

GEOTOURISM: SOME EXAMPLES IN NORTHERN-CENTRAL ITALY

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Abstract: Italy is a country with a rich natural heritage that is having difficulty in finding the right areas for acquiring knowledge, protection and improvement. In particular, the geological component of the landscape has not yet acquired a sufficient value as a cultural asset which people can learn about and share. Within the Italian territory geotourism activities and products are recently widespread and, in this paper, some examples of activities carried out in the Emilia-Romagna, Marche and Abruzzo regions (northern-central Italy) are illustrated. They show different possible approach to the realization of geotourism maps, geological itineraries, portable and on site illustrative materials, web based projects, geosites analysis. These activities are targeted at various potential users, tourists, local residents, young people, schools etc., and are aimed at the enhancement of geological and geomorphological aspects of the natural heritage making it available to the public.

Key words: geomorphology, geotourism, maps, northern and central Italy

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INTRODUCTION

Italy is a country with a rich cultural heritage and complex national territory. Just as the abundance of archaeological and architectural sites and finds does not yet correspond to any adequate conservation policy, also Italy's natural heritage is having difficulty in finding the right areas for acquiring knowledge, protection and improvement. In particular, the geological component (s.l.) of the landscape has not yet fully acquired

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value as a cultural asset which people can learn about and share. Therefore, new ways and new strategies must be found to awaken the interest not only of the scientific and official world but also of the general public.

The ever-growing consolidation of a new kind of tourism, more sensitive to environmental issues, has given rise to rapid expansion of the naturalistic tourism in Italy, which is among the countries with the highest tourism vocation worldwide. Observation and appreciation of Nature and traditional cultures are the main motivation inducing tourists to seek holiday sites and excursions with a well-defined naturalistic character (Coratza et al., 2008).

Recently, in Italy, like in many other countries, scientific and legislative initiatives have demonstrated an increasing interest towards the geological heritage and the development of a sustainable tourism. Particularly important is the „*Recommendation Rec (2004) 3 of the Council of Europe on conservation of geological heritage and of areas with special geological interest*“ (adopted on May 2004) and the recent „*European Manifesto on Earth Heritage and Geodiversity*“. In particular, as it is stated in this last document, „*Earth Heritage and Geodiversity create opportunities for education, recreation and tourism. [...] Geological landscapes and sites, by themselves or in combination with their cultural, historical and ecological heritage, offer potential for sustainable tourism, education and landscape appreciation*“.

In this paper some examples of geotourism activities carried out in the Emilia-Romagna, Marche and Abruzzo regions (northern-central Italy) are illustrated (figure 1). These examples are rooted in the complex geological and geomorphological setting and geomorphological features of the regions. They are based on the premises and intentions of the development of new activities in the field of geotourism with the following aims:

- Arrange integrated-type proposals based on well-tried itineraries which insert geological elements to support or complete the themes usually followed e.g. archaeology, architecture, flora and fauna etc. (Bertacchini et al., 2002; Piacente and Coratza, 2005).
- Put together geotourist maps and illustrative materials, aiming not only to spread information about our geological heritage but also to develop environmentally sustainable tourism (Coratza and Marchetti 2005; Miccadei et al., 2008).
- Encourage the creation of professional figures who can forge a connection with the world of science and with the business world (Panizza and Piacente, 2005).
- Increase the sensitivity of young people to scientific, and particularly earth science, knowledge providing the perception of the geological and geomorphological processes within their spatial and temporal scale.

GEOMORPHOLOGICAL OUTLINE

The Apennines of northern-central Italy are a fold-and thrust mountain chain related to an orogenic system (chain-foredeep-foreland), derived from the post-Eocene collisional history between the European and African plates and from a complex, multi-staged evolution (e.g. Carminati et al., 2004; Patacca et al., 2008; Mantovani et al., 2009).

The geomorphological features of the northern-central Apennines are connected to different processes which have been active over a long time (mainly from the Early Pleistocene) on different lithological types and with changeable geodynamic and climatic conditions in terms of areal distribution, intensity and recurrence.

The topographic relief of Apennines Chain is made up of a series of ridges elongated in directions that vary from NW-SE to N-S, separated one from the other by narrow valleys or by wide intermontane tectonic depressions (e.g. D'Alessandro et al., 2003 a).

The Adriatic Piedmont areas are characterized mostly by gently reliefs joining the wide Po Plain in Emilia Romagna, alluvial and narrow coastal plains in Marche and Abruzzo. At the Apennines front of the Emilia Romagna and within river valleys of the

Marche and Abruzzi Piedmont, a series of Pleistocene-Holocene river terraces are present. The terraces have been tectonically tilted towards plain and coastal areas, as a consequence of the high rate of the Apennine uplift during the Quaternary (e.g. Picotti et al., 2009; Mayer et al., 2003; D'Alessandro et al., 2008; Della Seta et al., 2008).

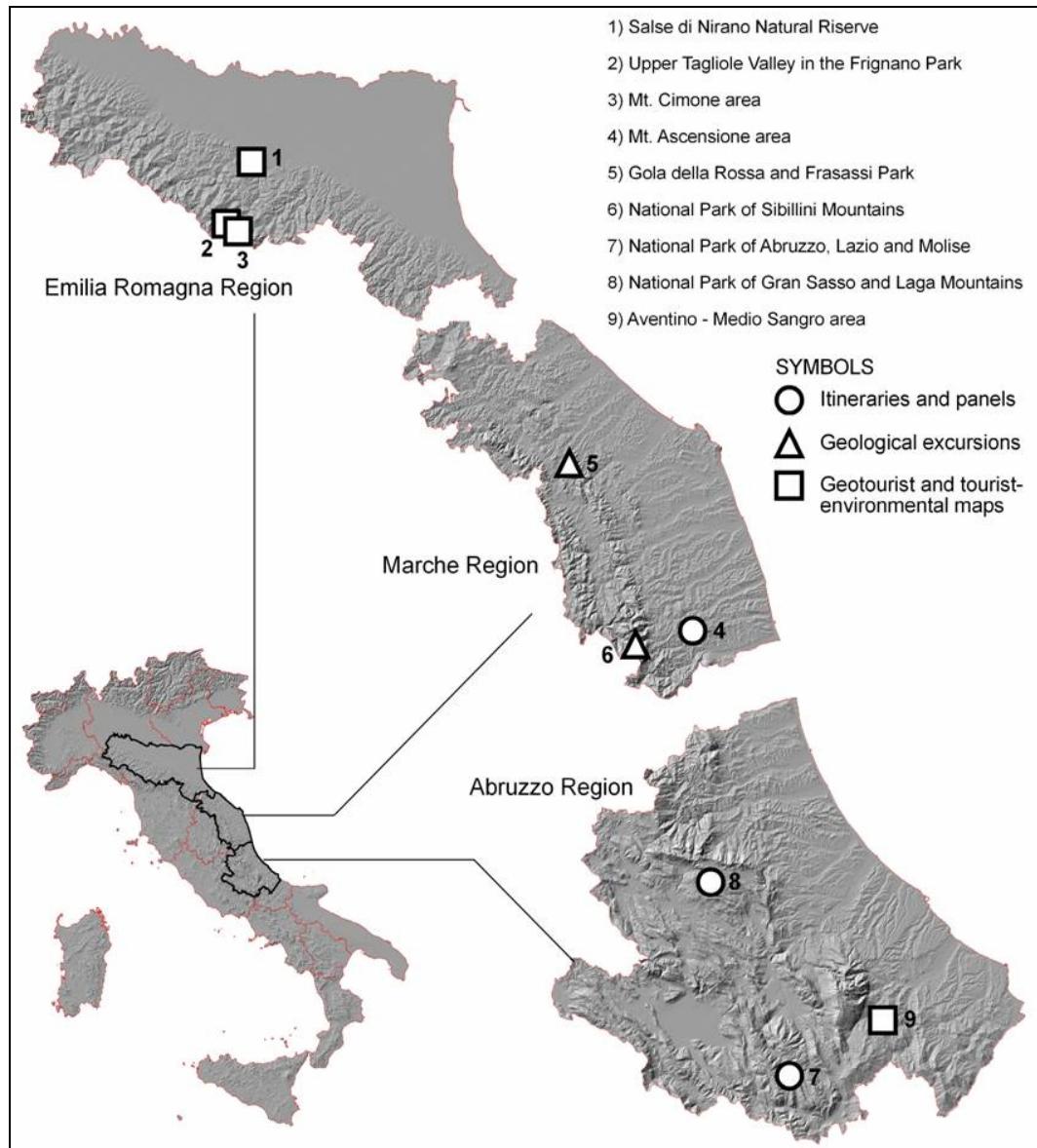


Figure 1. Shaded relief image of Italy and location of Emilia Romagna, Marche and Abruzzo regions. The symbols indicate the location of the examples described in this work
(Source: Authors' elaboration from SRTM DEM)

The northern sector of the Emilia Romagna Region belong to the Po Plain, which is the most extensive plain in Italy (Castiglioni et al., 1997; Castiglioni and Pellegrini 2001). Along the Apennine boundary of the Po Plain, extensive surfaces, corresponding to a Late

Pleistocene fluvial fan coalescence crop out. Holocene fluvial deposits, due to fluvial aggradation of both the River Po and its southern tributaries, occupy the plain. In the Emilia Romagna costal area the streams flow through sand dunes corresponding to old shore lines.

In the Marche and Abruzzo regions the coastal area is characterized by a high coast with cliffs and palaeocliffs, while the plains are limited to a narrow coastal plain and to the alluvial plains of the main rivers at the hilly piedmont area.

Structural landforms resulting from both regional tectonic evolution (also neotectonic) and selective erosion have assumed considerable prominence. The most characterizing morphological features are crests and valleys controlled by homoclines, folds, faults and joints (mid-northern Apennines). Within central Apennines characterizing landforms are fault related scarps and slopes as well as mesas and cuestas. In the piedmont area, small mud volcanoes („*salse*“) genetically connected to the emission of mud, gas and petroleum along discontinuities produced by the frontal overthrusting of the Apennine range, can also be found. Different interpretations can be made to explain the genesis mud volcanoes in this area, but in general they are associated to the hydraulic gradient due to rainfall and controlled by stratigraphic-structural setting of Pliocene clay deposits onlapping mainly pelitic-arenaceous Messinian sediments (Farabollini et al., 2005).

Landforms and deposits due to running waters (e.g. scarps, valleys, alluvial fans) are widespread all over the study areas. In the main fluvial valley, alluvial plains and terraces are present, made up of mainly gravels deposits. Along the Apennine margin, calanchi, landform similar to badlands, are widespread.

Slope processes, and particularly mass movements are important, due to lithological setting and to local high energy relief. Almost every slope in the piedmont area and several in the chain area, have been somehow affected by small or large landslides (APAT 2007). From the typological viewpoint all landslide types are represented.

Glacial landforms (e.g. cirques, roches moutonnées, moraine ridges) and moraine deposits are found in the upland areas. They testify Late Pleistocene glaciers which extended at altitudes as low as 900-1000 m a.s.l. (Federici 1979; Jaurand 1999; Giraudi 2004). Only the Calderone glacier (Abruzzo) is preserved at present all over the Apennines: although its size has decreased considerably, it is still the southernmost glacier in Europe (D'Alessandro et al., 2001).

In the upper sector of the Apennines, periglacial landforms and deposits (e.g. avalanche tracks and cones, rock-glaciers) are also widespread. Karst landforms (e.g. dolines, caves) are widespread allover the calcareous ridges of central Apennines.

Marine landforms give a strong imprint to the coastal landscape of high and low coasts with different features within the three regions.

Finally, as concern anthropic landforms, the irreparable damage to slopes caused by quarrying activities (raw materials) should be pointed out as well as the modification of the drainage of major and secondary catchments due to the building of artificial lakes both for hydroelectric and agricultural purposes. At the higher elevations, the geomorphological impact determined by the setting up of ski slopes and skilifts in some areas should also be mentioned.

GEOTOURISM AND LANDSCAPE OF NORTHERN AND CENTRAL ITALY

The coexistence of the features of an evolutionary history still active, has made the landscape of the Italian regions (among which Emilia Romagna, Marche and Abruzzo regions), a world fame gym for geologists (s.l.). The complex palaeogeographies find their expression in the main ridges of these regions whose rocky cliffs allow the researchers imaginary trips through ancient tropical heavens with lagoons, coral atolls and deep seas.

Glacial landforms, alluvial fans, terraced deposits etc., preserve the memory of „*past worlds*”. The landscape itself, now rough and steep in the chain area, decreasing gradually in the piedmont, and finally smooth in the hilly reliefs down to the alluvial and coastal lowlands, bear witness of different geomorphological processes that acted in the Quaternary age and are acting today. The result of the geological and geomorphological evolution is that the landscape represent a great example of variety and complexity of processes and phenomena that characterize and make unique the whole national territory and this geological heritage worth to be the subject of a specific protection and enhancement.

Environment protection is first and foremost ensured by an extensive network of protected areas. Parks and reserves safeguard rock exposures, ecosystems, landscapes, species and botanical associations, habitats and staging points for fauna, which are all typical of the regional territories. Recently, however, they have also started playing an active role in scientific research, in environmental education, in the conservation and maintenance of the local ecological balance, in the recovery and enhancement of the historical and geological heritage, in the promotion of environmental values, with a view to tourism.

The enhancement process is based on the combination of scientific research, analysis of existing risks and resources, increase and improvement of tourist facilities, and cultural promotion initiatives (Panizza and Piacente 2005). As such, this process is generally targeted at different potential users: tourists – by allowing them to find out more about the park areas; park area residents – by increasing their awareness of the resources, but also of the risks, that can be found in their territory; and tourist sector professionals – by developing new opportunities and sustainable ways of exploiting these area's peculiar features and uniqueness.

Examples of activities carried out in the field of geotourism and enhancement in northern-central Italy are illustrated in this paper. In particular, they are focused on geological itineraries and trails, tourist packages, geotourist maps and illustrative materials, creation of professional figures, and projects involving schools and young people, within Emilia Romagna, Marche and Abruzzo regions (figure 1).

EXAMPLES IN THE EMILIA ROMAGNA REGION

Environmental protection in Emilia-Romagna Region is ensured by an extensive network of protected areas which include 2 national parks of national and international interest and 13 regional parks of regional and national interest and 14 natural reserves, mostly of regional-local interest (<http://www.ermesambiente.it/wcm/parchi/index.htm>). The two national parks stretch along the ridge of the Apennines and down the Tuscan slope while the regional parks and reserves are mainly located in mountain or hilly sectors. One meaningful exception is represented by the huge park of the Po delta, which includes wetlands of international importance distributed both along the coast and inland, and also reserves for the protection of remnant environments in the Po Plain.

As it is impossible to list and describe all the initiatives, in the following notes will be illustrated those which, in our opinion, are considered the most significant.

Geosites

In order to meet society's increasing need for information on geoenvironmental matters, the Geological Survey of the Emilia-Romagna Region (Servizio Geologico, Sismico e dei Suoli - SGSS) has launched a comprehensive outreach programme to share the basic knowledge in the field of Earth Sciences. To achieve this aim the SGSS made geological information available to the public (students, citizens, tourists, politicians etc.) using its website (www.regione.emilia-romagna.it/geologia) and other media like: maps

of geoenvironmental itineraries, documentaries, educational CDs, exhibitions, books and information leaflets. To realize this material the SGSS created a working group, including geologists, graphic designers, educators etc., giving a job opportunity to young persons. In particular, a detailed census of the „*regional sites of geological interest*” (geosites, geotopes) has been implemented using data collected from more than 25 years of regional geological mapping (1:10.000 to 1:50.000 scale). The geosites census is constituted by 711 “elements”, to which can be added 775 caves developed on an area of 53,000 ha. A digital database stores all the information about the „*regional sites of geological interest*” facilitating the implementation of innovative geological maps and other products.

Geotourist maps, Geoenvironmental maps and itineraries

As concern cartographic material the SGSS implemented maps of geoenvironmental itineraries, which illustrate the most interesting geological aspects of some areas of Emilia Romagna Region. To date, five maps have been printed related to Ceno Valley, Bologna hills, Trebbia Valley, Casentino Forest and Matilde di Canossa territory (Regione Emilia-Romagna 1999, 2001, 2002, 2003 a and 2003 b).

A new document is the „*Emilia-Romagna Geological Landscape Map*”, at 1:250,000 scale (Regione Emilia-Romagna, 2009) (figure 2), which emphasizes the relationship between geology and landscape, showing how different rocks produce different features and different behaviour of the territory. The legend of the map includes 13 main landscape units (and of a series of low rank units): Western Peaks, Mid - Eastern Peaks, Mountains; Landslides and Badlands, Ophiolitic Crags, Sandstone Spurs, Windows on the Deep Apennines; Triassic Gypsum, Layer Upon Layer, Foothills, “*Vena del Gesso*”, Alluvial Plain of the Apennine Rivers, Po Plain, Coastal Plain. Each landscape unit is illustrated by clear photos and simple descriptions. The map try to shows the basic concepts of geoscience looking at the landscape that we see every day.

As concern the documents implemented by University researchers, a research group of Modena and Reggio Emilia University (in cooperation with local Boards) has the oldest tradition in the field of Geological Heritage (s.l.) studies in a local context. Important investigations were carried out over the territory of the Modena Province and Emilia-Romagna Region and were eventually collected in a volume presenting the census and assessment of the Geosites of Modena Province from a scientific standpoint (Bertacchini et al., 1999) and in a book dealing with geotourism methodological approach, published by the Emilia-Romagna Region (Poli, 1999). The spirit that inspired this innovative (at that time) research and defined the goals and methods was the deep conviction that in Italy, as in most other countries, the geological aspect has not yet assumed the value of Cultural Asset. In this sense research has produced not only a new census of significant geological sites on a regional scale, which reconsiders and updates previous ones, but also geological-cultural and tourist-educational itineraries which have Geology as a leading theme (Piacente and Poli, 2003). In these activities young graduates on Geological and Natural Sciences have been involved.

More recently, to improve knowledge, utilisation and appraisal of the environment of protected areas located in hilly and mountain areas of the Apennines of Modena, three Tourist-Environmental Maps and a CD-Rom have been implemented. The hilly area is the Natural Reserve of Salse di Nirano; the “*Salse*” are small mud volcanoes formed by emissions of salt water mixed with mud and pushed up by methane rising to the surface along ground discontinuities (figure 3; 1 in figure 1). The mountain sectors consist of the upper Tagliole Valley and Mt. Cimone area (2, 3 in figure 1), located within the Frignano Park; they are mainly characterized by glacial, periglacial, gravitational and running water landforms and deposits.

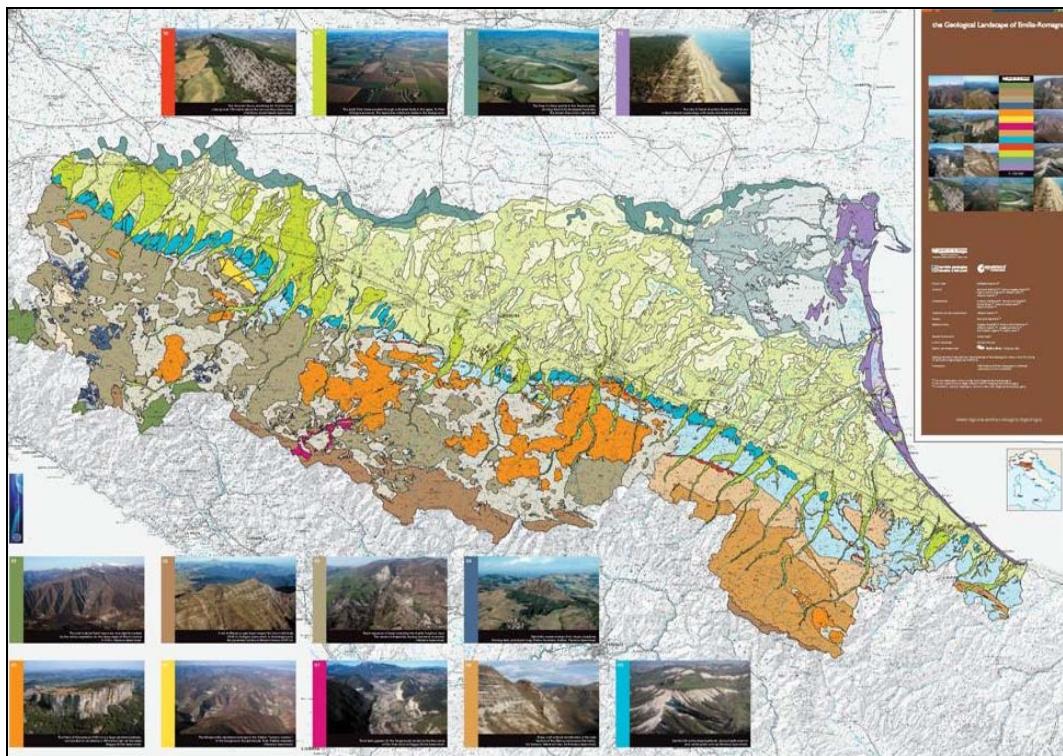


Figure 2. Emilia-Romagna Geological Landscape Map, at 1:250,000 scale
(Source: Regione Emilia-Romagna, 2009)



Figure 3. Mud volcanoes (*Salse*) in the Salse di Nirano Natural Reserve
in the Emilia Romagna Region

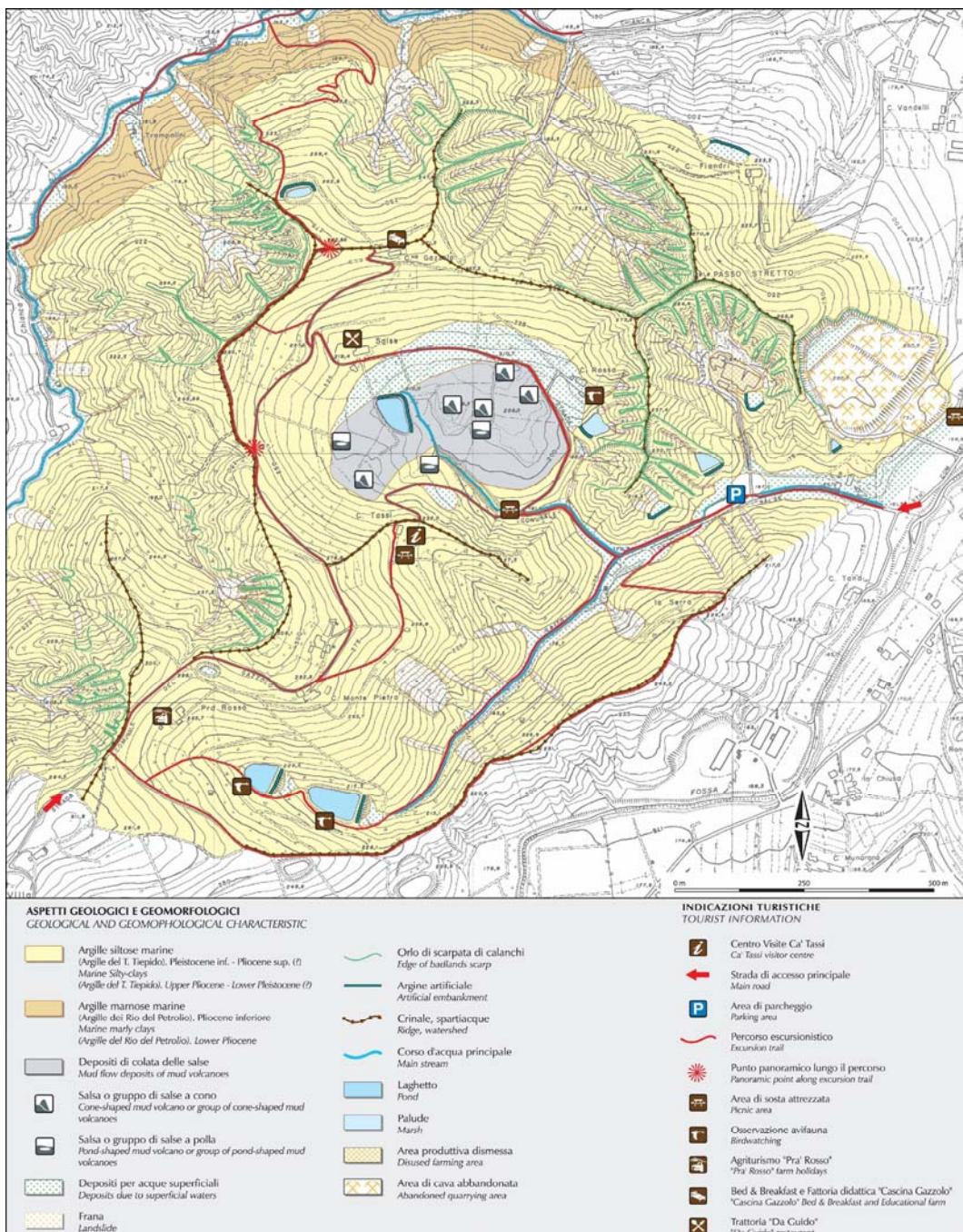


Figure 4. Geotourist map extracted from the front side of the Tourist-Environmental map of Salse di Nirano Reserve in the Emilia Romagna Region (Source: modified from Barozzini et al., 2004)

Geomorphological maps and Digital Terrain Models (DTM) have been produced in a first step. Geotourist maps are derived from the geomorphological maps in a second phase. The geotourist maps combine the most evident geological/geomorphological features with fundamental tourist information. The goal is to produce maps that could be

easily interpreted by tourists to help them understand the landscape. The geotourist maps and the DTM are the cartographic documents characterising tourist-environmental maps (implemented in a third step) which are thematic pocket foldable maps printed on both sides with illustration notes both in English and Italian (figures 4, 5; Barozzini et al., 2004; Castaldini et al., 2005, 2008). In addition, the tourist-environmental maps contain a synoptic description of the geological, geomorphological, botanical and zoological aspects, accompanied by photographs and information on excursion trails, visitor centers, behavior rules, refuges/restaurants and, finally, cultural and tourist attractions in the protected and surrounding areas.

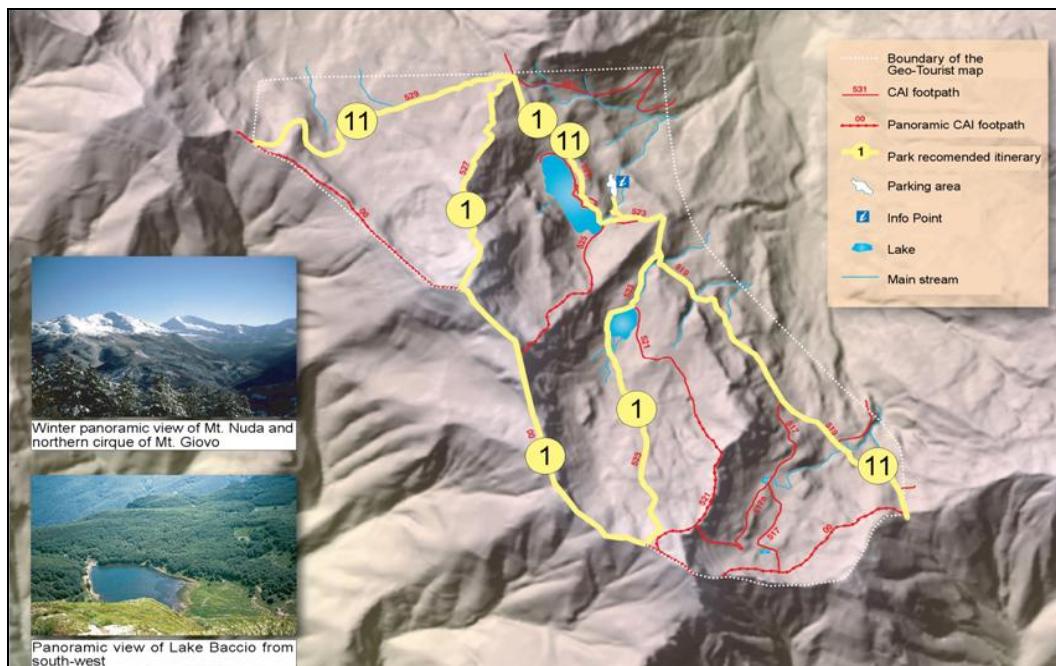


Figure 5. Digital Terrain Model extracted from the back side of the Tourist-Environmental map of the Upper Tagliole Valley in the Frignano Park, Emilia Romagna Region
(Source: modified from Castaldini et al., 2005)

The CD-Rom consists of a digital multimedia gallery, produced in the 2007 for 25th anniversary of the Reserve of Salse di Nirano, that can be browsed like a web page (Castaldini et al., 2007). The CD-Rom is structured in five main units. A brief introduction, with the guide to the CD-Rom, is followed by the description of the Reserve. The core of the CD-Rom is represented by the scientific aspects (description of geology, geomorphology, flora and vegetation, fauna, fossils and climate). The other parts are dedicated to the tourist aspects (with a Geotourist map) and to a multimedia gallery that groups sound recordings, movies, photos plus a virtual flight. The CD-Rom contain several thematic maps which can be downloaded as PDF files.

In the very last years several things have been changed in the Reserve of Salse di Nirano; many small and superficial landslides, which in some cases affect roads and trails, occurred or have been reactivated and new structures for tourists have been installed (an Ecomuseum, new educational and excursion trails). Therefore a new Tourist-environmental map containing an updated geotourist map and a 3D image, computed using a DTM and digital orthophotos, have been implemented (Castaldini et al., 2011).

Web based activities and field trips

Researchers of the Parma University very recently have realized the WebGis of the geological sites of the Parma Province territory (Artoni et al., 2009). The goal of the WebGIS (<http://webgis.geo.unipr.it/>) is to give a complete and easy to update description, of the geological, geomorphological and palaeontological assets which have been considered interesting as they testify the processes which led to the present day landscape. This WebGis contains a detailed description of 58 sites of geological (33), geomorphological (21) and palaeontological (4) significance which can be located on satellite images, aerial photographs and maps.

Researchers of the Bologna University launched the Project "**Edu Geo**" to develop the knowledge in the field of Earth Sciences to Upper-School teachers and to Upper-School and University students through field excursions, which can be booked contacting the organizers (<http://www.edu-geo.it/>). To date, five excursion have been programmed to illustrate the geological and geomorphological aspects of some parts of Italy. Two of them are held in the Emilia Romagna Region: in the Santerno River valley (Apennines) and in the Po delta (Po Plain).

EXAMPLES IN THE MARCHE REGION

The network of protected areas of the Marche region includes 2 national parks shared with Abruzzo, 4 regional parks, 5 natural reserves (<http://www.ermesambiente.it/wcm/parchi/index.htm>) and 31 local reserves, in which the geological and geomorphological landscape represent an articulate system of geoenvironmental-tourist interests (figure 1). The Marche Region, as almost all the other Italian regions, excepted general guidelines (PPAR Regional Plan for Landscape and the Environment), has no legislation that includes actions of preservation and safeguarding for geological heritages. However, following the indication of the general guidelines, the Marche Region has carried out a geosites inventory, that includes the most significant elements of the landscape, worthy of being preserves (Various Authors, 1991). The analysis of geosites as examples of geodiversity (Sampaolesi and Farabolini, 2002) and the spread of their knowledge, is the fundamental base to identify specific actions aimed at: restoring natural outcrop conditions; defining activities to promote and enhance geosites; establishing specific regional legislation for preservation and safeguard.

On this base the main goals of geotourism activities in the Marche area are: the natural and cultural protection of areas characterized by great geomorphological evidences (e.g.: glacial and periglacial landforms of Pilato Lake); the conservation of high natural dynamism areas (e.g.: badlands and mud volcanoes in the Mt. Ascensione area); the environmental improvement of high vulnerability areas due to marine erosion processes (e.g.: Conero cliffs); the enhancement of pre-existing tourism through the definition of territorial models using landscape asset and/or the development of business opportunity and sustainable employment in areas where tourism is very local, seasonal, and specific (e.g. Natural Park of Gola della Rossa and Frasassi). Some examples are presented in the following sections.

Geosites

The periadriatic area is characterized by the occurrence of several small mud volcanoes. One of the most interesting landform is located in the Montelparo area.

The relatively shallow nature of the water and the strong human impact in the territory that tends to erase such elements, represent the base for the enhancement and protection proposal according to their fragility (Scalella et al., 2008).

Therefore also at institutional level, the Province government has adopted in 2009 a specific act for the protection and enhancing of badlands, mud volcanoes and other

significant of geo-naturalistic sites of environmental and aesthetic interest (Farabollini et al., 2005; Scalella et al., 2008).

Methods and procedure for achieving an adequate protection and enhancement include in this case: analysis of the territory and its resources and hazards; exploitation mainly through geological-geomorphologic itineraries.

Geotourist maps and itineraries

The interest generated by geotourism necessarily give advantage to areas which, for natural and geological features, are already elements of great spatial and environmental concern. However, tourism can have a considerable appeal also in less known areas that, for their geological configuration and history, are characterized by the occurrence of several geosites with certainly aesthetic significance, as well as scientific and educational. This is the case of Mt. Ascensione (originally named Black Mountain, then Polesio Mountain), located in the southern Marche, whose scientific peculiarities are a key for the comprehension of the Plio-Quaternary evolution of the Marchean piedmont (figure 6).



Figure 6. Panoramic view of Mt. Ascensione (southern Marche Region)

The Mt. Ascensione features (higher Pliocene deposits in Europe, very developed badlands, thick glacis deposits, cuestas etc.), allow to consider this area as a pole of tourist attraction (4 in figure 1), according to the indications of the Province of Ascoli Piceno.

In particular, the development of tourism is promoted by the implementation of geotourist itineraries and maps (Scalella et al., 2008). These itineraries utilise the road infrastructure being mostly located on watersheds and providing spectacular panoramic views (figure 6, 7).

In the Park of Gola della Rossa and Frasassi (5 in figure 1), well known for its remarkable scientific value, the geotourism has been considered an economical resource. The Consortium of Municipalities of the Mountain area of Esino, to which the Park belongs administratively, classified this area as "*Geological Park*" taking into account aesthetic value of geological landscape and scientific-educational quality of the landforms (Farabollini and Spurio, 2007).

The "*Gola della Rossa and Frasassi*" Park has an extensive series of marked trails. The mapping of geological sites (Farabollini and Spurio, 2007) gave an improved attractive for those who wish deeply discover an area in which the most famous landscapes are dominated by geological and geomorphological processes. The explanation of geological sites such as the underground complex of the Frasassi caves, allows for the comprehension the karst processes that are the main attraction of the whole territory (figure 8, 9).

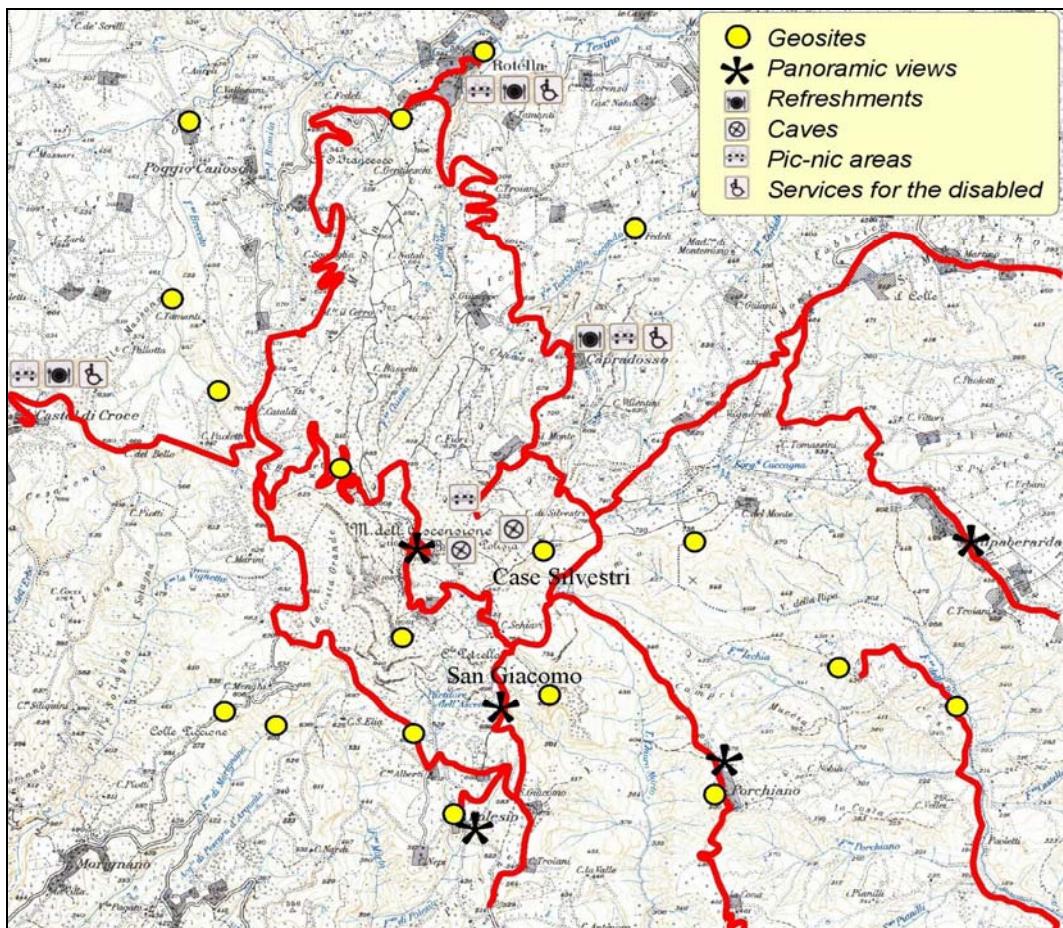


Figure 7. Proposal for geotourist itineraries in the Mt Ascensione area (Marche Region)
(Source: modified from Farabollini and Scalella, 2003)

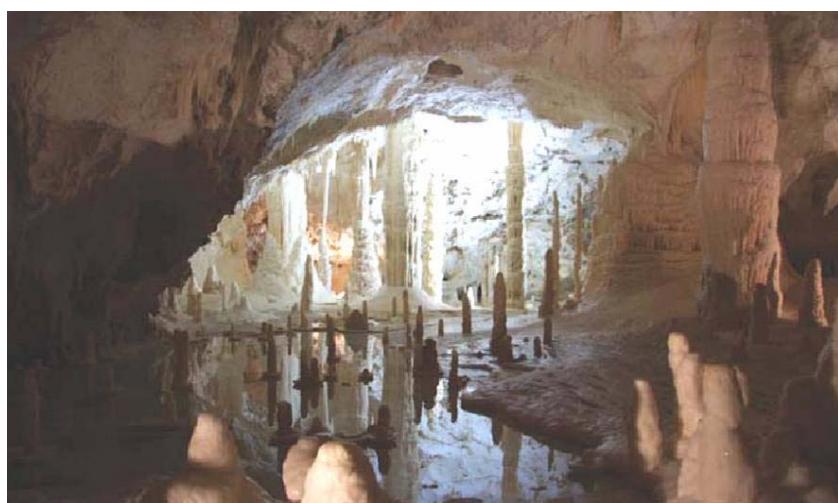


Figure 8. Small candles room (Sala delle candeline), Frasassi caves



Figure 9. Geoexcursion map of Gola della Rossa and Frasassi Park
 (Source: Farabolini and Spurio, 2007)

The mountain landscape of the Sibillini Mountains (southern Marche; 6 in Figure 1) represents the highest portion of the region (over 2000 m a.s.l.). This area, recently classified as National Park of Sibillini Mountains, thanks to its rocks exposures and landscape features, represents the “geologic history” of the region. Outcropping sedimentary rocks are mainly calcareous and the different sequences are the result of marine Meso-Cenozoic paleogeographies.

On the highest elevations, different glacial and periglacial landforms are present (i.e. glacial cirques, moraines, glacial lakes, stratified slope deposits etc.). The Pilato Lake (figure 10) lies within the “heart” of Sibillini massif, and represents one of the few lacustrine episode in central Italy, connected to the Quaternary glaciation. Placed at an elevation of 1940 m a.s.l. and surrounded by the highest peaks of the Sibillini Mountains (Mt. Vettore, 2476 m a.s.l. and Scoglio del Lago, 2448 m a.s.l.), it extends over a maximum surface of about 30000 m² and shows a peculiar “spectacles” shape. The valley-ward dam is due to a frontal moraine while mountain-ward, different generations of wide embedded glacial valleys and cirques are present (Aringoli et al., 2007a; Aringoli et al., 2008), thus, this lake constitutes a geosite of exceptional scientific value representing the only glacial lake preserved in central Italy. These features surrounded also by several legend about its origin, probably of medieval time, provide a strong instrument for the comprehension of the impact of glacial processes in the present Appennines landscape by a wide public.

Within the Sibillini Park a geomorphological study carried out on the risk associated to the use of the main tourist and popular hiking trails led to the synthesis of surveyed data along some major excursion itineraries of the Park and elaborated the assessment of geomorphological hazards and environmental resources with regard to the tourist fruition (Aringoli et al., 2007 b).



Figure 10. Pilato Lake, Sibillini Mountains

EXAMPLES IN THE ABRUZZO REGION

Complex Meso-Cenozoic palaeogeographies are still reflected by the main mountain chains of Abruzzo and offer imaginary journeys through ancient, now vanished, coral atolls and blue deep seas. Glacial valleys, alluvial cones, actual soils and palaeosoils still preserve the memory of these „Quaternary-worlds”, with unique landscapes all over the region.

Since the beginning of the 20th century, a specific protection policy for the safeguard of this landscape has been implemented by setting up a system of three national parks and one regional park that cover about one third of Abruzzo surface and several local protected areas, scattered all over the region (<http://www.ermesambiente.it/wcm/parchi/index.htm>). Most of them have biotic (wildlife) and abiotic (geology and geomorphology) interest, both main parks and local reserves, which may include a fluvial wetland and fluvial landforms, or coastal flora and fauna and beaches and coastal dunes, or a forest and a karst spring or a karst valley.

The geological heritage, deeply-rooted in the region is the subject of several projects of geological (s.l.) education for a wide audience, with the creation and installation of on site information panels and geological trails, the realization of geotourist maps and the planning of geological excursions (7,8,9 in figure 1).

Geotourist itineraries and information panels

Inside the park areas the enhancement process mainly consists, so far, in the creation of geological on site information panels – currently being set up in the National Park of Abruzzo, that includes same parts of Lazio and Molise regions (figure 11; 7 in figure 1) – and of geological and geomorphological itineraries proposed in the Gran Sasso and Laga Mountains National Park (8 in figure 1).

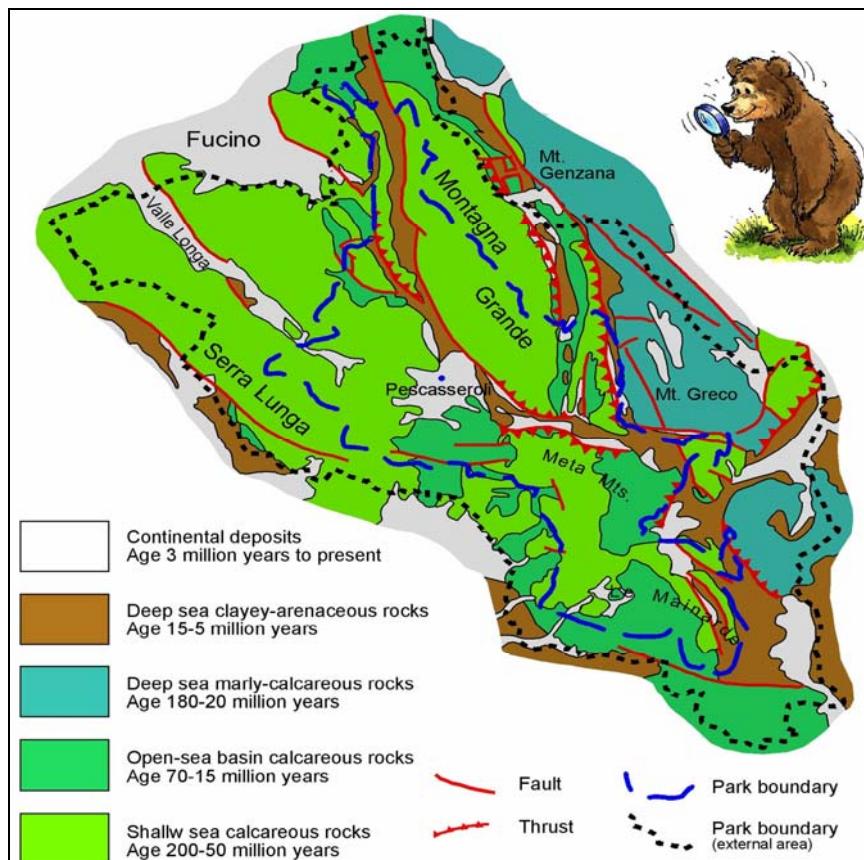


Figure 11. Simplified geological scheme of the National Park of Abruzzo, extracted from geological on site information panels of the National Park of Abruzzo, Lazio and Molise
Source: Miccadei et al., 2011 b

The information panels and the itineraries are mostly based on different type of tools variously combined, such as: a) 3D reconstructions, aimed to provide a three-dimensional perception of geologic geomorphologic processes and elements; b) landforms and rocks depicting on the landscape, aimed at increasing the perception and identification of rock, landforms and processes distribution, as well as their impact on the landscape; c) paleogeographic reconstructions, aimed at highlighting the concept of time and landscape evolution. Some examples are presented in the following notes.

Landforms and rocks depicting on the landscape of the Sangro River - The Sangro River is the main stream crossing the National Park of Abruzzo and is presented as the "sculptor" of the landscape. Several landforms bear witness to the erosional and depositional processes that took place over time along the river (figure 12).

The Pescasseroli plain is, indeed, extensively covered with fluvio-glacial deposits that formed in subsequent depositional phases, up to the Upper Pleistocene. They are presently preserved in clear alluvial terraces (figure 12 a) and bear witness to erosional and depositional phases in the alluvial plain during the Quaternary period due to climate fluctuations (D'Alessandro and Miccadei, 2010). The Opi gorges allow to get a clear perception of past and present erosional processes (figure 12 b), while the view on the Le Prata plain shows an alluvial plain whose formation is still ongoing and offers hints for possible explanations of the relationship between the land and resources like peat, which was once used for heating, or the ground water present in the alluvial plain (figure 12 c).

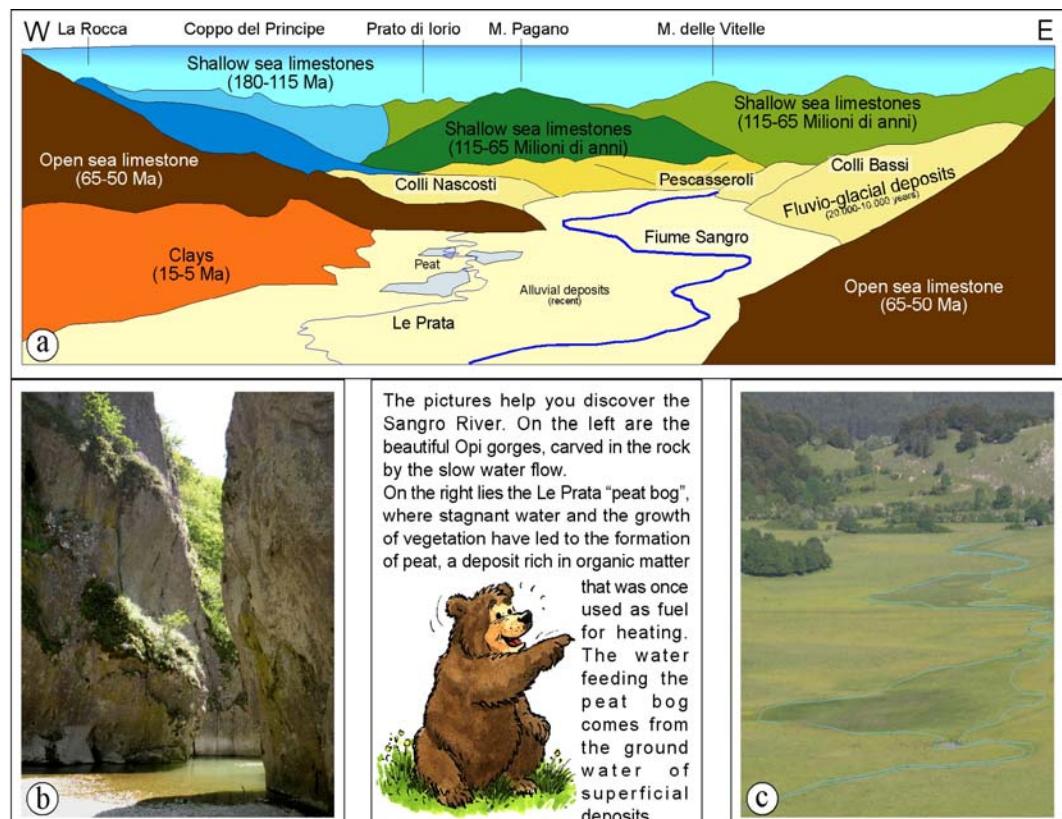


Figure 12. Geological information panel of Pescasseroli alluvial plain and Opi gorge (extracted from geological on site information panels of the National Park of Abruzzo, Lazio and Molise). a) Geological sketch of the Pescasseroli alluvial plain. b) Opi gorge along the Sangro River. c) Le Prata peat bog.

Source: Miccadei et al., 2011 b

Paleo-geographic reconstructions of ancient glacial landforms (Campo Imperatore) - The main reliefs found in the Gran Sasso and Laga Mountains National Park show clear signs of glacial morphology as relict landforms resulting from cold climate phases of the Pleistocene (e.g. Jaurand, 1999; Giraudi, 2004).

The southern slope of Campo Imperatore features a series of outstanding, very well-preserved cirques, as in the case of the Scindarella Mountains, while the glacial valleys are filled, in the lower part, by extensive moraine deposits which allow to reproduce and explain in a simple way the palaeo-landscape of the cold climate phases of the Quaternary period (figure 13a, b). This is basic for explaining to a wide public the imprint of glacial landforms in present landscape of the Apennines.

Geotourist maps

The first geotourist map in Abruzzo was realized in the Aventino - middle Sangro area (figure 14; 9 in figure 1; Miccadei et al., 2008).

The area shows a regional crosscut through the landscape that link the eastern front of the Apennines chain to the related piedmont area, with landforms carved in different type of rocks. The map is reinterpreted from geological maps, distinguishing outcropping rocks as concern their surface expression into distinct geological landscapes. Limestone, marls, sandstones, clays, chalks, gypsum, gravels and landforms are presented as windows over a 200 million years history that today can be observed in a unique "*breathtaking*" landscapes rich of colours and suggestions, labelled with appealing names (i.e. the sliding rocks, the shining hills, the floating mountains; figure 14). Symbols highlight the location of main geological and geomorphological features (i.e. national geosites, fossil sites, oil well, caves, glacial cirque remnants, and other geological interest areas). The main hydrography elements are also indicated (rivers, springs, hydrometric stations). Finally, tourism facilities (offices, information centers, museums, trails, etc.) are added to the geological and geomorphological aspects in order to complete the geotourist map. The map outline is very similar to that presented for the Emilia Romagna region, although in this case the distinction of rock units is more landscape oriented.

According to this, the backside of the map and the explanatory notes include text and figures explaining features and origin of different types of rocks and related landscapes. Furthermore, each of the eleven Municipalities included in the map, is itself presented as a window or terrace through which is possible to have a view of the Abruzzo Apennines geology, where overlook means plunge into a see far away millions of years or in a stream far away hundred thousands of years.

With this approach, in the geotourist map and its explanatory notes, the geology is presented in a simple and educational way written for children, teenagers and adults, going back over a history wrote during millions of years. In this way, the map represents a business card, useful to discover and enjoy a wrapping and spectacular nature and beautiful tourism oasis, using geological contexts or peculiarities as key elements to develop tourism in less-familiar areas.

Geological tourist field excursions for schools

Geological tourist field excursions have been planned and carried out in order to develop the knowledge in the field of Earth Sciences to young people (Upper-School students) and teachers. Excursions have been undertaken within the activity of the Italian Association for Geology and Tourism and of the University of Chieti-Pescara project "*Challenge of the Technical and Scientific knowledge*" (<http://ots.udanet.it/>). The main purpose of the project is to arise the sensibility of young people to technical and scientific knowledge and in the geology field it is aimed at with web based activities and games, lections and lab exercises, and particularly field excursions. In a broad sense, these could be considered both teaching and geotourist excursions.

To date, several excursions have been held in the Abruzzo Region. In the mountain areas field excursion have been held: in the Marsica area, illustrating the remnants of ancient landscapes and Mesozoic paleogeographies and the recent evolution of ridges and valleys (Miccadei 1993; D'Alessandro and Miccadei 2010); in the Sulmona basin, illustrating the evolution of a landscape due to tectonics and Quaternary climate fluctuations (figure 15a) (Miccadei et al., 1999, 2004). In the hilly piedmont area excursion have been held: in the Pescara hinterland (Penne) and in the Chieti town, illustrating the Pleistocene geomorphological history since the emersion of the area from marine environment and the recent dynamics of rivers and landslides with related risks. In the coastal and islands area excursion have been planned: in the southern Abruzzo rocky coast, illustrating the geological evolution related to Pleistocene uplift and marine processes, and the recent dynamics of beaches and active and inactive cliffs due to aeolian processes, marine processes and landslides (D'Alessandro et al., 2003b); in the Tremiti Islands (offshore the southern Abruzzo coast but actually in the Puglia Region; Miccadei et al., 2011a), illustrating the complex interaction among marine, karst, fluvial and weathering processes in the geomorphological evolution of an area that since the Pleistocene was alternatively connected and not connected to the Italy coast owing to sea level fluctuations (figure 15b).

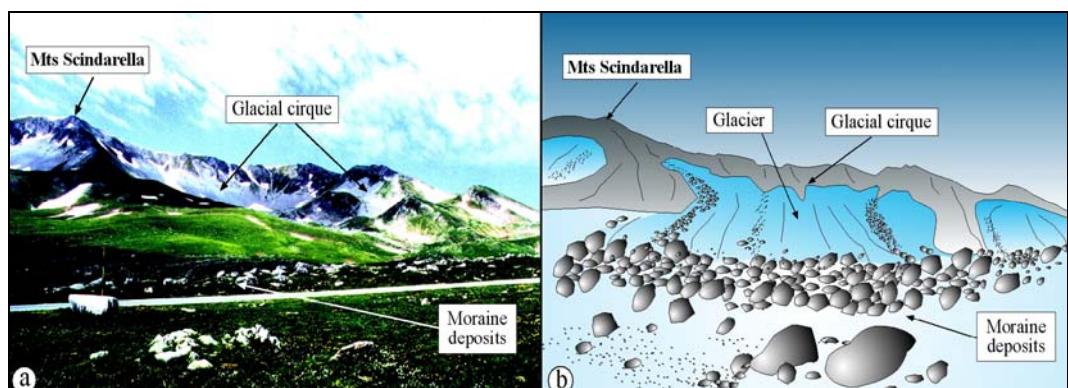


Figure 13. Geological information panel of Campo Imperatore (extracted from geological and geomorphological itineraries of the Gran Sasso and Laga Mountains National Park), Photo (a) and paleogeographic reconstruction (b) of Scindarella Mts. glacial landforms
(Source: Miccadei et al., 2011 b)

FINAL REMARKS

In this work examples of activities on geotourism in Emilia Romagna, Marche and Abruzzo regions are described. They are focused particularly on: analysis and enhancement of protected areas and geosites; geotourist and tourist-environmental maps; geological itineraries; portable and on-site geological illustrative materials.

The described examples illustrate the documents implemented for the enhancement of the geological (*s.l.*) landscapes, at different spatial (from regional to local) and temporal (from Trias to Holocene and present) scales. This is focused on developing the sensitivity of people to read in the landscape long term temporal scales processes, that lead to the present landscape of a region, as well as short term temporal scale processes characterising the resource management or the local geological and geomorphological risks.

Two types of geotourist maps have been implemented. The common aim was to produce maps that could be easily interpreted by tourists to help them understand the landscape. The Geotourist map elaborated by University of Modena and Reggio Emilia researchers combines the most evident geological/geomorphological aspects with basic

tourist information. The legend consists of two clearly distinct categories one with symbols representing the geological/geomorphological characteristics (e.g. simplified bedrock and superficial deposits, scarps, ridges, streams, lakes) and a second showing symbols concerning to tourist information (e.g. parking places, footpaths, picnic areas, refreshment and overnight-stay places etc). The geotourist maps by Abruzzo researchers emphasize the relationship between geology *s.l.* and landscape, showing how different structural factors, geomorphic processes and climatic features can produce different features and behaviour of the territory. Limestone, marls, sandstones, clays, chalks, gypsum, gravels and landforms are presented as windows over a 200 million years history but also as result of short term geomorphological processes.

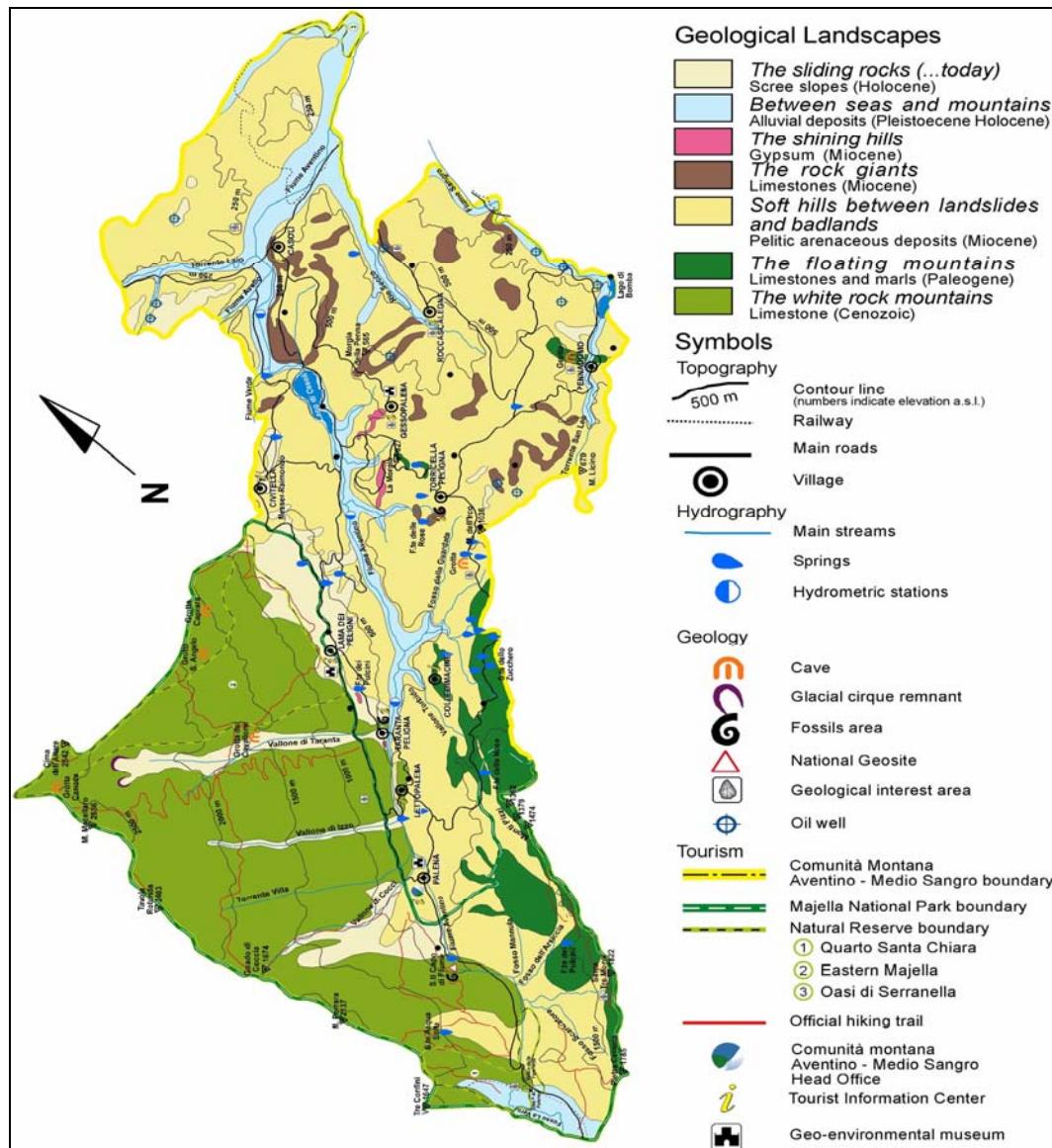


Figure 14. Extract from Geotourist map of the Aventino - Medio Sangro area (Abruzzo Region)
(Source: modified from Miccadei et al., 2008, www.geoplanet.eu)

3D reconstructions, landforms and rocks depicting, and palaeo-geographic reconstructions aim at providing three-dimensional perception of geologic geomorphologic processes and elements, at increasing the perception and identification of rock, landforms and processes, as well as their impact on the landscape, and at highlighting the concept of time and landscape evolution.

In many cases the improvement of people's perception of geological processes exploits the link of history, legend, and myth to geology and landscape.



Fig. 15 - Field geological excursion with students:

- a) observations of triangular facets along the Mt. Morrone fault slope in the Sulmona Basin;
- b) observations of active cliffs of the Tremiti Islands

The examples include activities at regional and institutional level, as well as at university level, in same cases in collaboration with upper school institutions. They also include activities developed specifically for tourism at local and regional scale or private initiatives, within the Park areas or within the Italian Association for Geology and Tourism. Besides the several possible approach to geological heritage enhancement, they show a different development level of geotourism in Italy. Indeed, only a wide interregional tourism network integrating initiatives targeted at various potential users and connecting universities, local and regional institutions, Parks and local reserves, schools, private initiatives etc., can lead to reach the goal in term of educational dissemination of geological and geomorphological themes, awareness of the complex meaning of the landscape.

Thus, according to the "*European Manifesto on Earth Heritage and Geodiversity*", the territory goes out of the "*classical*" role of simple scenery of the human history and becomes integral part of the different cultures that develop in it and that interact with it. The growth of interest in the geological and geomorphological thematic of the territory is bringing about the maturation of a strong sensibilities toward a geologic tourism both from the institutions and the private citizens. Furthermore all these activities can represent job opportunities in the field of tourism for the graduates and for people living and working in less developed areas within the Italian territory.

The integrated approach to the discovery of geological heritage - as presented in this paper - through various tools and activities and targeted at various potential users can be summarised by quoting a famous statement by Marcel Proust: "*the real voyage of discovery is not in seeking new landscapes but in having new eyes*".

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