key words: Lesvos Petrified Forest, Çamlıdere Fossil Forest, Geopark, Geotourism

Mediterranean region is characterized by a complex geological setting and evolution and was subjected to a variety of geotectonic and geomorphological processes, resulted in a high geodiversity. Thus large number of spectacular landscapes, geosites and geomorphosites are present along its coast. A number of geosites of outstanding scientific and aesthetic value have been protected for their unique characteristics. Recently such geosites considered as elements of value for the creation of Geoparks which is a new tool for geo-conservation and sustainable local development.

This research aims to explore the Geopark potential of two different earth heritage sites the Çamlıdere Fossil Forest, Turkey and the Lesvos Petrified Forest, Greece. Similarities among two sites in terms of geographical settings and geological origin/evolution enable this comparative study. Both sites are awarded with rich geological and geomorphologic diversity. However they principally outshine in Paleontological aspects; petrified tree fossils in particular, which were created by series of Miocene age volcanic eruptions. Both sites are located in rural environment, suffered from low economic development, immigration and natural disasters.

The Lesvos Petrified Forest is worldwide renowned for its outstanding petrified trees. Located on the western part of Lesvos island Greece, it is managed by the Lesvos Petrified Forest Geopark aiming to the protection, conservation, promotion and sustainable use of this unique natural monument. A broad range of activities combines the main components for the operation of the Lesvos Geopark, including scientific research, inventory of geological sites, protection and conservation of geological heritage, operation of open air parks, thematic museums and interpretation centers, interpretation and promotion of geological sites, organization of scientific and cultural events. Lesvos Geopark also promote itself as an ideal destination for geotourism and educational activities. Due to its quality operation and services Lesvos and the Petrified Forest was awarded by the European Commission as European Tourist Destination of Excellence in 2009!

Çamlıdere Fossil Forest is located 70 km northwest of Ankara, at Çamlıdere town comprises a core zone of 5 km<sup>2</sup> in Pelitcik village and a buffer zone of 300 km<sup>2</sup>. The core zone is very rich in petrified tree trunks while it also exhibits characteristic volcanic geosites. The Çamlıdere Fossil Forest was created by successive volcanic eruptions burying the site during the Miocene Period. The buffer zone encompasses 250 million years of earth history through the geological evolution of Central Anatolia.

In spite of its rich geological and paleontological resources, earth heritage monuments in the Çamlıdere Fossil Forest area are not yet managed properly or benefited from their geotourism potential. The cultural value of the area is also high. Çamlıdere is one of the few localities in Turkey where the Ottoman wooden architecture still dominates the settlement.

Being so close to the Ankara: the capital and second crowded city in Turkey with a population of 4, 5 million people; Çamlıdere Fossil Forest has great geotourist potential to attract enough visitors all year around. In Ankara, more than 300.000 students are studying in 10 universities which create another important opportunity for using the site as a geoscientific field laboratory for research and education.

## CONTRIBUTION OF THE GEOSCIENTISTS TO THE APPLICATION DOSSIERS OF TWO PROJECTS OF EUROPEAN GEOPARK IN THE FRENCH NORTHERN ALPS (CHABLAIS AND BAUGES MASSIFS).

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Key words: geopark, geoheritage conservation and promotion, geosite, Northern Alps

The approach European Geopark is above all a project of territory carried by its elected representatives, its socioeconomic actors and its inhabitants. But such a project based on the promotion and the conservation of the geoheritage, involves necessarily the community of geoscientists (*sensu lato*: geologists and geographers) whose fields of study concern the applicant territories.

We question here the purposes and the modalities of this implication, by taking the example of two projects of Geopark in the course of validation: those of Chablais (Haute-Savoie, mountains lining the French bank of the Lake Geneva) and with the Bauges Massif (Savoie / Haute-Savoie, between Annecy and Chambéry) in the French Northern Alps.

These two massive, distant about 70 km, have in common some geological characters (reliefs wrinkled by sedimentary low mountain ranges with skeleton of Mesozoic limestones) and to have deposited at the same time, at the end of 2010, their application dossier to join the European Geopark network (current expertise for result waited in the end of September, 2011).

In this context, a major stake in the mobilization of geoscientists was to mark down the contents of both projects so that they become complementary and not redundant.

This required the constitution of a team of geoscientists working simultaneously on both projects, in order to have an overview of the potential contents and to direct the choice of the themes emphasised in each of the dossiers.

So it was chosen to promote in Chablais first of all its glacial past, at the origin of the wealth and of the variety of its water resources (mineral waters of Evian and Thonon, Lake Geneva and mountain lakes, wetlands and peat bogs...). Secondly, the geologic structure of Chablais, massif builded by the Pre-Alps nappes, also allows to distinguish it from the Massif of Bauges, which belongs in the sub-alpine domain.

The subalpine folded relief is one of the major themes chosen for the Bauges Massif where it allows to compare in a spectacular way two very different morphostructural styles, showing from west to east a series of overlapping asymmetrical crests contrasting with an inverse relief with numerous perched synclines. The other major theme selected is the karst and its water resources, very present and developed in all the massif.

The water so constitutes the common denominator of both projects, but declined through very different aquifers. It should be a good link to make the two territories working together inside the European Geopark Network.

Beyond this action of demarcation of the thematic contents, geoscientists were also invited to work on innovative modes of protection and promotion, adapted both to the specificities of the geoheritage and to the local expectations in education to the environment, and management of the territorial resources, and to the public aimed by the development of the geotourism.

Even there, it was necessary to watch not to be redundant between both projects, what was translated by a rich collaboration between the local geologists and the team of experts common to both projects. This collaboration, involving advanced students too, resulted in the implementation and the creation of original tools of conservation and promotion of the



geoheritage, giving a good place to the new multimedia technologies. These last ones indeed allow to touch a wide public without placing panels everywhere in the landscape. They also allow to promote inaccessible or invisible heritages (Cayla and al ., to be published). These technologies allowed for example the reconstruction of the orogenic stages of the Chablais Massif in a 3D movie. The Chablais will be endowed also soon with a georoute to visit with readers of QRcodes systems.

As for Bauges, researchers and territorial actors finalize actions of participatory science and hybrid research tools serving at the same time to produce new knowledge and to give information and explanation to the territorial actors and the local or touristic public (Hobléa and al ., 2010). It is the case of the system "GeoVision", allowing to realize at once the monitoring of hydro-or geodynamic phenomena and their on-line display on Web; or MPDT (Multifunctional Participatory Dye Tracing). Two decisive experiments of MPDT were realized in the Bauges Massif in spring, 2010 and 2011. Other applications in the course of development involve the 3D imaging for the promotion as for the preservation of the underground geosites: laserscanning of sensitive sites, projection within a "geodome" of 360 ° panoramic pictures of endokarstic landscapes not easy to access, etc.

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## GEOTOURIST –MAP BAILE FELIX-1 MAY-BETFIA (BIHOR COUNTY, ROMANIA)

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Key words: Geo-Tourist map, Digital Terrain Model, Romania.

The paper describes the characteristics, criteria and methodology used for the implementation of Geo-tourist map Baile Felix- 1 May-Betfia (Bihor County) for the tourism promotion. The area is located at the contact between Tasadului Hills (structurally speaking they further continue the Padurea Craiului Mountains from the Western Apuseni Mountains) and the Western Romanian Plain. Geomorphological map and Digital Terrain Model (DTM) have been produced, geo-tourist map were derived from the geological and geomorphological map; the geo-tourist map combine the most evident geological-geomorphological features with fundamental tourist information. The goal was to produce map that could be easily interpreted by tourists to help them to better understand the landscape. The geo-tourist map is a thematic pocket foldable map colour printed with illustration notes both in Romanian and English. In addition, the tourist map contain a synoptic description of the geological, geomorphological aspects, accompanied by relevant photographs and information on excursion trails, visitor centers, behaviour rules, and restaurants, cultural and tourist attractions in area and in the surrounding areas etc. The tourist map can sucesfully contribute to the initiatives of local and regional stakeholders to improve tansfer of knowledge, utilisation this documents for tourism promotion.

## GEOHERITAGE IMPORTANCE IN REGIONAL NATURE PARKS IN THE JURA RANGE

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Key words: geoheritage, regional nature parks, Jura Range

Since 2006 (modification of the Nature protection law), about 30 projects of natural parks have emerged in Switzerland. Regional nature parks are ideal instruments for the promotion of geoheritage because they are not only regions with important natural and landscape heritage, but also because green tourism and environmental education are considered as fundamental activities in this kind of parks.

In this research, the Jura Range is considered. This is a region with rich natural and cultural heritage with six regional nature parks, one of which is situated in France (PNR du Haut-Jura). In the Canton of Vaud, the Parc jurassien vaudois has received in 2009 the label of “candidate park”. This is also the case of three other parks: PNR du Doubs (NE/JU), PNR du Chasseral (BE/NE) and PNR Jurapark Aargau (AG). The sixth park is the PNR Thal (SO), recognised of national significance by the Swiss Confederation since 2009.

This communication aims at presenting a comparative overview of geoheritage in the six parks. A recent study (Martin, 2011) has demonstrated that the Jura range represents only 4.6% of the Swiss surface but 16.2% of the geosites of national importance. Another research (Fontana and Reynard, 2011) based on the presence of geosites of national significance has shown that four of the six studied parks present a geoheritage that can be considered as very high. The results of both studies illustrate that geoheritage in this mountain range is very important. Therefore several questions will be addressed: what are the geoheritage specificities of each park and how are they used in the park?

A second objective is the study of strategies of geoheritage promotion developed by the different projects. For example some of these parks are developing an approach of geoheritage by the landscapes (folded and fluvial morphology) while others have developed very specific topics as ore and mines, karst and water management, dinosaurs and fossils. In this context we will trace what is the specific promotion techniques developed for promoting geoheritage in this quite homogeneous structural domain.

Finally, we will study if there is, through the promotion strategies developed by the park managers, a global and complementary view of the Jura Range geoheritage or if the public is in presence of identical geotourist products in the different parks? An analysis will be presented through a mapping and statistical approach.

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## INVENTORY AND TOURIST PROMOTION OF CULTURAL GEOMORPHOSITES IN THE TRIENT, EAU NOIRE AND SALANFE VALLEYS (SWITZERLAND)

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Key words: cultural geomorphosites, inventory, tourist promotion, geotourist products

The Trient, Eau Noire and Salanfe valleys are situated in the Mont-Blanc massif (France/Switzerland). They are shaped by fluvial and glacial processes in the crystalline Mont-Blanc massif and the Palaeozoic gneissic Aiguilles Rouges massif, separated by the permo-carboniferous Dorénaz syncline and over-tapped by sedimentary nappes. Because of the high geological variety, they present a good overview of Alpine geomorphology in a restricted area with diversified landscapes (Kozlik et al., 2009).

The area is also recognised for its rich cultural heritage, with archaeological remains dating back to Neolithic, numerous infrastructures, historical roads and railways related to 19th century tourist development. Traces of rural cultural landscapes are visible on the hill slopes, as well as vestiges of extraction activities carried out in the last centuries.

An inventory of cultural geomorphosites was carried out (Kozlik, 2006) in collaboration with Vallis Triensis, a local association dealing with heritage conservation. The inventory was focused on sites where the links existing between cultural and geomorphological heritage are particularly visible.

The previous assessment methods mainly focused on the scientific value of sites but did not include the cultural value. The assessment method proposed by the Geography Institute of Lausanne University (Reynard et al., 2007) included new criteria of evaluation (additional values) such as the ecological, aesthetic, cultural and economical values and was found appropriate to estimate the value of the sites in the context of natural and cultural heritage of these 3 valleys. The principal example is the Pierre Bergère (Salvan, Switzerland), an erratic block where future Nobel Prize Guglielmo Marconi made the first wireless experiments in 1895.

A synthesis map of cultural geomorphosites was produced and several tourist promotion proposals were made. In collaboration with Vallis Triensis association and Marconi Museum, two geotourist products were created: a brochure on regional geomorphology and cultural geomorphosites (Kozlik et al., 2009) and two pedagogical panels disposed near the Pierre Bergère block.

This communication allows us to present and discuss the inventory method developed at the Geography Institute of Lausanne University and to discuss the importance of scientific research preliminary to heritage promotion actions.

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## GEOCONSERVATION IN THE CZECH REPUBLIC AND GEOMORPHOSITE ASSESSMENT FOR THE GEOTOURISM AND GEOEDUCATION PURPOSES: A CASE STUDY FROM PODYJÍ NATIONAL PARK

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Key words: Geoconservation, geoeducation, geomorphosite, Podyjí, Czech Republic

Currently, protection of natural heritage is widely accepted in the Czech Republic, but the protection of wildlife still has more attention than geoconservation. In the past, as early as in the 19th century, protection of nature in Czechia was accomplished by declaration of the natural reserves and some geologically and geomorphologically important sites were also protected, but until 1950s conservation of nature was not anchored in the law and the sites with geological or geomorphologic values were not declared systematically.

In 1956, in the former Czechoslovakia the first law (40/1956 Coll.) of nature conservation was adopted, but this law was very benevolent and allowed a number of exceptions in relation to agricultural, industrial and other activities (such a mining or meliorations), so there were some cases of total destruction of natural phenomena, especially geologic and geomorphologic sites.

Currently, the main legislative instrument governing the protection of nature is Law 114/1992 Coll. The law defines six levels of natural protection (national park, protected landscape area, national natural reservation, national natural monument, natural reservation and natural monument). Despite of the progressivity of the law, geoconservation is still included in general protection of nature and it is not precisely defined. For the protection of geoheritage, two categories are used: national natural monument and natural monument. These are defined as natural features of smaller size, with particular geological and geomorphologic formations or deposits of minerals.

The Podyjí National Park represents an exceptionally well preserved example of canyon-like valley of river Dyje and its tributaries, which sometimes reaches the depth of around 230 m. These valleys create a unique river phenomenon with many incised meanders, rock slopes or blocky accumulations. These rock formations are important both from biologic (presence of glacial relicts) and geomorphologic (unique geoforms) point of view. These unique geoforms are represented especially by rock formations with a great amount of mesoforms (e.g. pseudokarst caves, rock towers) and by fluvial geoforms (e.g. segments of the deep valleys, alluvial plains). However, within the Podyjí National Park they are not very promoted and well-managed. There are also important cultural features in the area (e.g. old mills, traditional agricultural activities) which form a part of cultural heritage of the Podyjí National Park.

The aim of the project is to provide the complex inventory of significant geologic and geomorphologic forms in Podyjí National Park and to propose rational use of these sites according to the principles of geoconservation. This includes geoeducational activities, appropriate promotion of the sites and proposals for management measures of the sites. One of the objectives of the project is to justify the importance of geoconservation, because it can play a significant part in the knowledge and understanding of geological and geomorphological heritage.

## THE OCHRE OUTCROP IN THE PARC NATUREL RÉGIONAL DU LUBERON (FRANCE): FROM INDUSTRY TO SUSTAINABLE TOURISM

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Key words: Ochre, geotourism, industry, mineral resource, protected area

The ochre outcrop is located in the south east of France, in the heart of the Parc naturel régional du Luberon, European and Global Geopark. This major geological site shows special red and yellow sandstones formed in tropical conditions 100 million years ago. They also are "islands" of siliceous rocks supporting the development of calcifuges.

The physical and chemical properties of ochre sandstones have been at the origin of an industry that has developed in the nineteenth and twentieth century. The ochre outcrop contributed to the economic growth of a region in over a century. Since the 1930's, the activity has declined; a single open air quarry is still operated today by the *Société des Ocres de France*.

The ochre outcrop consists in a natural and cultural outstanding landscape of high quality, gathering together geological, ecological and economical interests. The site was designated as a protected area (Site classé) in 2002 under the leadership of the Parc naturel régional du Luberon.

### A conversion to tourism

Since the 1950's, tourism has developed in the municipalities included in the ochre outcrop with the execution of individual or collective actions. Today, the attendance in the ochre outcrop is estimated at more than 350.000 visitors per year.

### Conservatoire des ocres et de la couleur (Conservatory of ochres and color, Roussillon, Vaucluse)

The Conservatory (OKHRA) is located in an ancient ochre factory. This "ecomuseum" with an original approach (reference to Canadian conservatories) enhances and perpetuates the work and know-how linked to the extraction and the use of ochre through cultural initiatives (exhibitions, hosting artist), transmission (guided tours, training, home school), and developing the concept of living heritage. The site receives 34,000 visitors per year.

### Mines de Bruoux (Bruoux ancient mines, Gargas, Vaucluse)

Since 2009, the Bruoux mines, ancient underground quarries extracting ochre sands, are open to the public. This outdoor museum, created by the municipality of Gargas offers a journey along 650 meters of galleries and describes the history and techniques of extraction.

The management of the mines is entrusted to a private company born of the *Société des Ocres de France* and OKHRA.

The site receives 22,000 visitors per year.

Other sites host many visitors: the path of Roussillon, (220 000), Colorado Provençal, Rustrel (98 000 people ...). The last ochre quarry in Europe is located in Gargas.

### Future prospects: "Opération grand site"

Despite a worldwide reputation as a tourism destination, the ochre outcrop does not benefit from recognition as a whole but as individual actions. The Parc naturel régional du Luberon has been put in charge of the project Operation Grand Site- ochre outcrop by the State. Its role is to carry out the studies and to mobilize all partners, local councillors, businesses, professionals of tourism, etc. on a common project. The goal is to define, in cooperation, the prospects for coherent actions for the future years to better reveal the identity of the area around the discovery of Ochre.

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## INTEGRATING THE GEOHERITAGE TO THE LOCAL DEVELOPMENT STRATEGY OF THE BAUGES REGIONAL NATURE PARK, FRANCE

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Key words: geoheritage, geotourism, Geopark, Regional Nature Park, local development

In 2009, the authorities of the Parc Naturel Régional du Massif des Bauges (PNRMB) evaluated the possibility of applying to the European Geopark Network (EGN) label. At this moment, research was conducted on the integration of the geoheritage to the local development of a Regional Nature Park.

The first part of this presentation analyses the relevance of this project from a geographic perspective. The PNRMB has to deal with a set of spatial constraints serving as strong arguments for the acquisition of the EGN label. Internally, the villages of the territory of the PNRMB signed a charter that orients their development around three poles: natural and cultural heritage, sustainable economic development, and a sustainable tourism territory. These poles could easily translate to fulfill the conditions to obtain an EGN certification. Externally, the PNRMB is surrounded by other mountain ranges that are trying to distinguish themselves in a context of decreasing summer mountain tourism demand in France.

The main goal of the research was to assess whether the PNRMB had a geoheritage sufficiently interesting to obtain the EGN label. The second part of this lecture will present an inventory of the geosites that was conducted using the hiking trails network as a geographic anchor. From the inventory of 250 kilometers of trails, three sectors had the largest concentration of highly ranked geosites, each of which having its proper "personality". First of all, the sector around the Bange Mountain is characterized by a karstic system with a high geoscientific value since there are two of the most accessible caves in the park. Secondly, the geosites located in or around the Arclusaz Synclinal reflecting the structural landscape of the subalpine ranges had a distinctly high didactic efficiency. Finally, the sector around Duingt, located in the most densely populated area of the park, had many geosites that reflect the relationship between humans and the geomorphic landscape. Another site already developed, the ice caves trail of the Margeriaz, would be an ideal site to further widen the offer for general public activities related to karstic phenomena. In this fashion, the development of the first *via souterrata*, a subterranean *via ferrata*, in addition to be a unique geotouristic activity in the region, would also reinforce the commitment of the PNRMB to the EGN, since such a project would favour local development through the implication of local caving guides in the creation and animation of such a touristic attraction.

As a concluding remark, two years later, the PNRMB has deposited its application form to the EGN. The project of a Geopark in a Regional Nature Park will be analyzed through the glass of the local development model proposed by Klein (2006), in order to demonstrate how such a project could trigger the positive feedback necessary to provide empowerment to local initiatives and create the favorable conditions to such a sustainable local development.

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## INTERACTIVE VISUAL MEDIA FOR GEOMORPHOLOGICAL HERITAGE INTERPRETATION. THEORETICAL APPROACH AND EXAMPLES

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Key words: geoheritage interpretation, interactive media, dynamic, animation

Geomorphology is the most often defined as the science of the Earth's surface, of the visible landforms and processes. For this reason it can be considered as "the most accessible earth science of the ordinary person" (1). This maybe explains why geomorphologists think that landforms and processes can be understood quite innately by everybody with little help from simplified scientific explanation and pictures.

In fact, this understanding appears only after a complex learning process. Every explanation, all the more if it should lead to consider a landform as part of geoheritage for its special value, should be considered as transmission of knowledge, not information. Interpretive media should therefore take into account the user's interests, preoccupations and conceptions according to some cognitive and didactic theories (2).

In this field, the potential advantages of using interactive media are discussed for a long time and still not at the end (3-6). Some sound basis however exist that allow to build potentially more effective media as much in the user's interaction part (7) as in the semiology and structure's design part (8). Those contributions cannot be neglected.

Geomorphology has a long scientific tradition of using visual media such as maps, photographs or diagrams (9). An exploration of how multimedia can improve those classic media is presented here with different examples. We mainly concentrate on two points: firstly on the use of interactive functions to go beyond semiologic, cartographic or didactic problems and secondly on the use of animations and 3D models to approach geomorphological reality, which is dynamic and made of relief.

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## ARE PEOPLE INTERESTED IN GEOTOURISM? SURVEY ON EXCURSIONISTS IN THE SWISS ALPS

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Key words: geotourism, public's opinion, interests, interpretive media

Signs of the geoheritage promotion's vitality, many geotouristic products are published and implanted in natural areas (1). They are based on sound researches of local geological or geomorphological specificities. However the public's interests and preoccupations are often neglected. The choice of the medium – board, leaflet, numerical tool – is moreover mainly based on author's preferences or financial contingencies.

In order to reach its communication and promotion purposes, a geotouristic product should take into account all together the particularities of the site, the public, the content and the medium (2). That implies to collect information about each of those fields. Among them, the public is maybe the most difficult to assess.

To explore this field, a survey has been carried during summer 2011 in three different sites of the Swiss Hautes Alpes Calcaires (Muveran and Diablerets massifs) reaching more than 300 adult persons. As there is very few available data on this subject (3,4), we started with basic questions: are people interested in getting information and explanation about the visited site? If so, on what subjects? Then we went on with more specific questions focusing on the Earth sciences, on the existing and potential mediums and particularly on Internet use.

Some results of this survey are presented here. Their implications concern both geotourist products making and research on geoscientific interpretation. The results enlighten about the types of public visiting the sites, their opinion about existing media – like the visual impact of explanatory boards – and their preference for one or the other medium. Geotourism managers and geoscientists could find here some clues to design better interpretive experience. The option of mixing different media should in particular be considered in order to reach different publics and different purposes.

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## ONE DECADE OF SUCCESSFUL GEOSITE MANAGEMENT IN THE NORTHERN BLACK FOREST NATURE RESERVE – A LONG-TERM STUDY ON THE SPA TOWN OF BAD HERRENALB

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**Key words:** geosites management, geotouristic trail, nature reserve, long-term study, network Earth history

The spa town of Bad Herrenalb, situated in the Northern Black Forest Nature Reserve, had been a much frequented health resort, until reforms of the German health service in the 90s led to a dramatic decline in spa visitors. Having no other major sources of income, Bad Herrenalb had to attract new target groups of tourists.

As the small town has impressive tourist potential, in terms of wildlife and geology, the mayor decided to join the newly founded network 'Earth history'. This network, coordinated by the chair of applied geography at the University of Tübingen, has the overall aim to promote geotouristic offers throughout the state of Baden-Württemberg. Building on the multifaceted tourism potential of South West Germany, the network is made up of destinations, each of which represents one geological era. Bad Herrenalb was chosen as a representative of the early Triassic period (Buntsandstein).

Geotourism took advantage of hundreds of mineral springs, fields of stone boulders and rocky peaks formed by 'Rotliegend' sandstone layers as well as Triassic sedimentary rocks.

After much consultation, it was decided to create an interactive nature trail, focused on mineral springs. A popular hiking trail along the valley of the 'Alb' stream proved to be the optimal route. Unfortunately, the path led across a nature sanctuary, which provoked intense controversy about possible conflicts between nature protection, tourism development and the necessity of raising awareness for geosite management.

The involvement of the chair of applied geography stimulated a research project, which entailed a regional survey before the installation of the interactive trail, as well as a follow-up evaluation. As far as we know, the preceding survey and follow-up evaluation of the geotouristic nature trail at Bad Herrenalb are the only case study of its kind, and so far the only such field-study with a ten year observation period.

The results show that the trail has significantly boosted tourist numbers, but has also raised awareness of the importance of nature protection. Contrary to expectations, it had no negative repercussions on the highly sensitive ecosystem, not even one decade after the trail's inauguration.

The scheme also involved training specialist guides. These guides now offer more than a hundred tours annually, mostly for school children from the adjoining regions. Meanwhile a visit of the interactive geotouristic trail is almost mandatory for pupils in their fifth year from nearby schools, as supplement to the school curriculum in local geography and hydrology.

Many thousands of visitors have been attracted over the past decade, providing much needed income for the town of Bad Herrenalb. There is now also much greater awareness for the necessity to protect wetland areas.

Currently, a team of students from the University of Applied Forest Sciences at Rottenburg is engaged in developing new didactic strategies to ensure that popular interest for the geotouristic nature trail will continue to flourish in future.

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## TUFA CASCADES AND CAVES OF THE SWABIAN ALB – WIDELY KNOWN NATURAL MONUMENTS OF PREVIOUSLY SELDOM RECOGNISED CULTURAL SIGNIFICANCE

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Key words: geosite, natural and cultural heritage, tufa cascades, Geopark Swabian Jura

The Swabian Alb, one of the largest karstic regions in central Europe, is widely known for its spectacular tufa cascades and its large number of caves. The public and even some natural scientists regard these sites purely as natural heritage. The tufa cascades and most of the caves are nature sanctuaries, as defined by German law for nature protection. Their official protection has been based exclusively on biological, geological and geomorphological criteria. The high value of these monuments also as cultural heritage is rarely referred to and not well known.

According to Reynard's (2005: 183) classification scheme, the tufa cascades are of extraordinary scientific value, being one of the rare sites, which offer direct insights into recent rock formation. With an annual growth rate of about one to three centimeters, and up to 5 m<sup>3</sup> new calcareous tufa, the cascades near Bad Urach belong to the most active. The dynamic tufa ecosystem is also of significant ecological value. The small tufa terraces, covered by green moss, are of outstanding natural beauty, and the numerous tourists visiting the cascades, make them an economic asset too. But few are aware of the cultural significance of the cascades. The cascade at Bad Urach has been transformed by human intervention. The tufa was first exploited in quarries and later on the large number of small creeks was channeled into a single stream, so as to create the most spectacular cascade of the Swabian Alb. Nevertheless, most visitors would not believe that the cascade is not natural. The nearby cascade of Güterstein, equally being regarded as 'pure wilderness', had also been a quarry before, as well as the site of a now abandoned medieval monastery.

Most of the caves are not just important natural monuments, but provided shelter to Stone Age people. They include some of the most important archaeological sites in the world. The oldest works of art and musical instruments of mankind have been discovered in the caves of the Swabian Alb.

Karst springs, notably the Blautopf and the Aachtopf, are also worth mentioning. Each of them discharges more water than any other spring in Germany, sometimes reaching a peak of 32,000 liters per second each. The Blautopf in particular also features prominently in numerous legends and folk tales.

Only recently the high cultural values of these geosites are incorporated in geotouristic offers and mentioned in moduls of environmental education.

My presentation will emphasize how valuable these sites are to tourism, the economy and Germany's natural, cultural and historical heritage. I will seek to offer an explanation as to why the history of these monuments barely features in popular perception.

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## GEOSITE DESIGNATION AND GEOTOURISM DEVELOPMENT IN THE KARKONOSZE NATIONAL PARK (SW POLAND)

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Key words: geosites, geotourism, geoparks, Karkonosze

The Karkonosze Mountains, located at the boundary between Poland and the Czech Republic, have been long appreciated as an area of extraordinary natural beauty. In 1959 the most elevated parts of the area were formally designated as the Karkonosze National Park (KPN) and in 1963 a national park was also established in the Czech Republic (KRNP). Despite rich geological heritage traced back to the Precambrian and unique landscape resulting from a long-term interplay of tectonic, fluvial, and glacial processes, further conservation efforts have been largely focused on biological values. In 1993 both national parks joined the global network of Man and Biosphere reserves, which strengthened the impression that the outstanding value of the Karkonosze resides primarily in the biotic environment of the mountains. On the other hand, millions of visitors annually have long had little chance to learn about the Earth heritage of the Karkonosze due to limited availability of information passed to the general public. To redress the balance, a range of activities is now carried out by KPN, in cooperation with research institutions, aimed at increasing appreciation and understanding of geological heritage and landscape history.

A crucial component of this long-term strategy was a comprehensive project of geosite designation in the Karkonosze, fulfilled in 2008-2009. More than 130 sites in total have been subject to analysis which included both an assessment of their geological, mineralogical and geomorphological values (descriptively and numerically), as well as their suitability as sites of geotourist interest. The latter is defined by the state of preservation, educational potential, accessibility, and potential conflict with conservation measures focused on preserving and enhancing biodiversity. Geosites in the Karkonosze illustrate a multitude of geoscience themes such as rock type diversity (granite, metamorphic cover rock, basalt), mineralogy, tectonic history, landforms and geomorphic evolution (e.g. tors and monadnocks, glacial landforms, waterfalls and bedrock channels, periglacial features), and the history of mineral prospecting and mining. Many are excellent viewing points and show wider relations between geology and landforms. It is also emphasized how geodiversity underpins biodiversity.

The results of the project now serve as a basis for further activities such as designation of thematic geotourist trails, preparation of multilingual publications for the general public, and enhancement of web-based information content. Building of a new visitor centre, dedicated to geoheritage of the area, is under way. In recognition of these achievements and appreciation of this strategy, the territory of the Karkonosze National Park with its buffer zone was granted the formal status of a national geopark in September 2010 by the Ministry of Environment, as the third of this kind in Poland. Currently a similar inventory of geosites, using identical methodology, is carried out by KRNP in the Czech part of the Karkonosze. The long-term goal is to apply for membership in the European Geopark Network and thus to receive global recognition.

## PLANNING THE DOLOMITES: FROM THE CONCEPT OF GEOMORPHODIVERSITY TO AN OPEN CULTURAL APPROACH

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Key words: Dolomites, UNESCO, geomorphology, geodiversity, planning

In the collective imagination, the Dolomites are a spectacular area to study and to enjoy. In art, particularly in painting, the shapes of these mountains have inspired many visions, generating emblematic artistic images and also evoking fascinating ideas. Some examples of this will be illustrated.

In order to obtain a geomorphological understanding of these mountains, with reference to their inclusion in the UNESCO World Heritage List, an original interpretation has been introduced, that is, “*geomorphodiversity*” (Panizza, 2009): “the critical and specific assessment of the geomorphological features of a territory, by comparing them in a way that is both *extrinsic* (with other territories) and *intrinsic* (with the territory itself). It takes into account the level of their scientific quality, the scale of investigation and the purpose of the research”. Some typical situations are presented concerning the spectacular and attractive landscape and its morphotectodynamics, morphotectostatics, morpholithology, morphoclimatology and mass wasting.

This geomorphological key of interpretation can also be used to define the more general “*values*” of the Dolomites, referring to “geological” values in a broad sense, subdividing them into *extrinsic* and *intrinsic* values.

Starting from the concept of Geomorphodiversity, from the geomorphological suggestions and interpretations and from a deciphering of the landscape, the Authors outline a particular approach in planning the Dolomites.

In the evaluation of the “*livableness*” of the Dolomites, problems concerning “environmental criticism” must also be taken into account in terms of *risk* and *impact*. so as to achieve a correct and sustainable enjoyment of this mountain territory.

As for the appraisal of the Dolomites, particularly regarding Earth Sciences, a conceptual path is illustrated, following the phases of *scientific interpretation*, *communication*, *knowledge* and *awareness*. The idea is “not planning in order to protect and protecting in order to manage but *planning in order to educate*, *educating to develop awareness* and *developing awareness in order to appraise and self protect*”. (Panizza & Piacente, 2003).

Finally, *appraisal* and enhancement must be linked to a network of all the physical, biological and cultural elements of the territory. A “network” which cannot only be understood as being of “*spatial significance*” (a network of places, communities etc.), that is a group of sites bounded by territorial limits, but an “*open network*” system in its *cultural significance*, which therefore, exists apart from limitations of space, time and concepts.

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## CALC'ERE, A LOCAL ASSOCIATION LIVING FROM THE ENHANCEMENT OF THE GEOHERITAGE IN THE BAUGES MASSIF (FRANCE)

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Key words: Pedagogy, excursions, innovation, traveling planetarium, local development

CalcEre is an association of 5 scientific mediators who are both geologists (or with geosciences background) and Mountain Leaders. This double skill makes them specialists in scientific mediation on the field in mountain areas. They've been developing their activities in the Bauges massif Regional Nature Park for 10 years on the base of the rich local geoheritage and its inherited typical landscape.

CalcEre proposes geological excursions and activities for 3 different kinds of public:

1 - Environmental education for scholars (from Primary schools to High schools and Universities): The members of the association are also members of RePERE, a local network of environmental education professionals. The themes of activities, chosen in accordance with the National Education programs are dealt with along itineraries enhancing specific geological features, with the support of booklets in which the school boys and girls write their observations and understandings of the processes, step by step answering questions: therefore they experience living geology.

2- Geological training sessions for professionals or specific groups of interest, such as members of the Environmental Education network RePERE, Mountain Leaders, or voluntary guides from the French Alpine Club.

3- Enhancement of the geological richness for tourists, guided tours on specific themes:

- Geo-walks on demand
- Crémaillère trail (Aix-les-Bains/le Revard): enhancement of the links between geology, geography, human activities and biodiversity thanks to landscape interpretation
- "Let's drink the landscape": links between wine and geology
- Geo-drawings
- Guided tour on the Geotrail "Karst and ice holes": karst landforms and limestone processes
- Recreational geological workshops for children
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These activities, which are the core of CalcEre, represent up to 150 working days per year.

As the Bauges massif Regional Nature Park is applying in 2011 for the Geopark label (Peisser and Renau), it has provided the associated CalcEre with the opportunity to develop new activities.

- Engineering activities around the design of interpretation trails;
- Innovative development of a travelling planetarium: this inflatable dome, originally designed for presenting the starry vault, has been adapted by CalcEre for projecting images or videos of geological objects and specifically caves. Once inside the dome, the spectator is surrounded by the image of the cave and feels exactly as if he were in the middle of it.

The development of tight links with scientists, Nature Park staff as well as local stakeholders has enabled the association to become an important player of the enhancement of the local geoheritage and geotourism.

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## ASSESSMENT OF GEOSITES AT NATIONAL SCALE: INVENTORY OF THE IBERIAN MASSIF LANDSCAPE AND FLUVIAL NETWORK (PORTUGAL) FRAMEWORK

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Key words: inventory, geosite, assessment, geomorphology, Iberian Massif

The erosion of the Iberian Massif has resulted in a region of low relief known as Iberian Meseta, comprising a succession of cycles of erosion and weathering. The Iberian Massif designates the Variscan basement (granites and metamorphic rocks) and is the larger morphotectonic unit of Iberia, covering about 70% of the Portuguese mainland territory. Due to the different resistance to weathering of the basement, narrow NW-SE Ordovician quartzite ridges produced an Appalachian-type relief. Also the granite landscape shows a diversity of landforms at different scales.

During Cenozoic times, compressive tectonic events affected the Iberian Peninsula, creating relief and compressive structures interpreted as pop-ups, push-ups and strike-slip tectonic basins. Several allostratigraphic units occur over the Iberian Massif, mainly in the strike-slip basins and paleovalleys carved in the Paleozoic basement. These sediments are the records of the tectonic episodes and characterize several weathering and erosional cycles that are responsible by the multifaceted geomorphology.

Crossing an extensive area of the Iberian Massive, Douro and Tejo are the largest Iberian rivers. The geomorphological and sedimentary record of these rivers, as other rivers on the Atlantic western border, provides important information about the evolution of the fluvial network and landscape.

The diverse and rich geomorphological heritage provides evidence of a geological history with international relevance. Therefore, the *Iberian Massif Landscape and Fluvial Network* was selected as a geological framework of international relevance under the Portuguese inventory of the Geological Heritage (Brilha et al., 2005; 2010). A similar framework was previously considered in the Spanish inventory (Garcia-Cortes, 2001).

In the scope of this framework, five themes and 20 sub-themes were defined, taking into account the diversity of geomorphological elements in the Portuguese Iberian Massif. These themes are: Residual macro-landforms (quartzitic crests, inselbergs and plateaus sub-themes), Granite landforms (major and minor landforms sub-themes); Tectonic landforms (pop-up massifs, push-up blocks, fault valleys, tectonic basins, and fault scarps sub-themes); Cenozoic correlative sediments (Cretaceous, Paleogene, and Neogene sub-themes); Fluvial landforms (canyons, epigenic valleys, waterfalls, incised meanders, sedimentary terraces, and strath terraces sub-themes).

A total of 38 geosites of national and international relevance were selected based on the assessment of their scientific value. Representativeness, scientific use, scientific knowledge, integrity, diversity of interests and rarity of the geosite were the criteria used for the selection. Vulnerability of geosites was assessed in order to establish priorities in conservation actions.

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## VULNERABILITY OF NON-PROTECTED GLACIAL GEOSITES (PORTUGAL)

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Key words: glacial geosites, Portugal, geosites vulnerability

Under the Portuguese inventory of geological heritage a total of 326 geosites of national relevance were inventoried based on the assessment of their scientific value (Brilha et al., 2010). Sixteen of these were selected in the scope of the "Vestiges of the Pleistocene Glaciations" framework. From these, fourteen are entirely located within protected areas, namely in Peneda-Gerês National Park (PGNP) and Serra da Estrela Natural Park (SENP). The other two are partially or completely outside protected areas and despite being partly in the Natura 2000 Network they have not protection status regarding their geomorphological value. Protection actions are difficult in large geosites like these ones, mainly because: the absence of a proper protection status implies a lack of responsibility of the local administrations that manage the territory; these areas have several owners and various types of land-uses; traditionally, the politicians and land managers have a low awareness of geodiversity and geoconservation values. Vulnerability evidences and protection measures are presented in this paper, regarding two non-protected glacial geosites located in northern Portugal: Alto Vez valley (Peneda Mountain) and Toco-Soutinho (Cabreira Mountain). The Alto Vez geosite includes one of the most notable fields of glacial erratics in Portugal, in addition to other relevant glacial aspects as a U-shaped valley, lateral moraines, and a kame terrace. Much of the geosite is located outside the PGNP area. Recently, a horse racing track structure was deployed upon the glacial erratics affecting the integrity of the site. The Toco-Soutinho geosite comprises low altitude geomorphological and sedimentological evidences of a small glacier in the Cabreira Mountain as well as evidences of periglacial processes. These constitute the southernmost vestiges of Pleistocene glaciations in the NW Iberian mountains. The integrity of this site was compromised since 2004 due to the installation of a wind farm. Apart from the destruction caused by that construction the accessibility conditions were improved since then, which have contributed to increase the extraction of periglacial granite slabs from that part of the mountain. The scientific value and the vulnerability of the two geosites were numerically assessed and the exact delimitation of the physical borders was defined in order to support their management. In addition, actions have been developed in both sites, aiming the protection of the sites integrity and their promotion as natural heritage. However, and despite the collaboration with some local administrations, that protection seems to be insufficient justifying the formal geosites classification based on the Portuguese legislation. As a first step these geosites will be included in the national catalogue of natural values of the Institute of Nature Conservation and Biodiversity, the Portuguese institution responsible for the nature conservation management.

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## GEOTOURISTIC ITINERARIES IN LAZIO REGION (ITALY): GEOMORPHOSITES IN THE MILLENARIAN URBAN ENVIRONMENT OF ROME AND IN THE NATURAL ENVIRONMENT OF ERNICI MOUNTAINS.

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Key words: geomorphosites, Rome, central Italy, environmentl heritage

The analysis and enhancement of geological heritage in recent years has led to new terms such as Geodiversity, Geopark and Geotourism and to the increase of proposed itineraries that emphasize the natural-geological aspects combined with cultural aspects of the territory.

The aim of this study is to analyse the environmental heritage of some areas of Central Italy through the study and description of the geo-environmental aspects along two itineraries: the first one crossing the city of Rome and the second on the top of the Monti Ernici, (Ernici Monuntains, southern Lazio, ceno-mesozoic carbonate ridges, next to the Thyrranian coastal plane, 60 km southeast of Rome).

The Rome itinerary covers the historical center of the italian capital, an area which hold both many monuments, rappresentative of 2000 years of human presence, and wide areas of public parks. The city's ancient history is inscribed not only on monuments but also on varied morphologies, characterized by hilly and volcanic landscapes and the Tiber's river valley. Inspite of the heavy anthropic impact over the time, some interesting landforms survived that have geo-environmental interest and geoturistic in particular.

The Monti Ernici itinerary shows a karst landscape at high altitude, which is preserved under the Habitats Directive. This area has a very natural environment and many landforms of scenic aesthetic relevance have immediate impact. Human presence is nowadays seasonal and historical and cultural elements are not as prevailing as in Rome itinerary, but there are several marks of the passage of man on these mountains over the centuries that urge people to visit them.

The comparison between the two areas is an interesting one. Infact the long lasting antrophic reworking of the city center of Rome completely masked the natural landforms that however are at place still recognizable (Circus Maximus, ancient stadium for chariot races, was placed by Romans on Velabrum Maius valley flat bottom ); thus the addition of geouturistic routes to the historical monuments' itineraries could enhance the cultural value of Rome. On the contrary the high naturalness value of Monti Ernici, where natural landforms are obviously prevailing, could be increased by the historical evidence of human passage (Madonna delle cese chapel inside a karstic cave).

Millions of tourists visit Rome each year to see the historical monuments as well as many nature lovers and hikers walked on geological and naturalistic aspects of Monti Ernici: the fusion of cultural and natural features confers an added value to the proposal for tourism.

## ASSESSMENT AND PROMOTION STRATEGY OF THE GEOMORPHOLOGICAL HERITAGE IN THE VAL D'HÉRENS REGIONAL PARK (VALAIS, SWITZERLAND)

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In 2006, the Swiss Federal Law for Nature and Landscape Protection was modified in order to promote the creation of three new types of large protected areas: national parks, regional nature parks and nature discovery parks. The objective was to improve nature protection efficiency and to facilitate ecological corridors to be developed. Since, quite a large number of projects of new parks have emerged in the various parts of Switzerland (in 2011, 19 parks are in project).

A preliminary survey, carried out at the country scale on 19 parks in project, demonstrated that geoheritage of most parks is important to very important. However knowledge on geoheritage by park managers is generally low and geoheritage protection is often not a priority (Fontana & Reynard, 2011).

In the framework of a co-operation with a scientific foundation for mountain research promotion (Maison des Alpes) and a territorial community (Evolène), the Institute of Geography of Lausanne University initiated a program aimed at promoting knowledge about geomorphology within the perimeter of the Regional Nature Park of Hérens currently in course of creation.

The program to be carried out between 2010 and 2013 aims at the four following objectives:

- Improvement of scientific knowledge about geomorphological history in the area. Even if the scientific knowledge about geomorphology is quite good in the area – mainly due to process-oriented research in glacial and periglacial areas – the complete morphogenesis of the area at the Quaternary timescale was poorly known. Glacial landforms and deposits were therefore systematically studied in order to re-interpret Lateglacial history (Coutterand et al., in prep.).
- Geomorphological mapping. Several geomorphological maps were realised during the last two decades. A digital geomorphological map of a large part of the Park area is currently in preparation.
- Geomorphological heritage inventory. A first census was carried out in 2007 (Fournier, 2007). It is currently completed using the assessment method developed by the Institute of Geography of Lausanne University (Reynard et al., 2007). The inventory is managed by a digital database and a map of geomorphological heritage will lastly be published.
- Geomorphological heritage promotion. This part of the project is divided in three stages. First, an inventory of existing geotourist products is carried out. Secondly, a strategy for geotourism development is proposed. Finally, several geotourist products will be developed.

A synthesis publication about the regional geomorphology will finally be published.

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## GEOSITE ASSESSMENT AND MANAGEMENT PROPOSALS OF CAPE MONDEGO NATURAL MONUMENT (WESTERN PORTUGAL)

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Key words: Cape Mondego, geosites assessment and management, natural monuments, geosite vulnerability

Cape Mondego is located in the western coast of Portugal at approximately half distance between Lisbon and Oporto. The remarkable geodiversity of the Jurassic outcrops justifies the implementation of strategies in order to conserve and promote the geosites of Cape Mondego.

Based on the exceptional quality of the geological record, on its international importance and on its high scientific and educational values, this area is included in the National Network of Protected Areas under the designation of Natural Monument (Decree No. 82/2007). This protected area was created aiming the promotion of the geological heritage conservation, scientific research and environmental education. The Cape Mondego Natural Monument is well-known worldwide due to its international stratigraphical relevance given by the occurrence of two stratotypes: the Global Boundary Stratotype Section and Point (GSSP) for base of the Bajocian Stage and the Auxiliary Section and Point (ASSP) for the base of the Bathonian Stage.

Despite this protection, no systematic geosites inventory was ever done in the area. Therefore, the natural monument was subjected to an identification, characterisation and assessment of geosites. Based on the potential for educational and tourist uses, a set of 12 geosites was defined with values related with various geosciences domains (stratigraphy, paleontology, etc.). The eventual educational and tourist use of the geosites must be supported on territorial management plans. So, this work presents some contributions to the creation of a development plan expressed by “Planta de Condicionantes”, which defines all restrictions and limitations onto land use and anthropogenic activities. On the other hand, the evaluation of legal restrictions and geosites vulnerability substantiates the definition of partial protection areas and priority areas for geoconservation, expressed in the “Planta de Síntese”.

Finally, in order to promote environmental education, the sustainable use of this area and its geodiversity and geosites, some documents for educational purposes were created: a Teaching Guidebook, a Geosites Map, and an Informative Panel. These educational resources are seen as essential in implementing a geoconservation strategy in Cape Mondego Natural Monument and to promote its sustainable management.

## MANAGEMENT IN NATURTEJO GEOPARK (PORTUGAL): GEOMORPHOLOGICAL VIEWPOINTS

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Key words: Naturtejo Geopark, geosite management, viewpoints inventorying

Naturtejo Geopark, part of the European and Global Geopark Network under UNESCO, includes an outstanding geological heritage where conservation, education and (geo)tourism are the basis to foster sustainable development.

As human activities may increase the threats it is a priority to promote raising awareness towards geoconservation, through interpretation of geodiversity for general public, schools, tourists and local communities. Networking within European and Global Geoparks promotes information and best practices exchanging, in order to establish the best strategies for each geopark, concerning national and regional realities.

There are about 170 geosites identified in the ongoing Naturtejo Geopark Geological Heritage Inventory, 16 of them with an outstanding value, combining scientific, educational and tourist interests, some of them with international relevance and some are natural icons for the region. These 16 geomonuments tell the geological history of the Geopark for the last 600 million years and most of them can be observed from one or more viewpoints. In Naturtejo Geopark there are 27 viewpoints identified, distributed in two geological contexts: Geomorphology and Tectonics/Structural Geology, and sub-divided in 5 categories (Table 1).

Geological context	Category	N. of viewpoints
Geomorphology	Tectonic landforms	4
	Residual relieves	7
	Fluvial	10
Tectonic /Structural Geology	Variscan	5
	Alpine	1

Table 1. Viewpoints: geological context and categories

Viewpoints are privileged geosites for raising public awareness; in general these are sites with aesthetic value, good visibility to one or more elements of interest, with considerable scale, combining also biodiversity and historical heritage/land use. In these cases geological heritage vulnerability is low, the main threats evolve specially constructions and land(scape) management and not the human impact in visiting places that stay relatively far from the interest sites. Visitors cause few impacts that can be minimized by a proper monitoring strategy: equipment' conservation, garbage cleaning, visibility and accessibilities maintenance. Viewpoints represent important tools, especially the ones in the main roads, for visitors who cannot or do not want to walk or do not have enough time to explore the territory and these places promote a general overview for all the geopark. These sites are also important for formal and non formal education, with high legibility and global comprehension. Few viewpoints are not accessible by car and are integrated in walking trails.

Naturtejo Geopark is preparing thematic routes through viewpoints that are properly equipped (including interpretation in situ or portable, safety infrastructures and accessibilities) to receive people and that are spread for all the territory.

## GEOMORPHOLOGICAL HERITAGE AND GEOMORPHOSITES SELECTION IN THE BRIÈRE NATURAL PARK (FRANCE): NATURAL AND CULTURAL HERITAGE

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Key words: geomorphological heritage, Brière Natural Park, landforms tilted blocks, swamps environment, geomorphosites selection

The *Brière* is a big swamp of fresh water, close to the sea level (1 m), which belongs to the wetlands of the French Atlantic front. It is situated north of the estuary of the river *Loire*, at the back of the bay of *La Baule*, in one of the most touristic sector of the armorican Massif. In *Brière*, landforms are little contrasted but they nevertheless constitute a natural heritage deserving being popularized within the framework of the Natural Park established in 1970.

A swamp is at first an environment which involves three factors: some water - regularly supplied, a natural dam - without which a stream occupies only a valley, and a sedimentary mound without which the dam holds down only a lake. Waters of *Brière* come from the river *Brivet*, the last tributary of the *Loire*, which comes from the Northeast after having crossed the hillside Brittany Line and which floods the *Brière* basin before joining the estuary at *Saint-Nazaire*. In this basin, landforms are incorporated in a set of big tilted blocks, stemming from deformations of the armorican platform during the Tertiary era. These asymmetrical blocks are lined by fault scarps in the Southwest and form backslopes that disappear under subsiding depressions in the Northeast: *Brière* appears as a basin which subsidence is connected with the toppling of the Guérande plateau in the Southwest (61 m) and of a stripping of the Brittany Line in the Northeast (91 m). The twenty meters mound proceeds of marine sediments, alluviums of the river *Brivet* and from the *Loire* estuary. It is held to the Southeast by the levees of banks, which isolate *Brière* from the estuary, transforming the basin into a swamp of fresh water, finally subjected to the development of the peat.

Besides, *Brière* is a joint ownership swamp: the property is shared by the inhabitants of the peripheral municipalities and the collective management is recognized by letters patent of the duke of Brittany for the XV<sup>th</sup> century. This status, links by specific rights (exploitation of peat and reed, hunting and fishing, breeding on islands), involves a permanent management of the water levels according to the various swamp uses.

In these circumstances, the least variation of water levels modifies the configuration of every landform, and the selection of geomorphosites has to take into account all natural and cultural inheritances. Such a selection, led within the framework of the popularization of geomorphological heritage of the Park, supply the opportunity to use an integrated method, already applied in other places, basing on a landform analysis at different scales and leading to a deductive selection of geomorphosites.

The method includes several stages. The first one concerns the characterization of general properties of the studied area in the operation of popularization, such as it has just been made. The second stage concerns the identification of the major geomorphological components, of similar dimensions, but that present additional properties. In *Brière*, those major landforms are those of the land (*Brière's lands*), of the islands (*Brière's islands*) and of the swamps (*Brière's swamps*). The third stage concerns the subdivision of each of those major components in elementary geomorphological units. For *Brière's lands*, those units are steep slopes, backslopes and mounds; for *Brière's islands*, the "islands", vast and inhabited, and

"mounds", isolated and uninhabited; for Brière's swamps: banks (occupied by water meadows), reed bed swamps and smooth expenses of water (*piardes*). The next two stages concern the final selection of one or several representative geomorphosites for each geomorphological unit, whose choice considers scientific criterias (representativeness, didactic interest), then the determination of viewpoint which localization takes into account usual touristic criterias (accessibility, legibility). The choice of geomorphosites results from a deductive selection which involves a series of *taxons*, presented similar scientific and educational values.

In the case of Brière, geomorphology and history are conjugated for the geomorphosites selection, from tectonic steep slopes (major landforms) up to smooth expenses of water (human made swamps). This selection is significant of a conversely proportional influence of natural and cultural factors.

## FLUVIAL PATTERNS AND GEODIVERSITY OF XINGU RIVER – BRAZILIAN AMAZONIC REGION

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Key words: Xingu River, Brazilian Amazon, fluvial patterns, geodiversity

The Xingu River is one of the largest catchments of the Amazon River Basin, the largest drainage basin in the world, that covers 7,050,000 km<sup>2</sup> and is approximately 6,400 km long. Among the amazonic drainage basins, the Xingu River basin is also the one featuring the largest diversity of fluvial patterns, from upper areas with Tertiary Sedimentary rocks to medium and lower areas with, respectively, pre-Cambrian basement and Tertiary sedimentary rocks. There are many different meandering floodplain reaches, waterfalls, rapids, single and multiple channels, marginal lakes, rias, with different sizes and hydrodynamic processes. Most of its area - about 30,5 million hectares - is protected by Brazilian environmental law, mainly in the conservation areas known as Indian lands. However, many factors can threaten this diversity, even before the production of medium and detailed scale studies, particularly in their abiotic aspects. This study is being developed in the post-graduation program in physical geography of the University of São Paulo (Brazil), and is inserted in the fluvial geomorphology working group which develops researches on catchments with high level of conservation, including some in the Amazon region.

The aim of this study is to describe and evaluate the geodiversity of Xingu River Basin through morphological, morphometric, hydrological and sedimentary parameters of representative sample areas using a multi-scalar approach. Some of the main techniques and procedures include satellite images and aerial photograph interpretation, field works, sedimentology and statistical analyses of hydrological parameters. Those analyses enable the interpretation of the hydrodynamics of the selected samples and the production of the cartography.

In this specific case, fluvial geomorphology is not being considered only in its aesthetic value for purposes of geotourism. It will also be addressed in the following values:

- (1) scientific, whereas this parameter is the record of a history of geological, hydrological and geomorphological processes;
- (2) functional, since each type of morphology represents a different environment, which acts as habitats of different species of wild fauna and flora, often endemic to each section of river channel;
- (3) cultural, since many river features (such as caves, bedrock outcrops, waterfalls), and the river itself, are considered sacred sites for several indigenous people of 25 indian lands contained within the boundaries of Xingu drainage basin. From this, we expect to demonstrate the importance of fluvial geomorphology knowledge to geodiversity issues, and to contribute to the discussion about conservation politics to Amazon Region.



## NATURAL PARK “LENA PILLARS” (YAKUTIA, RUSSIA): BETWEEN NATURAL AND CULTURAL HERITAGE

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Key words: Lena Pillars, frozen ground karst, archaeological site Diring-Uryakh

Natural Park “Lena Pillars” is situated in the middle part of the valley of great Siberian River Lena: N 60° 06' 30" – 61° 17' 13", E 124° 59' 33" – 128° 53' 00". Territory explored is placed on Prilenskoe Plateau, uplifted 300-600 m above sea level. Limestones and dolomites, dated by Lower Cambrian, by a thickness more than 500 m outcrop here. Some objects, characterizing by the natural and cultural values, are distinguished in the framework of NP Lena Pillars. At present the educational and geotouristic excursions are conducting to certain of its.

Frozen ground karst of NP Lena Pillars is the object of Natural Heritage of international level. This specific type of the karst represents the only and unique example of the recent development of karst processes on the plain plateau, constituted by the limestones and dolomites, in conditions of Sub-arctic extreme continental and dry climate: average annual temperature of the air is –9,8°C at the annual temperature amplitude to 98°C. Average annual precipitations doesn't exceed 249 mm. Karst processes are developed in the area of continuous permafrost up to 300-400 m thick.

Classic superficial and underground karst manifestations: karst sinkholes, ponors, suhodols, karst lakes, dry channels, disappearances of the rivers, karren, karst pillars, etc. are observed here. Activity of the recent karst processes on the territory of NP Lena Pillars is estimated by 10,3 mm per 1000 years.

Cultural Heritage of NP Lena Pillars is determined by the unique archaeological finds (more than 4,5 thousand objects of ancient culture) revealed starting from 1982 by the Prilenskaya Archaeological Expedition. The archaeological site was opened in the region Diring-Uryakh, situated on the territory of NP Lena Pillars, on the height 105-120 m above the level of River Lena. The area of archaeological excavations exceeds 32 thousand square meters. The age of the site is dated by more than 2 million years.

## GEOSITE SELECTION FOR GEOTOURISM IN KILIM KARST GEOFORESTPARK

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Geoheritage conservation works required serious efforts and often are time consuming. In order to convince the authority on the significance of scientific inputs and the necessity to conserve a geosite, one would require huge amount of paper works and endless communication. A conservation effort on a site is generally considered successful if it ends up protected by any provisions of law or act. In order to ensure the sustainability of a geosite one should consider the sustainable utilisation of the site, and perhaps in this case promoting it into geotourism is the best solution. However, due to the different nature of the geosites, not every geosites are suitable for geotourism development, and yet there are no systematic processes available for selecting geosite for geotourism. In Malaysia, current geotourism approaches are mostly very sectoral in nature and top down in approach without much consideration on the benefit to the local community as the direct benefactor. This study examine variables necessary for the good practise in selecting geosites for geotourism base on a case study in Kilim Karst Geoforest Park permanent forest reserve within the Langkawi Global Geopark. There are 22 geosites in the geoforest park, but only 6 of them have been utilised for geotourism purpose. This selection was based on four criteria, namely the environmental impact, economic significant, local benefit and knowledge enrichment. This preliminary study shows that geosite selection process for geotourism can be systematically exercised in order to optimise their sustainability and their benefit to the public. The criteria for geosite selection should be continuously reviewed in order to achieve quality tourism, recreation and community development.

## SITINET – CENSUS, NETWORKING AND DEVELOPMENT OF GEOLOGICAL AND ARCHAEOLOGICAL SITES

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Key words: geosite, web-gis, geological heritage, SITINET

SITINET is one of the projects financed by EU in the INTERREG 2007-2013 programme Italy-Switzerland.

The area for the development of the project is called “Regio Insubrica”: it develops on the boundary between Italy and Switzerland, precisely in the counties of Verbania, Novara, Varese, Como, Lecco (on the Italian side) and Ticino and Binntal (on the Swiss side).

The project involves both Italian and Swiss universities, natural sciences museums, natural parks and local governments, with their tourist and cultural departments.

After the first step of the project, when all together worked at the same table in order to define the contents of the inventory form, each of the partners worked on his own competence area and subject during the inventory of sites and itineraries.

The aim of the project is to give a high touristic and cultural value to the geological and archaeological heritage of this region, through the creation of a net of walks and events dedicated to tourists and schools.

Some of the project's objectives :

- planning the geological and archaeological heritage, taking evaluation about conservation and tourist and educational exploitation of the sites . These actions are taken through a detailed census of geosites and archaeological sites, collecting not only scientific data, but even informations about accessibility (roads and paths), presence of visitors' centres, accommodation,
- taking actions to give values to these sites inside the local tourist economy. For example, Veglia-Devero Natural Park is planning three new geological trails: two about geomorphology and glaciology (one in Alpe Veglia and one in Alpe Devero) and one about the formation of the Alps, with a circular tour of two days between Italy and Switzerland (Binntal)
- creating educational activities (tours, laboratories, conferences and so on) both inside and outside Natural parks. For example, educational activities about archaeology have been already organized in the previous school year, in different natural parks.

The final product will be:

- a website with a web-gis ([www.sitinet.org](http://www.sitinet.org)), where the user could find all the informations about sites and tours. He will have the opportunity to query the database depending on his own interests or by geographical method and obtain detailed forms for geo and archaeological sites with tourist, hiking and scientific informations: these will be printable from the webgis, and could be updated often and immediately ready for the final user
- new publications about trails, museums, events
- new educational proposals both for adults and youngs

- a powerful net of knowledges about this new touristic and cultural resource

During summertime all the partners will start filling the database both with geo and archeological sites, while during fall some of the partners will realize actions on the field (i.e. Veglia-Devero Natural Park with its geo-trails and an archeological museum). By wintertime the website will be full operational, while other actions will go on to be organized and will be ready by next springtime.