

GEOMORPHOSITES: A BRIDGE BETWEEN SCIENTIFIC RESEARCH, CULTURAL INTEGRATION AND ARTISTIC SUGGESTION

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ABSTRACT: M. Panizza & S. Piacente, *Geomorphosites: a bridge between scientific research, cultural integration and artistic suggestion*. (IT ISSN 0394-3356, 2005).

The authors start with noting that the geological aspects has not yet assumed its proper value as a Cultural Asset. This seems to derive above all from a static approach and museum-like view of our geological heritage current in society, that have limited its meanings and potentialities considerably.

Now there is a very important occasion for re-launching Geology as a cultural and social discipline though some activities that can be summarised in three main fields.

- *Scientific research* on geosites which are one of the components of the cultural heritage of a given territory as well as works of art, fauna and flora etc.
- *Cultural integration* between the geological-geomorphological aspects of a territory and the other landscape components (biological, historical, artistic etc.) within a concept of "integrated cultural landscapes".
- *Artistic suggestion* of those geological sites which have been source of literary, pictorial, musical etc. inspiration.

For each of the above mentioned fields some different characteristic examples are highlighted.

RIASSUNTO: M. Panizza & S. Piacente, *Geomorfositi tra ricerca scientifica, integrazione culturale e suggestione artistica*. (IT ISSN 0394-3356, 2005).

Gli autori partono dalla constatazione che gli aspetti geologici non hanno ancora assunto il valore di Bene Culturale. Ciò sembra derivare soprattutto da una percezione statica e da una visione museografica con cui il Patrimonio geologico viene tuttora percepito, che ne limitano fortemente i significati e le potenzialità.

Attualmente si sta presentando un'occasione molto importante per il rilancio della Geologia che potrebbe e dovrebbe trovare inedite vocazioni culturali e sociali. Le attività per tale rilancio possono essere schematicamente raggruppate in tre campi principali.

- *Ricerca scientifica dei geositi, che rappresentano una delle componenti del Patrimonio Culturale di un dato territorio così come monumenti, flora, fauna etc.*
 - *Integrazione culturale tra gli aspetti geologico-geomorfologici di un territorio e le altre componenti del paesaggio (biologica, storica, artistica etc.) nel concetto di "paesaggio culturale integrato".*
 - *Suggestione artistica di quei siti geologici che sono stati fonti di ispirazioni letterarie, pittoriche, musicali etc.*
- Di ciascuno dei campi sopra citati vengono illustrati alcuni esempi significativi.*

Keywords: Geomorphosites, Scientific research, Cultural integration.

Parole chiave: Geomorfositi, Ricerca scientifica, Integrazione culturale.

1. FORWARD

In a modern society like ours, where environmental problems are usually pressing and urgent, Earth Sciences still occupy a marginal role. This is hardly justifiable if we consider the importance they have actually had and will have in the history and development of life and civilisation. It is therefore necessary to find new paths and strategies in order to spread better information and communication which can fill this gap.

In particular, the geological aspect has not yet assumed its proper value as a Cultural Asset. Therefore, before proposing its conservation and appraisal, its status must first be recognised and new strategies for spreading information must be found, which can reach not so much in the scientific and institutional world but rather society at large. The static approach and museum-like view of our geological heritage current in society so far, have limited its meanings

and potentialities considerably. Furthermore, the nearly total lack of a tradition of communication and education in Geological Sciences has contributed to causing a delay both in understanding and in arousing an awareness of the cultural value of Geology in society.

This is a very important occasion for re-launching Geology as a cultural and social discipline. We should therefore define a geological space where Nature itself can offer inspirations for finding the best relationship with Man, the right "distance" (Secchi, 2001): metric, visual, sensorial and symbolic or suggest new practices for territorial management. This need has become ever more felt in the past few years which have been characterised by a marked democratisation of the space around us and its usage.

New impulses and expectations are opening up new ways, hardly ever followed before, as confirmed by the activities of ecologist associations, public boards, protection agencies and government norms. All this has

been accompanied by research programmes carried out at a national and international level, such as the research programme activated by UNESCO, Progeo, the International Association of Geomorphologists and confirmed in their provisions, in particular in articles nos. 1 and 6 of the "European Convention on Landscape" (Florence, 2000).

All the interventions, perspectives and goals of these activities can be summarised in three main fields.

- *Scientific research* on geosites which are one of the components of the cultural heritage of a given territory as well as works of art, fauna and flora, etc.
- *Cultural integration* between the geological-geomorphological aspects of a territory and the other landscape components (biological, historical, artistic etc.) within a concept of "integrated cultural landscape".
- *Artistic suggestion* of those geological sites which have been the source of literary, pictorial, musical etc. inspiration.

The above described points will be developed by making reference to the experiences so far achieved by the authors at a local, national and international level. These experiences have mainly interested sites of geomorphological interest which have been defined as "Geomorphosites" (Panizza, 2001; Panizza & Piacente, 2003).

2. SCIENTIFIC RESEARCH

Basic investigations have been carried out and applied research projects have been implemented or are still in progress with funds from Italian Ministries, the European Union and by means of conventions with public boards.

Investigations, which started some 20 years ago, have been developed with the following aims:

- To emphasise and assess the relationships between physical landscape and quality of the environment and between development of geomorphological knowledge and socioeconomic development (Panizza, 1988; Panizza, 1989a; Panizza, 1990a; Panizza, 1990b; Panizza, 1990c; Panizza & Piacente 1991; Panizza, 1992b; Panizza & Piacente, 1993; Panizza, Pellegrini & Pozzi (1993), Panizza & Piacente, 1999a; Panizza & Piacente, 1999b; Piacente, 1999a; Piacente, 1999b; Panizza & Piacente, 2000; Panizza, 2001; Panizza, 2003; Piacente, 2003; Piacente & Poli, 2003; Panizza & Piacente, 2003).
- To define a methodology for the identification and census of geosites (Panizza, 1992b; Carton *et al.*, 1994; Panizza & Piacente, 1999a, 1999b; Bertacchini *et al.*, 1999; Bertacchini *et al.*, 2001; Panizza & Piacente, 2003).
- To present and test in different environmental contexts a catalogue card linked to a computer-based archive (Bertacchini *et al.*, 1999; Bertacchini *et al.*, 2002a; Piacente & Poli, 2003).
- To provide an example of geo-referenced mapping sites within a given regional territory (Castaldini *et al.*, 1997; Bertacchini *et al.*, 1999; Piacente *et al.*, 2001).
- To set up a thematic itinerary, where a geosite can be transformed from a "geological object" into a "cultural asset" available to the public (Panizza & Spam-

pani, 1988, 1989; Panizza 1989a, Panizza 1989b; Piacente 1989; Carton & Panizza, 1991; Piacente *et al.*, 2000; Bertacchini *et al.*, 2002b; Piacente *et al.*, 2001; Panizza & Piacente, 2003).

- To organise educational projects in which the curriculum carried out can offer the opportunity to bring students from all levels closer to Field Geology, during their normal period of cultural formation (Piacente & Soldati, 1989; Piacente & Giusti, 2000; Panizza & Piacente, 2001; Bertacchini *et al.*, 2002; Piacente & Poli, 2003, Panizza & Piacente, 2003).

Starting from these observations, our investigations have tried to turn the complex environment-geological asset system into a language accessible to the widest possible public, even in unusual ambits, such as the elderly, the disabled and young children, making use of local forces and resources and involving young and old in a privileged role: the former in the educational and professional phase, and the latter in conveying experiences and values, using the past as a preparation for the future.

3. CULTURAL INTEGRATION

A landscape is to be appreciated with all its physical, biological, historical, architectonic etc. components, it can then be considered a primary cultural asset resulting from complex relationships. There is now the awareness that only an in-depth understanding of all the environmental components of a territory and their history can lead to proper conservation and management initiatives. Naturally, the first source of understanding lies in the territory itself, with its geological structure and its morphological features. Then we have to consider interventions made by Man on the natural elements. Lastly the archaeological, historical, socioeconomic, etc. elements must be fully taken in. Therefore, the relationships and reciprocal influences between physical landscape and cultural assets (here considered in a strict sense, that is the above mentioned archaeological, historical, architectonic etc. assets) should be identified.

As regards research methodology, five operational phases can be identified (Panizza & Piacente, 2000).

The first phase consists of a *physical setting* of the territory in which the cultural (i.e. historical and architectonic) asset is located, in terms of geological and geomorphological evolution, in terms of resources (raw materials, lithology, morphology, hydrology etc.) and in terms of stability and, therefore, of natural hazards (disarray processes, landslides, floods, earthquakes, volcanic eruptions etc.). Subsequently, the geomorphological causes which have conditioned the location of a cultural asset should be taken into account. In fact, if the construction of a historical-archaeological site generally responds to the socioeconomic needs (housing, religious practices, defence etc.) of a given community over a given territory, at the same time the particular location selected is chosen also on the basis of its environmental characteristics. Among these, for example, the lithological characteristics, owing to the availability of building materials, the hydrological characteristics, owing to the presence of a watercourse, the geomorphological characteristics,

owing to the presence of a naturally sheltered area or a look-out point and so on. Subsequently, it will be necessary to assess whether a given cultural asset may be affected by natural hazards (in our case, geomorphological hazards) and, consequently, subject to *risks*. In this case, defence and mitigation interventions must be planned. Furthermore, it should be assessed whether the possible fruition of a cultural asset – for example following social or tourism initiatives – may bring about negative consequences for the natural, in particular for the geomorphological, environment in terms of *environmental impact*. Finally, it should be taken into account that the correct management of a historical-archaeological asset cannot be separated from its *knowledge integrated* in the surrounding environment (Panizza & Piacente, 1991; 1999a). In this way the proper fruition of both aspects will be implemented, with a positive spin-off from the socioeconomic viewpoint, also as regards conservation and appraisal. This sort of activity, including all promoting and protecting initiatives and measures, must necessarily be based on interdisciplinary studies and multiple management of *environmental education* initiatives.

Another significant example is offered by *Mont-Saint-Michel*. This is a granite islet, located in the bay bearing the same name near the mouth of the Couesnon River. On top of the islet, various monumental buildings were constructed, making it one of the most interesting and typical places of northern France (Fig. 1).

At the centre of this historical-artistic complex there is a Benedictine abbey overlooking the cliff. The original core of this monumental area was an oratory dating from the year 708, which was dedicated to St. Michael. Later, a Carolingian church was built (X century), a Romanesque abbey (XI-XII century), a monastery and a Gothic cloister and a choir (XIII to XV century). One of the most singular characteristics of this site is its cyclic isolation from the mainland caused by the alternation of low and high tide. This is a magic, constantly transforming landscape, where another “tide” has been flowing in for centuries: first pilgrims, and nowadays, prevalently, tourists. Like all bays, even Mont-Saint-Michel bay is subject to silting. This natural process has increased with time owing to various human activities carried out through the centuries: dams, canals and locks built on the course of the River Couesnon resulted in a decrease of its stream velocity and flow rate. As a consequence, this watercourse lost the energy necessary to evacuate the debris materials deposited at its mouth causing also a decrease of the ebb current. A further consequence of this activity was the development of a particular marine flora which retains

the sediments in the bay. Furthermore, the road on an artificial embankment which links the little island to the mainland has modified the original aspect of the area. An interdisciplinary study involving hydraulics, geomorphology, biology etc., and laboratory analysis utilising a model of the environmental situation have allowed a solution to be identified for re-establishing the original conditions. A mobile dam able to control the runoff of the R. Couesnon will be built and one of its branches will be diverted in order to decrease the amount of solid load towards Mont-Saint-Michel. In this way the combined sea/river action will be enhanced in order to increase the ebb current which, in turn, would wash away part of the debris. The embankment road will be substituted with an “ecological shuttle” on a footbridge. Within forty years, the sea floor between the islet and the mainland should be lowered by about 70 m and the surrounding marine floors should gain some 50 ha. All this should take place without compromising the traditional activities of the inhabitants, such as mussel farming and fishing on foot. The unique landscape of this special site will therefore be recreated “where sea and man have united to give origin to this masterpiece of human heritage”.

In order to negotiate more specifically the relationships between geomorphology and cultural assets (in a strict sense), three types of conceptual approaches may be identified and, consequently, three types of methodological approaches (Panizza, 2003): an *environmental* approach, a *historical* approach and a *cultural* approach (in a broad sense).

These different procedures are strictly derived from the multidisciplinary of the research; therefore they do not make up factors of discrimination or criticism, since the different points of view are directed to the pursuit of the same goal.



Fig. 1 - The Mont Saint Michel, in northern France, with the Benedictine Abbey architectonic complex.

Il Mont Saint Michel, nella Francia settentrionale, con il complesso architettonico dell'Abbazia benedettina.

3.1 Environmental approach

The *environmental* approach is based on the relationships between the *environment* (in particular geomorphological) and archaeological, historical-architectural etc. assets, in conformity with a scheme in which the environment can be considered according to two points of view: on the one hand we have landscape *resources* (e.g. geomorphosites), and, on the other hand, geomorphological natural *hazards* (degradation, disarray etc.). In turn, cultural assets (in a strict sense) may be considered as both *vulnerability* (i.e. susceptible to material damage) and sites for fruition *activities* (e.g. tourism). These relationships may produce situations of either *risk* or *impact* (Panizza, 1992a).

An example of geomorphological risk is offered by the valley and adjacent hill of the temples of *Agrigento* (Cotecchia *et al.*, 2000). The conservation of this site, which is a unique case of world relevance owing to its historical, archaeological, artistic and anthropological value, has been seriously threatened by both geomorphological disarray processes and man's activity. In particular, the situation of the temples of Juno Lacinia and Concordia, which are aligned along the southern edge of the hill, is very serious since the calcarenites making up the slope are affected by rock falls, topples and rotational slides, with involvement also of the underlying clay shales.

Examples of risk linked to chemical weathering are those resulting from *sulphatization* processes, which cause disaggregation of calcareous artefacts through the action of precipitation water made more aggressive by sulphur compounds produced by the combustion of coal. Similar processes can occur on the basement of buildings where humidity is higher. In other cases *hydrolysis* processes may trigger differential erosion in buildings made up of materials with feldspar components and others constructed with more resistant types of materials.

A well-known example of environmental risk and impact is offered by the situation of Venice: recurrent "high water" has determined risk conditions whereas strong anthropic pressure has caused considerable degradation of the ecological, physical and biological standards of the lagoon environment.

Another example is *Mount Sinai* near the Monastery of Saint Catherine (Fig. 2), where there are ever increasing numbers of tourists, owing to the strong appeal of this site where, according to the Old Testament, Moses received the Tablets of the Law from God. Interest in this site is becoming more and more consistent also in relation to tourism infrastructures, which are expanding at a considerable rate near the seaside villages on the Red Sea, such as Sharm el Sheik. In this case, progressive remodelling and flattening of the

slopes is taking place in order to create areas for building new hotels and related structures, with heavy consequences for environmental impact.

3.2 Historical approach

This approach is based on history considered as a factor of interpretation, that is on the concepts of continuity and integration between the *present* landscape and, going back in time, its *history*, *prehistory* and, finally, *geohistory*. For example, we may refer, on the one hand, to the relationships between social, strategic or religious needs and, on the other hand, to the geomorphological constraints of a particular site. Our purpose is to analyse the landscape and recognise in it the integrations and relationships which have been established through time, by interpreting in an interdisciplinary manner all its "historical" components (in a broad sense) (Panizza & Piacente, 2000). Examples can be as follows.

A first explanatory case is offered by the *Balzi Rossi* (= red cliffs) (Fig. 3), near Ventimiglia (Liguria): one can start from its geohistory (dolomite limestones from the Upper Jurassic, with tectonic joints), geomorphological genesis (sea cliff, karst modelling, littoral erosion and sedimentation, marine regressions and transgressions, reddish weathering of iron minerals, hence the name of "red cliffs" etc.), up to the arrival of Man in the Lower Palaeolithic. In particular, the remains of the most ancient settlements were wiped out by the marine transgressions of the interglacial periods, which stretched as far as the caves, reworking prehistoric artefacts and depositing beach sediments, like those dating from the Tyrrhenian (150,000-75,000 years BP). One of the most important discoveries consists of a three-fold burial from the Upper Palaeolithic (dated between 30,000 and 25,000 years BP). The latest "historical" evidence is given by the remains of military forts from the Second World War and the inadequacy of the area for fruition by tourists.



Fig. 2 - Example of environmental impact in the Sinai, near the monastery of St. Catherine. Various parts of this territory appear remodelled and flattened for the construction of buildings and tourist infrastructures.

Esempio di impatto ambientale nel Sinai, presso il monastero di Santa Caterina; vari settori del territorio appaiono rimodellati e spianati per la costruzione di edifici e infrastrutture turistiche.



Fig. 3 - Balzi Rossi (Red Cliffs), near Ventimiglia, in the western Ligurian coast: cave with prehistoric settlements corresponding to various Palaeolithic levels.

Balzi Rossi (Red Cliffs), vicino Ventimiglia, nella riviera ligure di ponente: grotta con insediamenti preistorici di vari livelli del Paleolitico.

Another example is offered by the rocky cliff of *Vallerano* in the province of Viterbo (Margottini, 2002), with a cave-dwelling containing frescoes depicting Jesus Christ as the Saviour. This is a cliff made up of volcanic rocks from the *Vicus apparatus*, dated between 200,000 and 150,000 years BP, in which a human dwelling of probable prehistoric origin was excavated. This site was subsequently remodelled and used by Benedictine monks who turned it into a place of worship with rare frescoes, presumably ascribable to the IX-X century A.D. On the cave's left-side wall the Saviour is depicted, flanked by St. Peter and an angel, whereas, on the bottom wall, a group of saints is shown. These frescoes, which stand out from a background adorned with multi-coloured frames, seem to be the work of an important Byzantine artist. This cave was brought to light in the XIX century, following a collapse that destroyed its outermost wall which was probably also frescoed. Its rocky wall shows evident signs of geomorphological instability which point to progressive deterioration that could eventually lead to the disappearance of this settlement and the works of art housed in it. Geomorphological investigations (Margottini, 2002) have also identified several boundary conditions, mainly due to the penetration of tree roots into rock joints and consequent destabilisation, and water infiltration into the rock discontinuities and consequent slope failures. Finally, conservation interventions should take into account possible aesthetic impacts on the site.

3.3 Cultural approach (in a broad sense)

This approach concerns the dialogue and cultural integration between humanistic and scientific disciplines. For example, one can refer to the relationships between construction, degradation and restoration of an architectonic site and the provenance, characteristics and deterioration proneness of the materials used

for its construction, also in terms of culturally oriented upgrading policies. More in general, a response should be given to the ever-felt need for a "neo-humanistic" culture, that is for the unity of culture (Panizza, 1989a).

An example of this is offered by the investigations carried out on the paving of the historical centre of *Modena* (Comune – Università di Modena, 1999), which could be the starting point for a cultural, educational and tourist path. At first, the petrographic nature of the material (e.g., a marble slab or the use of cobbles from different rock types) is examined, by observing its mineralogical characteristics and going back to the area of provenance (for example: a quarry of "Ammonitico Rosso" in the Verona hills for the marble slab; the geomorphological evolution for

the cobblestones: from an Apennine mountain down to the valley through erosion, fluvial transportation and sedimentation processes). Subsequently, the methods of extraction and transport of the materials would be considered, as well as the epoch of these operations and the laying down of the paving. Furthermore, the historical, social and cultural motivations for the choice of this type of material would be illustrated, as well as its state of conservation and the causes of possible disarray processes. Regarding this, in a chapter of the previously quoted investigation (Bertolani *et al.*, 1999), it is pointed out that the state of conservation of the sidewalks in Modena depends not only on the resistance of the material used or on the method used for its laying down but also on exceptional events. For example, in the last period of World War 2 street-paving in Modena underwent very serious damage owing to the passage and parking of heavy military vehicles of the Nazi forces. As regards modern paving interventions on some streets, where cobblestones are used, the construction of a central lane made of rock slabs or concrete would be advisable for the benefit of cyclists; this would in fact avoid unpleasant jerks or the improper use of sidewalks by cyclists (Panizza, 2003).

Finally, we would like to quote the recovery for tourist-cultural purposes of a military fortress built by the soldiers of the Italian Alpine regiments during the First World War. This appraisal operation was carried out by the well-known mountain climber R. Messner, who transformed this stronghold into a "Museum amidst the clouds", the highest in Europe, located on Mt. Rite, at an altitude of 2100 m in the Italian Dolomites, between Cortina d'Ampezzo and Pieve di Cadore (Fig. 4). Here, reality and representation are intertwined. Reality is embodied by the "pale mountains", with their mythical names such as Pelmo, Civetta, Marmolada, Cristallo and Tofane, which surround the fortress and break into the space of the museum through small win-

dows. Representation is given by the evocative collection of paintings of the Dolomites, among which the watercolours of the English painter E.T. Compton (1849-1921) stand out, together with many other objects and materials belonging to the history and myths of these mountains. The way to the fortress is an old military track readapted for the use of hikers and closed to motorised traffic, which starts from the XVI century village of Cibiana, a small "jewel" of Cadore, still showing its original plan and made cheerful by over fifty coloured, lively murals.

4. ARTISTIC SUGGESTION

There is no region, no place without natural features, among which the geomorphological aspects, in particular, make a landscape significant, unique for its landforms and the suggestions it conjures up. The features of the landscape are a sort of writing traced on the earth's surface, an unpublished alphabet, used and reinterpreted by poets and artists who through their sensitivity can convey emotions to the onlookers.

On the basis of these observations, a geological-literary itinerary was created starting from the assumption of the existence of specific Emilia-Romagna poetics and culture, linked to the outstanding morphological and geological features of our territory (Bertacchini *et al.*, 2002a). Each geosite, with its description, has been combined with a literary passage by an author expressing atmospheres and identities of particular sites, further enhanced by the photographs of a great Emilian master of the camera lens like Franco Fontana. This geological-literary itinerary was organised as a sort of guide for a sightseer yearning to meet Nature also in its poetical forms by travelling in space and time. This can take place only through the awareness that Nature can acquire a value for Man only if the latter finds a way to go through the complete range of his/her senses, including those most specifically spiritual.

At present, another research project is in progress: it consists of the study of some natural scenes from an artistic and geomorphological viewpoint, describing landscapes which. This approach aims to identify in the landscape the natural features which were painted in a picture. Therefore, an art critic will carry out a detailed research on the painting whereas a geomorphologist will study and describe the landforms of the real landscape.

It is by now evident that also Science can offer itineraries of contemplation and aesthetic emotions which, although different, can be compared to those of the artists. The triggering of emotions comparable to the famous "Stendhal's syndrome" is not rare when particularly sensitive souls admire landscapes rich in



Fig. 4 - "Museum amidst the clouds", military fortress from World War 1, located on Mt. Rite, at an altitude of 2100 m in the eastern Dolomites.

"Museo nelle nuvole", fortezza militare della prima guerra mondiale, situato sul Mt. Rite, 2100 m, nelle Dolomiti orientali.

specific suggestions.

Rañada (2003), in his recent book "The one thousand faces of Science", says: "Nature shines with different lights and things sing in diverse ways many different songs. Artists, poets and philosophers can perceive some of them, whereas scientists can perceive others".

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