This workshop on “Geomorphological Sites: assessment and mapping” is the second scientific meeting of the Working Group “Geomorphological Sites” created within the International Association of Geomorphologists (IAG) in 2001, and that I have the honour of assuring the co-ordination.

More than one year has passed since our last meeting held in Modena in June 2002. Since, a lot of work has been realised. A poster and flyers have been edited in order to publicize our activities. This material is available to all members for use in their own country. Several articles have been published in information journals in different countries. Our colleague E. Serrano has organised a symposium at the sixth Spanish Meeting on Geomorphology held in Valladolid in September 2002. The working group was also involved in the organisation of a Swiss seminar on geomorphological landscapes held in Lausanne in February 2003. Several members of the WG gave lessons during this postgraduate course. In Italy, the activities of the WG are highly co-ordinated with the research program COFIN 2001-2003 Geosites in the Italian Landscape, co-ordinated by Prof. Sandra Piacente. I would congratulate our Italian colleagues for the book La Memoria della Terra, la Terra della Memoria, which is one of the high quality and concrete products of the research. I also met two times with our scientific secretary Dr. Paola Coratza, once in Modena and once in Lausanne in order to co-ordinate the administrative work. I thank very much Paola for her efficient work and her cordial collaboration.

The results of our works need to be published in scientific journals in order to be diffused in the scientific community. I thank therefore Prof. Mario Panizza and Sandra Piacente, who were at the origin of the Modena’s meeting last year and who organised the publication of the workshop’s proceedings in the journal Il Quaternario.

The theme of the current workshop is about assessing and mapping geomorphological sites. The aim is to discuss about methods that could be used in the complex processes of geosites assessment, and in various contexts (environmental impact assessment, geosite inventories, landscape assessment, etc.). The workshop should also permit to discuss about mapping methods of geomorphological sites, a subject that has been very poorly studied until now. I hope that the presentations, posters and discussions, and of course the excursion in Sardinia will be very profitable for all participants.

In conclusion, I would address a particular thank to our hosts in Sardinia who welcome us at the University of Cagliari. My sincere thanks go especially to Prof. Antonio Ulzega and Felice Di Gregorio, scientific organisers of the workshop, and Dr. Valeria Panizza and Jo De Waele, who assure the very hard work of co-ordinating the scientific secretary.

I also remember the next appointments at the Regional Conference on Geomorphology in Mexico next month and at the 32th International Geological Congress in Florence in August 2004. In both conferences, topical sessions on geomorphosite arguments are organised by members of the WG. And don’t forget the International Conference on Geomorphology in 2005 in Saragoza, where we will conclude our works with a symposium on the theme “Geomorphological Sites”!

Dr Emmanuel Reynard
Co-ordinator of the IAG working group “Geomorphological Sites”
WELCOMING ADDRESS

On behalf of the International Association of Geomorphologists (IAG), I wish to express my friendly welcome to all the participants in this Workshop on “Geomorphological Sites”. The last Workshop was held in Modena just over a year ago, and it is a pleasure to see most of the same participants here again, together with new ones, for the meeting between the IAG “Geomorphological sites” Working Group and the COFIN 2001-2003 Italian research project “Geosites in the Italian Landscape”. We meet here in Sardinia, an island extremely rich in geomorphological sites and therefore an ideal place for our research. I wish to address my sincere thanks and appreciation to the organisers of this Meeting and, in particular, to Felice Di Gregorio, Antonio Ulzega and Valeria Panizza.

The Working Group “Geomorphological Sites” represents one of the most advanced research activities of the IAG and, together with six other working groups on different topics, involves many geomorphologists from all over the world. The IAG Executive Committee has greatly appreciated the scientific activity and results of this Working Group. On their behalf I would like to thank all the researchers concerned, in particular the Chairman, Emmanuel Reynard, and the Secretary, Paola Coratza. At the same time I also wish to express my most sincere appreciation of the members of the Italian research project for their scientific commitment and the results they have achieved, and in particular of their co-ordinator Sandra Piacente.

The rich list of lectures and posters, the highly qualified scientific level of the participants and the interesting topics to be encountered on the field trips all lead me to think that this Workshop will be successful. Indeed, we will have the opportunity to discuss and compare the various concepts and research methods applied in the assessment and mapping of Geomorphological Sites.

I also wish to emphasize that the themes of this Workshop are not only an essential cultural framework for basic research but also an important element to be applied in environmental policies aiming to safeguard and enhance our territory. This is borne out by the ever-growing interest shown by public opinion, local administrations and environmental policy makers.

I wish you all an enjoyable and rewarding time during these days here in Sardinia.

Mario PANIZZA
President of the I.A.G. – International Association of Geomorphologists
WELCOMING ADDRESSES

One of the aims of the National Interest Relevance Research Project (PRIN – COFIN 2001) entitled “Geosites in the Italian Landscape: Research, Evaluation and Development” is the testing and the proposed cartography of the geosites.

In this end-of-project meeting, being held in Cagliari, among the different issues that will be discussed, some proposals will be presented concerning the production and the purpose of cartography in regards to the description and development of the geomorphsites, drawn up by various project working groups. The literature suggests common standards and guidelines for the creation of this kind of thematic cartography, but at the same time it should serve as an incentive and a starting point for the realization of more updated and easily comprehensible geomorphosite maps, using, where possible, informatics systems.

We all agree that the representation of the geomorphosites by way of topographic maps is an efficient tool for their accessibility and availability, in particular for the broader public which, due to its lack of knowledge concerning this subject, remains relatively unreceptive. We all wish that in the near future the existence of the geomorphosite or more generally geosite, will be marked with different levels of relevance, as well as on the traditional tourist and excursion maps along with the usual historical, architectural and biological indications.

The representation of such thematic indications on maps is and will remain the most efficient way of providing easy and integrated information about the topic that we will come across. The faculty of perception and the information that a human eye receives from a graphic image are far superior to that received from a written text, which provides details not immediately indispensable.

To summarize the cartography representation of geomorphosites is considered a vital resource of communication in order to arouse the larger public’s interest in geoconservation. This also provides the reader with an immediate perception of the topic both concerning the disposition of the territory as well as the representation of the landscape forms and their evolution which make up a geomorphosite.

Alberto Carton
METHODOLOGICAL PROPOSAL FOR MAPPING GEOMORPHOSITES

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Italy has an extremely complex territory and also a rich environmental heritage. Therefore, particular instruments and models are indispensable in order to manage and appraise it properly. In both paper and in the more evolved digital format, mapping allows the most varied topics to be represented according to simple patterns, not requiring translation into other languages, by utilising standardised instruments which are unlikely to cause any misunderstanding. Mapping can therefore be defined as a basic, introductory instrument for providing information concerning a territory both in its own complexity and in its single components. As the study of geomorphosites and, more in general, of geosites, is a very recent development, the problem of cartographic representation has not yet been faced, but the geosites should be shown in a way that helps the user to easily identify and understand them. Indeed, seldom is a geosite shown on a map with specific symbols that allow its immediate identification and description.

Starting from these preliminary remarks, within the framework of the co-funded Project (PRIN-COFIN 2001) entitled “Geosites in the Italian landscape: research, assessment and improvement” (National Co-ordinator Prof. Sandra Piacente), the goals and methods for setting up a common methodology have already been defined. This methodology for mapping geomorphosites has been experimented and assessed in geologically and morphologically different areas. This has produced an important means of communication involving not only specialists but also and mainly a wider public of possible users in the topic of geoconservation. Therefore, the main goal in mapping geosites is to provide the user with immediate perception of the object, concerning both distribution over a territory and representation of those landforms which, according to certain criteria, make up a geomorphosite. Identifying a geomorphosite on a map, inspired by the principles of a traditional geomorphological map, leads the reader to acquire the concept of “dynamic landscape”. In this way users consulting this kind of map can pinpoint the processes and, more generally, the events which have taken place in generating that particular object. The latter finds its place in space and time by means of a deductive analysis which helps the user to be aware of the concepts of fragility, renewability and present dynamic processes, which are also useful for environmental education.

The remarks here presented are the result of discussions and comparisons among some of the participants in this research project, who belong to the five units making up the PRIN web of research centres (Genova, Modena-Reggio Emilia, Pavia, Sassari and Urbino Universities). As a starting point it has been convened that geomorphosite representation can be carried out by utilising both the traditional paper map and computerised systems which allow the data to be managed in an autonomous way (CD) and through the Internet. The former, traditional technique of representation is still necessary for producing “practical documents” that can be used in the field, whereas the computerised technique is useful for setting up a mapping inventory that goes beyond the single cases and, owing to its versatility and possibility of continuous implementation, is particularly suitable for realising a geosite database on a national scale. In addition, this mapping technique will allow updated consultation in real time, up to more complex uses, including those related to correct territorial planning.

Therefore, an index map of the Italian territory has been produced both in the paper format and through computer elaboration. The Italian territory has been subdivided into regions in which geosites have been shown only for the areas so far investigated in the studies carried out by the various Operative Units of the COFIN Project. At the same time, point-like, linear and areal geomorphosites, chosen according to their representativeness among those identified and assessed by the various O.Us., have been shown on large-scale, simplified geomorphological maps. The single maps are provided with an adequate legend made up of a list of geomorphosites with their denomination, accompanied by a summarised description. These maps also explain the reasons why a
particular object, a landform or a set of forms has qualified as “geomorphosite”. Finally, the large-scale map has been implemented by means of computer-based systems. This map will therefore be manageable through the monitor according to the traditional query phases: national index map, regional index map, location of regional geomorphosites, detailed description of some of them by means of specific maps, photos, list of main features and cards.
In Europe, landscape is put under a growing pressure because of the combined effects of urbanisation, tourism, development of communication systems and changes in the farming practices. Geology and geomorphology, although they make up the basic pillars of the architecture of natural and cultural landscapes, are not considered according to their real importance. Among the various reasons responsible for such a situation, there is the fact that methods for the assessment of the geomorphological quality of landscapes are poorly developed. This paper presents the principal improvements that have been made on geomorphological site assessment in Switzerland during the last decade. They concern four main domains: inventories of geosites, geosite assessment within EIA and within natural object inventories, and methods for assessing geomorphological sites.

An official inventory of geosites and geomorphosites does not exist in Switzerland at the moment. Several incentives were made during the 1990s in order to realise geosite inventories at the national and regional scale. A working group was created in 1994 within the Swiss Academy of Sciences (www.geoforum.ethz.ch). In 1995, a strategic report was published. It listed several criteria that should be taken into account in the realisation of geosite inventories and proposed strategies concerning the degree of protection, the management of protected geosites and the integration of geosite protection within the framework of nature protection in Switzerland. In 1998, a first list of about 400 geosites of national importance was published by the Swiss Academy of Sciences. At the same time, several Cantons realised their proper inventory of geosites, and often developed their own assessment methods. Lobbying for the realisation of an official inventory, based on a unified methodology, and to be coordinated by the Swiss Environmental Agency, has not been successful, principally because of financial reasons.

In 1985, the new Environment Protection Act was adopted, which regulates the realisation of EIA reports. After the first experiences, it was realised that geomorphology was not or very superficially assessed, a situation that could be explained by the fact that EIA reports were often realised by biologists and that a simple method for assessing the geomorphological value of the environment did not exist. The Research Group on Geomorphology at the University of Fribourg developed therefore methods to be used within EIA procedures. That methods were tested in the assessment of the impacts of the future Jura Highway (Transjuranne), which crosses very sensitive landscapes of the Jura Range in northern Switzerland.

The principal instrument for the implementation of the Swiss Nature Protection Act adopted in 1966 is the realisation of inventories of natural objects. The first lists concerned objects with landscape importance or endangered animal or vegetal species. During the 1990s, a more process oriented and systemic approach was adopted, and several new inventories of biotopes were realised (dry meadows, wetlands, alluvial zones, marsh landscapes, etc.). Methods for the assessment of the geomorphological quality of biotopes were developed by geomorphologists within the framework of two of these inventories: the marsh landscapes and the alpine alluvial zones and proglacial margins.

More theoretical reflections were developed by V. Grandgirard in his PhD thesis presented at the University of Fribourg in 1997. A method based on three discriminatory criteria (rarity, integrity and representativity) was proposed and tested in the Canton of Fribourg. It is now used in several current researches in other cantons. Very recently a new method was developed at the University of Lausanne for assessing the tourist value of geosites (Pralong and Reynard, this volume).

Further work should be now done in order to develop mapping methods and legends, that could be implemented in GIS environments and that could therefore be combined with other environmental data.
GEOSITE EVALUATION; CAN WE MEASURE INTANGIBLE VALUES?

Antonio Cendrero

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A discussion on issues to be addressed in the process of cataloguing and assessing geosites is presented. Different stages of the process are considered: identification, classification, inventory, evaluation, protection and use. Inventories to be elaborated should be satisfactory from different points of view: scientific quality of sites, definition of protection levels, possibility of educational or recreational use, or potential for generating economic activities.

A problem that permeates all stages of the process is subjectivity. Establishment of ranks of scientific interest for sites in a region, proposals for protection measures or drafting plans for the use of geosites cannot be based exclusively on scientific, objective criteria. Subjectivity is an unavoidable (perhaps even desirable) part of all of them. This represents an important difficulty because if protection and use plans for geosites are to be successful, they should be based on sound, transparent criteria that can be subject to external, independent scrutiny and evaluation. This should include some sort of validation to determine to what extent classifications and proposals presented reflect social values, be they expressed by specific stakeholder groups (earth scientists, decision makers, elected officials, conservationists) or general public. If those values are well reflected plans will be socially acceptable and more likely to be useful.

An approach will be presented based on the definition of three groups of criteria, related to: a) intrinsic quality of sites; b) potential threats and protection needs; c) potential for use. Indicators will be presented for each criterion. Particular efforts have been made to propose indicators that can be expressed by means of continuous variables. When this has not been possible categorical, “objective” variables are used. Combination of those indicators into different types of indices can be used as a means to “measure” the type of intangible qualities mentioned above. The advantage of the approach proposed is that numerical classifications of sites obtained using that kind of “quality models”, can be validated through comparison with independent external opinions. Initial models can be refined by trial and error, until a reasonably satisfactory reproduction of key stakeholders’ assessments is obtained. Examples will be presented. Advantages and shortcomings of the approach will be discussed.
The vocation of the Réserve Naturelle Géologique de Haute-Provence is to protect the geological heritage on nearly 200,000 ha of territory in southeastern France. This mountainous area in the Southern Alps has a complex geological history going back as far as 300 million years, with the confrontation of two different domains: the Provençal and Alpine domains, each with a different palaeogeographic and tectonic history and brought together by the most recent Alpine phases. Moreover, this territory is located at the southernmost limit of the extension of Quaternary glaciers.

The result is a great variety of reliefs that produce landscapes of awe-inspiring beauty.

For the RGHP to fulfil the mission of protecting the territory, it is necessary to educate visitors and the local population. The Reserve’s actions include the conservation and enhancement of geomorphological landscapes.

The approach to the geological heritage from a distance, through such spontaneously attractive elements as natural landscapes, provides initial awareness of the place of geology in our environment. This initiation, through decipherment of significant elements commonly perceived as inert backdrops, introduces a new dimension to these landscapes.

One of the main difficulties encountered in the context of understanding geological phenomena is the time scale involved and the recording of time over long periods. As a general rule, the processes involved in the formation of geomorphological features (geomorphosites) are much closer to the human time scale.

For both these reasons, we believe that the presentation and enhancement of such sites is very useful in raising public awareness to the value of the geological heritage.

In recent years, the Reserve has undertaken a programme of setting up discovery trails to further understanding of the territory’s natural and human heritage, with special emphasis on the geological heritage. The sites of geomorphological interest along these itineraries provide opportunities to introduce visitors to the meanderings of the Earth’s memory.
GEOMORPHOSITES AND GEODIVERSITY OF THE IFRANE REGION
(MIDDLE ATLAS, MOROCCO)

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Morocco has an extremely variable and interesting territory in which the most ancient rocks of Archaeozoic (2 billion years old) crop out representing the Moroccan basement of the African craton. Upon these ancient rocks folded at least twice during Precambrian and submerged several times during Palaeozoic, an impressive sedimentary sequence was deposited (mostly sandstones, limestones and conglomerates) in the period Cambrian-Carboniferous, intensely deformed by the Caledonian-Hercynian orogenesis and subsequently partially eroded. The following Alpine orogenesis is although the most evident and best known and caused the formation of an impressive series of almost parallel mountain ranges (Anti-Atlas, High Atlas, Middle Atlas and Rif) characterised by the local outcropping of the Palaeozoic basement complex and especially by widespread Mesozoic and Tertiary mostly carbonatic and slightly deformed rocks. The structural control of the Alpine orogenesis has lead to the geologic-tectonic subdivision of Morocco in four structural domains: Anti-Atlas, Atlas, Meseta and Rif. Finally, during Late Tertiary and Quaternary plate tectonics caused marine transgressions and volcanic activity in various Moroccan regions.

The outcropping of this wide variety of lithologies of various ages, the many different geological episodes (tectonics, marine transgressions, volcanism, etc.) and the climatic variability both in time and in space have determined a very interesting and rich geological and geomorphological landscape with a high index of geodiversity.

For this reason, in the framework of the Project "Geological Monuments in the Oued Sebou basin (Morocco)" financed by the Sardinian Regional Government (Regional Law 43/1990, Responsible Prof. Felice Di Gregorio), the geo-environmental research group of the Department of Geology of the University of Cagliari has started a research Project in collaboration with the Department of Earth Sciences of the University Mohammed V of Rabat that aims to identify, classify and evaluate the geosites and geomorphosites of Morocco.

In the present paper the preliminary results of geosites and geomorphosites inventory in the region of Ifrane, Azrou and Sefrou (Middle Atlas) are illustrated. By means of a detailed literature and cartographic research, of field studies and surveys and with the aid of satellite image elaboration many sites of geological and geomorphological interest have been identified.

A first satellite imagery processing has been performed on Landsat ETM+ data to visualise a wide range of different features useful in landscape characterisation. The interpretation keys were created based on field work. Two different approaches are planned to make use of these data: the first is a spectral analysis for lithologic interpretation, while the second one is a spatial analysis to identify tectonic structures. The integration of these two image processing techniques, correlated to field and bibliographic knowledge, permits a good landscape description and to understand the geomorphological dynamics.

Among the identified geosites isolated, disseminated, coalescent or complex effusive centres, basalt plateaux, lava tunnels, cryptokarstic caves, karstic depressions (dolines, poljes and lakes), ruin-like carbonate landscapes (rochers), karren fields, waterfalls, travertine deposits and several erosional forms can be mentioned. The preliminary results of this study, performed in a small territory, already demonstrate the wide variety of forms and encourages the prosecution of this kind of researches also in neighbouring regions in order to contribute to the raise of awareness of geological heritage and geoconservation also in developing countries.
Tozeur is the most important tourist town of South-Western Tunisia, situated in between the two salt lakes Chott El Djerid to the South and Chott El Gharsa to the North. This area is known for its luxuriant oasis in the middle of the desert (Tozeur, Nefta etc.), the mountain chains to the North close to the border with Algeria with its villages and waterfalls (Tameghza, Chebika, Midès), the mountain chain East of Tozeur (Jbel Morra etc.) with its arid canyons, and the wide salt plains (Chotts). Tourists usually visit the region rapidly without staying overnight, overlooking and ignoring the great geomorphologic and geological interesting places and landscapes.

Therefore, in the framework of a Research Project performed by the Department of Geology of the University of Cagliari in collaboration with the "Institut des Régions Arides" at Medenine and with the "Faculté de Sciences Humaines et sociales" of Tunis and financed by the Sardinian Regional Government (R.L. 11 April 1996, n° 19), also following a short note on the same issue presented in June 2002 at the National Conference on Environmental Geology at Genoa and about to be published, the multidisciplinary Research Team has studied seventeen geosites and geological landscapes in the region of Tozeur, with the purpose of constituting a network of geosites in these arid and semi-arid areas.

Field work combined with remote sensing techniques have enabled to start preparing thematic maps of these geosites which, together with their description (genesis, evolution, state of conservation, proposals of valorisation, etc.) will be useful for obtaining financial aid for their protection and valorisation. The definition of morphostructural units landform analysis at a large/medium scale was performed by TeleGIS Laboratory, involved in these studies on Southern Tunisia from 1997 in collaboration with the Institute des Régions Arides, applying remote sensing techniques on multi-spectral satellite images. During this project the interpretation keys for the image classification were created in the different steps of field observations and digital image processing. The radiometric and geometric response were used for the discrimination of spectral units (lithological sequences) and textural units defined by photo-interpretation techniques (structural units like anticlines, fault-controlled valleys or forms like chevron etc.).

Many geomorphosites are represented by canyons (Gorges de Ben Nebhana, Sidi Bou Hellal, Selja, Negueb, Midès, etc.) and waterfalls (Grande Cascade and Cascade de l'Oasis at Tameghza, Cascade de Chebika and its geological-structural features). Others are related to aeolian processes (Barchan dunes of Chott El Gharsa, Aeolian sculpture of Ong El Jmel, Yardangs close to Ong El Jmel, Nebkha fields of Chamsa). The remaining geosites are an ancient coastline testified by a lumachelle with Cardium near Tozeur, the anticline of Brikis close to Tameghza and an ancient phosphate mine at Chouabin (Jbel Chouabin close to Redeyef).

These sites and landscapes of geological and geomorphological interest represent the entire geological history of the Tozeur region. This history starts from Early Cretaceous, and the various sites narrate the sedimentary and tectonic events, the palaeo-environmental and palaeo-climate episodes, the birth, development and extinction of animal and plant species, the geomorphologic erosion and deposition events, explaining the present morphology, climate and landscape in a most interesting scientific and educational way.

The linking of all these places of geological and geomorphologic interest in networks of Geosites along a thematic issue (the "Living Desert" network with Nebkha and Barchan dunes, Yardangs and Aeolian sculptures, the "Rocks and Water" network with waterfalls and canyons and the "Travel through Time" network across the canyons of Jbel Morra-Sidi Bou Hellal passing through more than 100 million
years of Earth’s geological history) or as singular elements (phosphate mine, salt pan, oasis, canyon, anticline etc.) give an interesting opportunity of telling the history of the Earth, promoting geology and geomorphology to the local people and to the tourists. In fact, geological heritage can and should become a cultural and economical resource for the local people, and therefore these inhabitants should be taught understanding their natural and cultural environment, enabling them to use these elements in the framework of a touristic and sustainable development of their region.
SA CONCA DE SU DEMONIU. A RARE EXAMPLE OF WEATHERING ON ORBICULAR GRANITE (NE SARDINIA)

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The large hollows, quite common in the Gallura territory (north-eastern Sardinia), originated by the hollow-outs, from the bottom upwards of granite, are known as “tafoni” (that means “windows” or “perforations”) and as “conche” in the local language.

The reason why the Conca de Su Demoniu (located in Padru - SS environs) is unique of its kind is because of its orbicular granite layout, that consists of ellipsoids (decimeters in size) encircled by brownish thin (in mm) edges. These big and uncommon ellipsoidal forms, easily discernible on the Conca’s hollowed-out surface, have always attracted people’s attention so that the folk legends tell tales of their being the footprints of the devil, come to Earth to frighten the sheperds who led their flock up onto the tableland. The Conca de Su Demoniu orbicular granite can be described as an apophysis with the shape of a tridimensional, injected body, on which the displacement effect of magmatic injection is evident, probably because of the high value of magma viscosity.

This apophysis (about 10 metres in size) is enclosed by pinkish peraluminous leucogranites – of isotropic texture and medium-, fined-grained, distinguished by a red garnet and by rare muscovite crystals (few mm in size) with a radiometric age date from 289 ± 1 Ma to 274 ± 9 Ma (Del Moro et alii, 1975; Cocherie, 1985; Castorina & Pietrini, 1989).

The subhedral K-feldspar is pinkish, has an average size of 2-3 cm and sometimes presents biotite poikilitic inclusions (Carmignani, 2001).

Its orbicular structure, common in hypabyssal consolidated rocks, can be assimilated to the Ghistorrai (Fonni) spheroidal granite, mentioned by Lovisato in 1880 but not found anywhere else, to the corsite or orbicular diorite of Santa Lucia di Tallano (Corse) and to the rapakivi (found in southern Finland), although different in composition, colour and size of the spheroids. Actually, these spheroids found at Conca De Su Demoniu are bigger in size and tend to have an ellipsoidal shape, with a sub-horizontal major axis, probably due to the pressure during the consolidation stage, that caused the flat and oblong shape of the feldspar phenocrysts.

This geomorphosite is located not far from the geologically well-known Posada-Asinara Line, where relic granulite combinations in femic and ultra-femic bodies are present, stratified within gneiss with cyanite relics (Ghezzo et alii, 1979); this Line is thought to be an Hercynic oceanic suture zone between the Armorica Plate - NE - and the overburdens of Gondwana continental edge, that metamorphosed during the Hercynic orogeny and stratified in the chain nappe area (Cappelli et alii, 1992).
The Molise region is characterised by a high geodiversity due to its geological-gemorphological setting and the related relief and landscape features. It is marked by a high degree of naturality and the presence of a consistent number of natural and protected areas allowing above all the conservation and valorisation of its fauna and flora. Its economy is largely based on agricultural activities. In particular, till recent years, this region was extensively interested by pasture mainly based on the seasonal migration (transhumance) of herds along defined strips of territory, the so-called tratturi. These tratturi are an important evidence of the social, economic and environmental features which have largely guided man’s activity, and are considered of great importance for the history of the Molise region.

Though the Molise economy is widely based on the use of its natural attributes, up to now no significant attempt was made to valorise its geological heritage. Our research, undertaken recently and restricted at the moment to the Province of Isernia, may be considered a starting point for the census and valorisation of geosites in the Molise region.

The Province of Isernia, with an extension of about 1500 km², is characterised by a prevailing mountainous to hilly morphology and the presence of two major catchments, the Volturno and Trigno river basins, draining respectively to the Thyrrhenian and Adriatic Sea. The main landscape units are represented by the Venafro and Mainarde mountains and the north-western portion of the Matese mountains, the plains of Isernia-Venafro and Sessano, and the mature head water portions of the Volturno and Trigno basins.

Taking in account the presence of protected/natural areas, the landscape features and the distribution of archaeological remains, a number of areas of particular interest were distinguished within the provincial territory. With particular reference to its archaeological heritage, the Province of Isernia can be considered extremely rich as evidenced by numerous discoveries of lower Palaeolithic to historical age.

The distinguished areas are considered basic land-units for the singling out and characterisation of geosites and for the development of specific itineraries for the touristic fruition of both the natural and geological heritage.

Aim of our research is to contribute to the national inventory of geosites and, with reference to the regional territory and its specific environmental features, to find the best way for the protection, valorisation and management of recognized geosites.

At present, a first list of potential geosites for the Province of Isernia can be presented and some examples be illustrated with particular reference to the areas currently under study. One of these areas is represented by the confining headwater portions of the Vandra and Tirino torrents, tributaries respectively of the Volturno and the Trigno river. This area includes the zone of Collemelluccio-Monte di Mezzo, under protection of the UNESCO, and is approximately confined between the tratturi Celano-Foggia and Lucera-Castel di Sangro. Besides its significant prehistoric discoveries and particularly high landscape qualities, it is characterised by a series of interesting geological and geomorphological elements, which are very important and representative for the tectonic setting and the Quaternary geomorphological evolution at a local to regional scale.
11 geological Itineraries located in eleven Italian regions (from north to south: Friuli-Venezia Giulia, Liguria, Tuscany, Marche, Umbria, Abruzzo, Apulia, Basilicata, Calabria, Sardinia, Sicily) are presented in this paper for the first time. The Itineraries are aimed at the identification, study, conservation and exploitation of the geo-tourist values of 70 important geomorphological sites, which are mostly unknown to non-geologists. The objectives of the project, the stopovers at one or more geomorphological sites, and the Itinerary average travelling time were identified with regard to each Itinerary, and a map showing the Itinerary and the related stopovers was drawn up. A file card concerning each geomorphological site was drawn up for the Italian geosite inventory (National Geologic Service and Geosite Documentation Centre), and a “specialist” file card of the MIUR/COFIN Research Project “Geomorphological Sites”, including the geological and geomorphological descriptions of the site and the relevant bibliography, was also prepared. Furthermore, a number of photographs of each geomorphological site were taken.

The average travelling time of the Itineraries ranges from half to one day, and all the Itineraries are covered by car, with the exception of the Itinerary of the Isle of Lipari, where a motorboat is used.

The eleven geological itineraries that are planned out in this paper are the following:

1 - From the delta of Tagliamento river to the Park of Risorgive (Udine)
2 - Plateau of the Manie (Savona)
3 - Historical sandstone quarries of Maiano-Mount Ceceri (Florence)
4 - From Frasassi Gorge to Mount Catria (Ancona-Perugia)
5 - Aterno valley-Mount Sirente (L’Aquila)
6 - From Pizzomunno Stack to the Doline of Pozzatina (Foggia)
7 - Dolomites of Basilicata and Aliano (Potenza-Matera)
8 - From the Castle of Melfi to the Lakes of Monticchio (Potenza)
9 - From Cape Colonna to Le Castella (Crotone)
10 – The granite landscape in Gallura (Sassari)
11 – Circumnavigation of the volcanic island of Lipari (Messina)

The objective of this research is the organic enhancement of the geo-tourist offer, which has proved to be really inadequate so far: geo-tourism is a sector with great potentialities, and it can offer the opportunity of numerous and various geological excursions to the significant flows of visitors who invade the whole peninsula all over the year. Indeed, the geological Itineraries that are planned out in this paper offer at least three advantages:
- the dissemination of knowledge about Earth Sciences, which is not significantly widespread among the general public and in the media;
- the transfer of part of the enormous tourist flow from the coastal to the inland areas, which generally show a low degree of development, thus guaranteeing that economic and social readjustment, in which all the Italian and European institutions and boards have been interested for long;
- the offer of new professional and cultural prospects to young geologists.
The IVS - Inventory of historical Traffic Routes in Switzerland - is an inventory of the Swiss Federation, being dressed in charge of the Federal Roads Office (FEDRO) at the University of Bern; until 1999 the Swiss Agency for the Environment, Forests and Landscape (SAEFL) was the orderer of the IVS. Based on the Law for protection of nature and landscape (Art. 5 and 6), it represents a constraining planning instrument for the offices of the Federation and offers multiple proposals to communities and cantons on how to integrate and re-use historical paths in our times. The IVS includes an inventory of ancient roads and traffic routes, worthy of being preserved and protected. Moreover, the work affords insights into the history of traffic in Switzerland.

What are historical routes of communication?
Historical routes of communications are communication routes from past epochs that are still traceable through their traditional appearance in the landscape or through historical documents (old plans and maps, written and illustrated sources). Transit routes of more than regional importance, such as the trading routes passing over the Gothard and the Simplon belong to these historical routes just as much as local communication routes, like a mill's path, a church path or a local smugglers path do.

Bridges and components (elements that are closely linked to the route such as inns, tolls, customs sites, milestones, roadside crosses and wayside shrines, inscriptions etc.) are also recorded in the inventory.

As one of the most impressive man-made landscape components, historical traffic routes belong today to one of the most endangered cultural monuments. For their protection, they are being recorded and documented by the Confederation in the IVS for all of Switzerland.

Methodology
The IVS methodology is described in detail in a Methodology Handbook. In Bulletin IVS 90/1 (available in German, French and Italian) one can find a resumé of the handbook. An A3 leaflet 'IVS in short' describes the most important points and can be obtained from the contact address.

The tasks and goals of the IVS are the cartography and the research about historical ways of communication as well as the road complements and relics that have lost their function. The aim of the IVS must be to gather sufficient material on the roads' shapes, surfacing materials and wayside complements in connexion with their historical, morphological and planning importance and to describe them in their spatial context. A comprehensive historical study taking into account all aspects of basic research in the sense of a complete history of communication cannot be the subject of the IVS's research.

Itinerary, line, segment
The survey of historical communication routes is subdivided into itineraries, lines and segments. Each one of these components is given its own description (text, photos, possibly detailed drawings) and shown on the inventory map.

Three degrees of preservation
Besides the evidence, three degrees of preservation have been distinguished:
They give information about the appearance and the remaining structure of the historical communication routes.

**National, regional or local importance**

On the inventory map, sections are assessed according to their national, regional and local importance in conformity with the law for the protection of nature and landscape. The classification in one of the three levels of importance is decided on the basis of qualitative evaluation criteria by the IVS staff member in charge, scientifically evaluated by the "accompanying working group IVS" of the relevant Ministry and then finally forwarded to the Federal Council for final approval.

The results are recorded in a landscape map and an inventory map as well as in the canton's IVS documentation. Presently the last series of finalized cantonal documentation is being audited.
The glacial landforms of the Apuan Alps, dating back to the last climatic change of the Pleistocene, deserve particular attention both for their importance in paleogeographical reconstructions and for the study of the glacial phenomenon in the Appenines mountain chain. It is particularly interesting to investigate the reasons for the extension of the Apuan glaciers given the various factors typical of the chain, such as its height, no greater than 2000 m, its closeness to the sea and its latitude. During the last glaciation, on the north eastern side of the Apuan Alps there must have been at least 9 glaciers, which managed to descend to the Garfagnana piedmont. The traces show that the glacial phenomenon influenced, also the seaward side. There are both relict erosive landforms, such as cirques, sills, typical valley profiles, and relict deposits. However, little remains of these forms. With time much evidence of glacial presence has been obliterated by fluvial-glacial or fluvial action, by the particularly strong karstic action typical of this mountain range and above all by human action in the direct form of quarrying and indirectly through the more subtle ignorance of the essential inherent value of these forms. It is worth noting that the morainic forms are often muddled and buried under the ravaneti (waste marble deposits) or have even been completely removed. A typical example of the degradation that has involved these landforms can be observed near the village of Arni, where the glacial deposits described by Cocchi and Stoppani in 1872, the first to be identified in the Apuan Alps, have been mostly eliminated. Similar degradation has affected not only the deposits, but also the erosive forms like the cirques, which, due to their location, have usually been saved from man-induced erosion. In the Apuan area, however, the quarrying activity has reached such high altitudes as to threaten and destroy even these forms. This is the case, for example, of the Sagro Basin and Mt. Corchia. Fortunately, in some areas, there are still some well preserved and recognisable glacial remains. In particular, some complete cirques are visible in the area of Mt. Pania Secca and Mt. Grondilice - Mt. Cavallo, while some well modelled morainic arches can be observed near the districts of Campocatino and Gramolazzo. In these zones, therefore, an appropriate intervention of protection and value enhancement should be guaranteed.
THE FLUVIAL MEANDER AS A COMPONENT OF THE LANDSCAPE

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Within the framework of the MIUR project entitled “Geomorphological sites in the Italian landscape: research, assessment and improvement”, for which the Genoa task force has been conducting a series of surveys and analyses of the geomorphological sites, the study of meanders has proved to arouse a particularly lively interest, since they strongly mark the territory of the Ligurian region. This paper aims at systematically analysing the shapes of meanders.

When studying the landscape components, which are considered as elements to be protected and safeguarded in the current planning activities, the analysis of the features of fluvial morphology has often been considered as an incidental question, if compared to the attention devoted to other territorial categories and their evolution through the time.

When thinking back to the development of the landscape and environment planning in the light of the evolution that the concept of landscape has witnessed in the course of time, the opportunity is given to study the fluvial meanders as components of the landscape-territory.

Unquestionably, the geomorphological study is an essential and overriding element to acquire extensive knowledge of the landscape physical structure: the study of the morphological features of the hydrographical network is a particularly useful in-depth investigation to understand a number of morphogenetic processes that have led to the present configuration of the territory.

Meanders have been defined as “bends mostly regularly chasing one another along a stretch of a stream” (Castiglioni, 1980). Therefore, these shapes are described as “prescribed” sinuous curves typical of some stream beds, and are classified as “free” and “embanked” or “trapped” meanders according to their origin. The simple definition is generally approximate, since not all bends are proper meanders and, in their attempts of drawing a distinction between bends and meanders, many authors have suggested numerical indexes calculated according to the tortuosity ratio. The concept is rendered increasingly less clear by the fact that meanders, which are indeed “meandering” shapes, are governed by the typical variables of the wavelike movements, and so their perception, and mapping, is a function of the observation scale, and also of the precision of the measures.

Given these assumptions, before taking the census of these shapes, the research of a “systematic” mapping method for these shapes has proved necessary in order to define a formal objectivation of these elements, and guarantee their “enhancement” sensu Wimbledon (1999).

This method enables researchers to free themselves as much as possible from personal interpretations, and it is based on an adjusted criterion complying with the principles of cartographic restitution, regardless of the dimensions of the elements analysed. In order to conduct the mapping, the utilities made available by the Geographic Information Systems (G.I.S.) have been used, which guarantee uniform mapping procedures. Moreover, the G.I.S. guarantee the archivalization of further dimensional variables useful for the study of the parameters that are necessary for the classification of meanders, and for the calculation and the statistical sampling aimed at identifying their shape.
A review of procedures for cataloguing and assessing sites of geomorphological interest (SGI) is presented; the main problems and shortcomings are identified. One such problem is the initial identification of sites to be included in one inventory. The usual procedure is based on the elaboration of lists by geomorphologists well acquainted with an area or group discussions among them. The main problem here is subjectivity in the elaboration of potential SGI lists.

A possible way to reduce such problem is to define, for each kind of geomorphic feature (landslides, glacial forms, etc.) a series of conditions (indicators of SGI quality) they should fulfil to be included in the inventory; these can be defined by any group of geomorphologists, irrespective of their acquaintance with the area. The degree of coincidence between the actual characteristics of SGIs proposed and the list of conditions defined can then be used to both identify indicators that “de facto” determine the selection by local experts and the relative importance of sites. Examples of the application of the procedure to both elaboration of a new inventory and analysis of existing ones are presented.

A second problem arises with respect to cataloguing. Previous works have shown the need to clearly define the characteristics that should be included for describing inventoried SGI. A proposal is presented here for description of relevant characteristics using indicators that can be expressed in quantitative or, at least, objective categorical terms. Those indicators refer not only to the intrinsic quality of the sites (based on purely geomorphologic criteria) but also to their potential for tourism-recreational or educational uses. Indicators proposed and an example of their application to cataloguing and ranking of SGI are presented.
CONSERVATION AND VALORIZATION OF GEOMORPHOLOGICAL SITES IN THE BERGEGGI REGIONAL NATURE RESERVE (WESTERN LIGURIA)

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The morphology of the section of coastline between Bergeggi and Sportorno, in which pocket beaches alternate with small cliff promontories, is very varied. The small island of Bergeggi lies about 250 metres off the coast, reaching a maximum height above sea level of 53 m.

There are two reasons why this section of coastline is of such interest and so deserving of conservation and enhancement. The first is linked to the lithology of the area and its sedimentary and tectonic substrate structures, the second to the radical modelling of the latter as a result of the action of exogenous agents.

The substrate is made up to a greater or lesser degree of calcareous dolomites forming part of the “San Pietro ai Monti dolomites”, large areas of which are common in the Savona area. The rock is at times massive and at times well-stratified, with some slate type intercalations. The rocky mass features overlie faults, with locally visible folds of various scales and origins (tectonic, metamorphic, sinsedimentary). All this has conditioned the erosion and therefore the profile of the coast, providing an excellent example of the relationship between the coastal morphology and geological aspects of the substrate.

The second aspect is linked to dynamic exogenous processes, of which the most significant is the karstic process which caused the existing cavities, many linked to the sea and re-modelled by it.

The highest sea levels, in the Pleistocene and Holocene periods, gave rise to cliffs, caves, channels and platforms along the coast.

An analysis of sections inside the caves has allowed us to establish the height of the characteristic forms (marine notches, Lithophaga borings ecc.). Combining this with a study of the deposits found has enabled us to establish three sea levels at 5.20, 3.90 and 2.80 m.

The paleo-marine levels found in Bergeggi most probably originated in the last interglacial period. Without any datable items, a comparison between the measurements taken and bibliographical data seems to indicate that the highest level of 5.20 m above sea level occurred during the interglacial period in the Tyrrenian, corresponding to climate substage 5e. The other two sea levels can also be attributed to the same climate stage.

The enhancement and protection of one of the most beautiful natural environments in Ligura, with its strong potential for tourism, is justified by the close relationship existing between the typical geological characteristics of this section of coastline and its history in relation to climatic and eustatic changes.
This article describes the contribution of geomorphological documents to the elaboration of Tourist maps. In particular, the criteria and methodology used for the implementation of the Environmental-Tourist Map of the Natural Reserve of Salse di Nirano, located in the Modena Apennines (northern Italy), are illustrated.

The “Salse” are small mud volcanoes built by emissions of salt water mixed with mud and pushed up by methane (and sometimes liquid hydrocarbons) coming to surface along ground discontinuities produced by the overthrusting along the front of the Apennine chain. Since they are the most developed pseudo-volcanic phenomenon of the whole Italian territory, Salse di Nirano have always aroused great interest and were first described by Pliny the Elder, around 60 A.D. In 1982, a Natural Reserve was established in the area by the Emilia-Romagna Region: the reserve territory covers a total area of about 200 ha with elevations ranging from 140 to 308 m.

Within the framework of investigations for assessing and appraising Geosites in the Italian landscape and in collaboration with the public Board which manages this Reserve (Municipality of Fiorano Modenese), some geomorphological documents have been implemented by means of ArcView GIS computer programme. The orographic arrangement of the territory has been effectively represented by means of Digital Terrain Model (DTM), which was implemented on the basis of altimetric data taken from the Regional Technical Map (CTR) of the Emilia-Romagna Region. The detailed geomorphological features are represented in a Geomorphological map from which a GeoTourist map has been obtained by means of opportune simplifications and integrations. The latter map conjugates the illustration of the most evident geomorphological aspects (mud volcanoes, badlands, landslides, anthropogenetic landforms, bedrock, surface deposits, hydrography, etc.) with fundamental tourist information (main roads, parking places, visitor centre, excursion trails, picnic areas, panoramic points, restaurants and overnight places). The GeoTourist map and the DTM are the cartographic documents characterising an Environmental-Tourist map. This is a thematic pocket foldable map printed on both sides with illustration notes both in English and Italian. In addition, the Environmental-Tourist map contains a synoptic description of the geological, geomorphological, botanical and zoological aspects, accompanied by photographs and information on the visitor centre, excursion trails, essential regulations of the reserve, restaurants, refreshment points and overnight-stay places in the reserve and surrounding area and, finally, cultural and tourism attractions.

The Environmental-Tourist map, which is part of the initiatives adopted for improving the knowledge, fruition and appraisal of the Regional Natural Reserve of Salse di Nirano, is in press thanks to the funding granted by the Municipality of Fiorano Modenese.
GEOLOGICAL HERITAGE AND CULTURAL TOURISM

Paola Coratza, Mauro Marchetti and Mario Panizza

Department of Earth Sciences – University of Modena and Reggio Emilia (Italy)

For some years researchers of the Geomorphology Group from the Earth Sciences Department of the University of Modena and Reggio Emilia (Italy) have been carrying out investigations in the Dolomites and in particular in the areas of Cortina d’Ampezzo and Corvara in Badia. These research activities have prevalently concentrated on aspects of so-called “dark geology”, that is, the study, assessment and mitigation of geomorphological hazards and risks. The research was conducted as part of both international (European Commission), national (CNR and MUIR), regional and local projects and conventions.

At the same time, interest in geological heritage has been growing. It seems both right and opportune to pay more attention to this heritage and in particular to geomorphosites, providing the means to promote and provide information on the Dolomite area.

In response to this renewed interest, this paper illustrates a range of activities and prospects, in particular regarding the Upper Val Badia, which are listed below.

- Geotourism maps: in particular, some itineraries have been selected in this valley as a suitable way to approach geological-geomorphological themes. In this way, tourists may gain a deeper understanding, and may be more aware of what they can observe in the surrounding area. In particular, the chosen areas – eastern slope of the Sella Group and southern slope of the Upper Val Badia - are characterised by dynamic relief forms resulting from contrasting lithologies and geological structures, like dolomites and underlying clayey rock types. The morphology of the areas is suitable for this operation since they have undergone significant climate changes from the Pleistocene up to the present day. In fact, the areas have been subject to glacial, periglacial and temperate morphoclimatic systems. For this reason the landforms are particularly varied and have gone through periods in which they were modelled by diverse forces. Glacial forms are common and bear witness to the presence of a consistent ice cover during the last glacial maximum (LGM). These now inactive forms contrast with others both of gravitational origin (landslides, talus fans etc.), which are abundant on the slopes, and of anthropogenetic origin on the valley floors.

- Guided excursions: some guided excursions of a geological-naturalistic nature, with particular reference to geomorphological features, have been outlined along some of the itineraries included on the “geotourism maps”.

- History of recent geology: an accessible work about the Upper Val Badia is in preparation, including an introduction on the geological evolution of the Dolomites and geomorphological occurrences of the most recent Geological Era. It makes particular reference to the geomorphological consequences of glacier expansion, the most recent developments due to landslide phenomena in particular, and hydrogeological alterations. It also takes in more recent factors connected to anthropological development from Pre-history to the present day.
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A COMPARATIVE INVENTORY OF GEOMORPHOSITES IN “FOLD AND THRUST” BELTS

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This paper illustrates a comparative inventory of geomorphological geosites, synthesis of three research projects inserted in the frame of a doctorate in Earth Sciences, developed in cooperation with the Institute of Geography of the University of Fribourg (Switzerland) and carried out in peculiar folded and faulted reliefs and in nearby sedimentary basins. The following areas have been examined: the north-eastern sector of the Jura chain, around the Delemont Basin (Jura Canton, NW Switzerland); the complex of the “Collina di Torino” (Torino Hill) and the Monferrato hills, forming the so called “Monferrato arc” (Central Piemonte Region, NW Italy); the southern Cottian Alps (SW Piemonte Region, NW Italy).

The aims of the work have been to produce a list of typical morphogeosites, which should allow the demonstration of the geomorphological wealth of the surveyed areas, and to draw a comparison among different landscapes partly linked by analogous geological histories.

In order to achieve a comparable inventory of geosites in distinct environments, to select and assess relief features the same method has been applied.

Firstly, according to main scientific bibliography and owing to cartographical analysis, remote sensing, ground survey and mapping, the most significant “geomorphological objects” (limited landforms, wide sites and even particular landscapes) have been spotted and categorized. Secondly, a scientific value has been assigned to geomorphological assets by an evaluation process based on six fundamental criteria (integrity, representativeness and exemplarity, rarity, paleogeographic value, particular site of interest, geosites included) and on several secondary criteria (e.g.: geo-diversity, morphogenetic activity, dimensions, other scientific or cultural reasons of interest …). Lastly, the geomorphosites picked out have been recorded in a structured database and characterized by informative cards, that as regards the geosites selected in Italy correspond to the forms proposed in 2001 by the Italian Geological Service (SGI).

The comparative inventory of geomorphosites points out the similarities and differences among the examined “fold and thrust” belts and the geomorphological diversity of each landscape.

The geomorphosites of Jura chain result mainly from fluvial, glacial and karstic processes deeply influenced by the evident “classical” and homogeneous folded structure of the relief, which in affected by overthrusts, normal faults and strike-slip faults mainly linked to the recent geodynamic of the “Rhine horst and graben structure”. The “Monferrato arc” makes up a very large area of recent uplift where fluvial erosion and mass movements are the main morphological processes: due to the characteristics of the bedrock, easily worn away by the weathering, the influence of the structures (cylindrical folds, strike-slip faults and thrust faults) upon the geomorphogeny is less clear than in the Jura region. The morphogeosites of southern Cottian Alps provide an interpretation of a nappe belt characterized by geo-diversity, that’s wider than in the above-mentioned examples: as a result of structural, lithological and climatic variety the morphological framework in this relief, that is a limited sector of the Western Alps, is proportionally complex and heterogeneous.

This list of geomorphosites has been the basis to discuss management and exploitation perspectives suitable to Natural Heritage of each territory, according to the different goals of the research projects that the proposed inventory partly sums up.
GEOLOGY AND GEOMORPHOLOGY OF THE “ROSANDRA” VALLEY FOR A CULTURAL VALORIZATION.

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The Rosandra Valley is located near Trieste Italy, on the border of Classical Karst, and is a gully excavated in tertiary limestones. The origin of the valley is mainly due to presence of faults and overthrusts and different attitude to erosion between limestones and marls, which makes it a beautiful example of geomorphological conditioning influenced by litological and structural factors. Besides its slopes are interested by an extended and mature hypogean karst phenomena which contribute to make the whole hydrostructure more interesting. The valley is also interesting for its local vegetation, due to its particular climatic conditions, and prehistoric and historic interest due to its geographic location.
KARSTIC GEOMORPHOSITES OF MONTE ALBO (NORTH-EAST SARDINIA)

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Since more than ten years our working group has been occupied in identifying, describing and studying geomorphosites in many parts of Sardinia, and since then many scientific papers have been presented in several international congresses (Digne-les-Bains, Belogradchik, Madrid, Hammamed, Genua, Modena, Dublin) or published in scientific reviews. These researches have regarded geomorphosites of Sardinia in general, of Cagliari Province, of the volcanic regions of Logudoro, Monte Arci and the coast of Bosa, but also many karst areas such as Supramonte, Gulf of Orosei, the Tacchi region and the Palaeozoic mine district of Iglesiente-Sulcis.

In this paper the Authors present the results of a study performed on the geomorphosites of the Monte Albo chain (North-East Sardinia), an important karst area elongated in a NE-SW direction for a length of 30 km and a width of 5, starting from 50 m a.s.l. and reaching altitudes of more than 1100 m. This impressive relief is constituted of Middle Jurassic-Lower Cretaceous dolostones and limestones covering with an unconformity a metamorphic Palaeozoic basement. This latter is composed of four distinct metamorphic complexes derived from a sedimentary sequence showing increasing metamorphism towards the North-East where high grade "bird's eye" gneiss and migmatites can be observed. After a continental period during Triassic-Lower Jurassic this basement complex has been eroded and upon this hilly topography the Middle Jurassic Sea entered and left its first fluvial and delta sediments (conglomerates, sandstones and siltstones). This transgression and following deposition of carbonatic sediments reigned for about 30 million years from Baiocian to Hauterivian.

The Mesozoic sedimentary sequence starts with conglomerates and quartz sands, followed by dolostones, limestones and marls for a thickness of more than 600 meters, intensely deformed by tectonic movements (faults, overthrusts etc.) and with evident karst features.

Although the geomorphosites of Monte Albo are not that impressive as in other Sardinian karst areas (e.g. Supramonte, Gulf of Orosei) it seems noteworthy presenting them in the framework of this spectacular landscape unit that, in its whole, represents an area of great geomorphological interest.

Among the described geomorphosites many places with didactic surficial karst phenomena (Karren fields of Monte Turuddò and Punta Cupetti, suspended valley of Janna Nurai, Solution flutes and kamenitza of Punta Catarina, macro-dolines of Campu ‘e Susu, Sas Puntas and Altudè, canyon of Riu Siccu), the structural geosite of Punta Urros and the landslide of Punta Ervare ‘e Chervos and two places of hydrogeological interest can be mentioned (Sinkhole of Bonaettè and karst spring of Fruncu ‘e Oche). Furthermore many subterranean places are enclosed, two vertical karst shafts (Tumba ‘e Nudorra and Tumba ‘e Nurai), several horizontal caves (Sa Conca ‘e Crapa, Omines Agrestes, Locoli, Su Santuariu, Cane Gortoè) and a natural tunnel (Listincu).

All these geomorphosites should be connected in a local network inserted in the Monte Albo landscape unit, already part of the Geomining, Historical and Environmental Park of Sardinia (Area 6), through the realisation of equipped pathways and the elaboration of explicative maps and panels and a website in which geology, geomorphology, karst, fauna, flora, archaeology and industrial archaeology are described. The explanation of the landscape, its evolution, its geodiversity and the single elements it contains can help the visitors in understanding the importance of geology and geomorphology on landscape evolution, flora and human activities, that combine in an educational model of great suggestion and efficiency.

This proposal of valorisation of these landscapes and geomorphosites could well be connected to other areas of the region, and the Authors hope that the local and regional stakeholders will participate in the valorisation of their territory, giving an important service to the many tourists that come and visit the Monte Albo.
The Infreschi Bay: an example of geomorphosite in the Cilento - Vallo di Diano National Park

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The carbonate coastline between the village of Marina di Camerota (SA) and the bay of Porto Infreschi is characterised by several coastal caves, known above all for their archaeological record. In many cases, the depositional history of the filling successions is characterised by fluctuating marine and continental environments, as testified by the presence of marine sandstones or conglomerates alternated with or covered by continental deposits (eolian sands, palasoil, speleothems) that are often rich of pre-historical findings.

The Porto Infreschi bay can be surely considered as one of the most representative site for the richness of evidence in it preserved.

This bay is so called for the presence of some submarine springs which rend the sea water colder; the mixing between sea and fresh water allowed the formation of karst caves along the emergence of the basal water table of Mt. Bulgheria.

Upon sea level several fossil caves are also present, which testify the water table level variations directly connected with sea level fluctuations. Some of these caves present a characteristic horizontal morphology.

Besides these karstic morphologies, marine erosional and depositional features are also well represented all along the bay. Between 10 m and 3.5 m a.s.l. different paleo-sea level stands have been recognised. The bioerosive notches and wave-cut platforms located at 4.5m a.s.l and 3.5 m a.s.l. testify respectively the sea level stands during the isotopic substages 5a and 5c.

Real natural archives are proved to be two caves: Grotta degli Infreschi and Riparo degli Infreschi.

The first one represents a remnant of an ancient karstic phreatic level located along the western rim of the bay. Even if its small dimension it has preserved a very interesting sedimentary record of marine and continental deposits. In particular an evident bierosive notch about 8 m a.s.l. is well preserved. More over a wave-cut platform at 4.5 m a.s.l is covered by a Cladochora-bearing biocalcarenite which is clearly visible and it is possible to recognize the coral life structure.

The Riparo Infreschi cave represents a remain of an ancient coastal cave now destroyed by roof falls. Also in this case a well preserved record of marine and continental deposits is present. Mousterian lithic industries were found in the graviclastic breccias representing the youngest continental part of the succession. Below these breccias, marine sands and conglomerates alternating with speleothems have been found. The Th/U series dating of these flowstones allowed to constrain the different marine ingressions in the cave between isotopic substages 5a and 5c.

During the low stands of the isotopic stages 4 and 3 both caves clearly were abandoned by the sea and they became a safe refuge for the prehistoric man.

For the richness of the geomorphological and stratigraphical record, all the bay can be considered an important “geomorphosite” with a national importance, cause to its didactic and scientific value.
In an area of rich contrasts like Liguria, the Parco Regionale del Beigua, which was designated as a protected area by Italian regional law 16/1985 and covers 8,715 hectares astride the Provinces of Genoa and Savona, provides an exemplary cross-section of the region’s characteristics. It features some very different environments, often in a small area, including meadows and high altitude humid areas, thick forests of beech, oak and chestnut, steep crags and rocky outcrops, Maritime Pine woods and areas of Mediterranean vegetation. This mosaic of environments makes the Beigua mountain area one of the most rich in biodiversity in Liguria. 

The geological-geomorphological configuration of the Beigua nature park

The Beigua park area is also one of the most fascinating in Liguria in terms of geology and geomorphology. It is therefore of extreme interest in reconstructing the geological history of Italy and in particular in understanding the evolution of the Alpine mountain chain. There are three reasons for attributing a central role to geological and geomorphological factors in the interpretation of the landscape of Beigua Nature Park:

• the large area of ophiolites of Alpine metamorphic origin, representing a fragment of a Jurassic oceanic basin which rarely surfaces to this extent;
• the particular geomorphological characteristics of the park area, the product of past morphogenetic processes, make it unique in Liguria;
• the surface and underground hydrology of the massif, which includes the springs of some major rivers on both the Ligurian and Po Valley sides, is of vital importance both in terms of both the ecology and the provision of drinking water.

Identification and assessment of the geomorphological sites in Parco del Beigua: some examples

The wide-ranging scientific importance of the area required ad hoc preliminary studies during the preparation of the Protected Area Plan, drawn up pursuant to national and regional legislation (national law 394/1991 and regional law 12/1995).

The “sites of geological and geomorphological interest” identified were plotted on the geomorphological map and a special data sheet prepared for each of them.

Three clearly distinct areas in bands parallel to the coastline and watershed were also identified and mapped:

• the Tyrrenian side of the Beigua mountain complex features very steep gradients: its modelling can be traced back to the genesis of the Ligurian-Balearic basin, with characteristic regressive forms of erosion which are very well conserved and easily recognisable; the drained pattern, strongly conditioned by the tectonics as demonstrated by numerous rivers captures, presents features which cannot properly be termed young, but which are nevertheless significantly immature;
• the morphology of the ridge and high slopes on the Ligurian and Po Valley sides is not very steep (flat summits); modelling due to climatic changes (glaciations) is clearly evident and areas of great scientific (including biological) interest are frequent, such as small humid, marshy and peaty areas.
• the Po Valley side, on the contrary, has a gentle, articulated morphology: the valleys, with their floods (both historical and recent, as well as being terraced for the most part) and watercourses (in many cases with inherited meander shapes), have mature drainage pattern.
Of the sites of geomorphological interest surveyed, those identified and mapped in the central area along the ridge where periglacial processes are predominant, have proved to be of particular significance, giving rise to extremely interesting shapes and deposits. **Many bodies have been individualized (block field, block streams), of which two are object of a morphometric survey of detail**

The distribution of these features is mainly concentrated in the summit area and on the northern slope. The forms have been mapped, coded and stored in a GIS archive.

The block streams are located always along the valley floor while the block fields occur on not very steep slopes (10° -12°).

The block streams are characterized by the occurrence of lobes oriented both along the flow direction and transversal to this. Several concentric furrows and ridges typical of compressive flow occur in the frontal areas of the block fields.

The very coarse (always more than 60 cm of diameter) open-work texture of the block streams surface is characterised by blocks vertically dipping along the borders or with a dip of more than 30° in the opposite way to the flow direction.

To understand if periglacial conditions still remain in the area since January 2003 different dataloggers with thermistors placed at different depths are recorded hourly ground temperatures.
GEOTURISM AS OPPORTUNITY TO DEVELOP A NEW “NICHE MARKETING” IN TAORMINA AREA (MESSINA, ITALY)

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The ancient and famous town of Taormina in Sicily, situated along the Ionian Sea in the eastern side of the Peloritani Mountains, was built by the first Greek colonists on the rocky headland of Monte Tauro. The Taormina area attracts visitors from all over the world, thanks to its historical and cultural heritage together with its healthy climate and incomparable natural beauties.

Just on 2002 the overnight stays of tourists were 977,542 with an average of 604 Italian tourists and 2,074 foreign guests per day for a total of 2,678 tourists per day.

Considering the tourist flow in 2002, we can record an increment of presences, compared with 2001, in March of 4,774 units, in August of 1,852, in September of 6,500 and in October of 3,242; all that testimonies that there is a change in tourism strategies to associate with a rising attention of travellers for non-peak months.

In spite of its numerous events like international meetings and detailed cultural itineraries, that from Taormina lead to discover the old millenary Sicilian history, the study area includes a large variety of beautiful coastal resources, all dynamic and natural environments between aquatic and terrestrial systems, where continental and marine processes converge and interact carrying out to original physical, chemical and biological characteristics.

It is necessary to intensify and allow the fruition of these attractive natural corners through geotourism to discover what and how the morphogenetic processes act changing continuously the coastal landscape.

Therefore it was born the idea of a geomorphological itinerary starting from a panoramic viewpoint in the town of Taormina (205 m a.s.l.) to come back in the same site after a guided tour by boat along the coast, between the towns of Letojanni and Giardini-Naxos.

Several stops will be done on the way, one of these in the Bay of Isola Bella, a Natural Reserve, to allow a more accurate observation of selected geomorphosites and to explicate with illustrations and maps the formation of ancient and present mixed sandy-gravelly beaches, notches, caves and cliffs. Other interesting natural processes can be illustrated as the tectonic and seismic uplift, the relative sea level rise, the coastal erosion and sediment transport.

The aim of this research is that to promote the variety of coastal resources in the Taormina area, justifiable of the highest geoscientific knowledge, giving a basic knowledge to the less skilled tourist awakening in it, overcoming the common idea of a static and inactive nature, and giving to the most keen one, the chance to reach easily, with a guided tour, the most interesting coastal geomorphosites in the time of half a day.

This research aims also to consolidate and increase the geotourism as opportunity for the development of a new “niche marketing” in Taormina area, utilizing a period of lower tourist flow from October 1st to April 30th, making different geomorphological itineraries, starting from the town of Taormina and connecting all the most important geosites of the Eastern Sicily, between the Volcano Etna and the Aeolian islands.
THE CIRCUMNAVIGATION OF THE ISLAND OF LIPARI TO DISCOVER THE COASTAL GEOMORPHOSITES OF VOLCANIC ORIGIN (AEOLIAN ISLANDS, ITALY)

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Lipari is the largest island of the Aeolian archipelago and it is totally composed of volcanic rocks. During the Neolithic Age it was one of the rare sources of obsidian in the Mediterranean Sea and after it was also celebrated like Mediterranean emporium of kaolin and pumice.

It is crossed by numerous pathways through which can be reached, sometimes with difficulty, different places of the island, but it is more interesting to explore the extraordinary coastal scenery of Lipari by boat, circumnavigating the island to the discovery of its volcanic coastal geomorphosites.

The aim of this geological itinerary is that to explain to the many visitors and tourist groups, every year visiting the Aeolian Islands, such as the input of energy into a coastal system via waves constitutes one of the main forces driving coastal processes and as the coast-forming volcanic materials of Lipari act in response to wave erosion. So, wave-dominated sandy-gravelly beaches and a large variety of cliffs, very dynamic and sensitive coastal systems, often susceptible to interference from human activity, are easily visible along the coast.

From a geological and volcanic view-point, the island of Lipari, similar to the island of Stromboli, is the emerged part of a vast volcanic apparatus, starting from the sea floor at about -1,000 meters.

The geological evolution of Lipari, even if complex, can be synthesized in two phases of different volcanic activities, separated by a long period of quiescence (about 45,000 years) indicated by an evident subaerial and marine erosional surfaces.

The volcanic activity of the first period (Paleolipari) starts with emission of products with basaltic-andesite composition about 230,000 years BP. Instead, the volcanic activity post-erosional begins again (about 42,000 years BP) with very different eruptive styles and magma composition as testified by the emission of evolved magmatic products (rhyolite and obsidian lava-flows) and large amounts of pyroclastics (pumice deposits). The last volcanic activity in Lipari, starting about 16,800 years BP and located in the northeastern sector, was surely important and substantial for the emission of pumiceous pyroclastic deposits in Monte Pilato and exceptional obsidianaceous and rhyolitic lava-flow in Rocche Rosse.

The complete voyage around the island of Lipari, including the stops under the coast and on the beach to observe or reach the most important coastal geomorphosites, needs about 9 hours.

Therefore, circumnavigating anticlockwise the island can be illustrated the following coastal geomorphosites of volcanic origin:

- the famous and large Castello, built on a rhyolitic lava dome strongly eroded;
- the long beach of volcanic pebbles and black sands in Canneto;
- the Porticello beach, characterized by the interaction of berms with dark volcanic gravels and pebbles and bright roundish pebbles of pumice;
- the enormous open-cast mine of pumice in Campo Bianco with long jetties on the coast, used to discharge the extracted mineral on the ships from eastern side of Monte Pilato;
- the rhyolitic obsidianaceous lava flow of Monte Pilato (about 580 years BP) in the northernmost sector of Lipari, showing highly spectacular convoluted flow foliation structures, well visible along the coast between Porticello and Acquacalda;
- the coastal zone between Lo Inzolfa and Cala Sciabeca, in the western side of Lipari, where there are evidences of Late-Quaternary raised shorelines and marine terraces;
- the southernmost sector of Lipari with the long and high cliffs of Scogliera Sotto il Monte, the beautiful stacks of Pietralunga and Pietra Menalda and the sea-cave of Grotta degli Angeli.
Different starting conditions (active and passive factors) define the various landforms in Umbrian territory. Furthermore in Umbria many lithotypes outcrop, as limestone, sandstones, volcanic bedrock and fluvial-lacustrine sediments, all involved in different tectonic styles. A first inventory of umbrian geomorphosites is reported in -Workshop "Geomorphological Sites": Modena 2002- Proceedings. With the aim to promote the knowledge, the protection and the valuing of the umbrian geomorphosites a more careful research was made. In this paper different characteristics are reported both to compile the Italian Geological Survey computerized data base of geosites and to increase the number of umbrian geomorphosites and their characteristics with the aim to describe the potential economic, teaching, scientific, tourist and natural consequences. For each geosites the main geological research was accompanied by a large number of informations from various disciplines. A better understanding of the mechanics and statistics of the geological and geomorphological processes involved, addedd to the increasing available attention to the cultural heritage, in particular has facilitated the individuation of the degree of hazard and the ex-post recovery and fruition activities. Finally with a careful inventory of geosites in umbrian territory different tourist itineraries was made. For each itinerary all characteristics are reported to link scientific interests to historic-artistic and eno-gastronomical tours.
Actually G.I.S. (Geographical Information Systems) are used in geomorphosites research to select and identify automatically landforms with an high scientific or cultural value. In this paper we propose an example of using GIS for tourist request as regards to geomorphosites presence on the territory. Some attributes (scientific, cultural and social economic) well known in literature, identify geomorphosites. Generally one could prevails over the other two and it could becomes the most important for geomorphosite characterisation.

Nowadays naturalistic itineraries, for particular tourist groups, request geosites and geomorphosites as an important attraction. Anyway tourist request may be turned mostly towards one of the three attributes characterising a geomorphosite. Different interests could be focused to main cultural and artistic characteristics (i.e. medieval centres builded on or near particular landforms), instead of scientific attributes (rare landforms or morphogenetic processes). Furthermore the socio-economic aspect could be the predominant one (i.e. eno-gastronomic itineraries or local craftsmanship).

To this end the studied geomorphosites are focused in the Umbria Region where the three attributes are presents in different ways in each one. The opportunity to infer a specific range of values (from one to three/ null to high) for each attributes related to the geo-database allows to build queries. These last mentioned are used to divide geomorphosites in peculiar features selected by attributes to solve different requests linked to tourist expectations. Different tools, specific of GIS, allow to join the selected geomorphosites to roads network present inside the project as a specific layer.
The Cilento – Vallo di Diano National Park, located in the southern part of the Campania region, preserves a geological heritage characterized by a high degree of diversity: it encloses coastal and mountain areas made up both by mesozoic carbonate successions and miocene clastic successions that give rise to a landscape alternating between steep mountainous districts and hilly areas.

In this note a preliminary selection and inventory of the geosites of the Cilento-Vallo di Diano national Park is proposed.

On the basis of literature analysis and personal knowledge more than one hundred sites have been selected and mapped using a geographic information system. Different categories of geosites have been distinguished (stratigraphical, paleoenvironmental, paleobiological, structural, geomorphological, hydrogeological) according to the scheme proposed for the global site inventory of geosites.

Among them geomorphosites are widely represented. The Alburni massif karstic area for example can be considered an important model to explain the origin and evolution of phreatic caves (Pertosa and Castelcivita tourist caves) together with that of ponors like Fumo and Vitelli caves.

The deep gorges of Sammaro creek and Calore river are other examples of geomorphosites in which the scientific and didactic values are associated with a high scenic impact. Remaining in the internal areas the morphostructures of M. Vesole and M. Chianiello represent a good example of monoclinal structures with well preserved “flat irons” along the dipping slope.

Along the coastal sector the most important geomorphosites are represented by marine terraces (Camerota, Palinuro, Licosa capes) fossil dunes and coastal caves, a lot of which preserve also important geoarchaeological records.

The geosites inventory has been produced using a relational database management system. Each site has been catalogued by means of a card containing the following information:

- General location data (UTM coordinates, province, IGM cartography)
- Site category (geomorphological, stratigraphical etc)
- Description of the main value
- State of preservation
- Referring maps
- Illustration

This work can represent a first step for the knowledge and the appraisal of the geological heritage of this wide territory.
THE MAP OF THE GEOMORPHOSITES OF GEOLOGIC INTEREST FROM BIHOR COUNTY (WESTERN ROMANIA).

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Bihor county is located in the western part of Romania, composed by the major densities of geosites in Romania.

The protected areas of geological interest in Bihor county are about 1200 ha. The geomorphological resources delimited in Bihor county, through its geological, geomorphological, or geoeconomic importance can be framed in in the act of its selection and conservation for the future.

The landmarks on the map, were selected taking into account the Law 5/6 March 2000 about the national territorial planning-section protected areas. The natural or built protected areas delimited from geographical or topographical point of view, which contain the natural or cultural heritage are declared as such for the accomplishment of the particular objectives and the heritage preservation.

The digitalising of the collected data was made using GIS ArcView methodology, accompanied by a data base which can be consulted according to the interest points. The data base created and organised by sheets can offer a lot of information about: the selection and location of the geosites at the regional level, description and assessment, images of geomorphosites in the landscape context, bibliographical indications, citations in the literature. The conceptual structure of the map offers a temporal dynamics with the possible integration of the other geosites, with the renewal and improvement of the information.
THE ERRATIC BLOCKS OF THE «TRIANGOLO LARIANO» (PREALPS OF LOMBARDY)

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The Alps and Prealps of Lombardy, affected by a repeated succession of glaciations during all the Quaternary times, show to the visitors also the picture of a noteworthy quantity of erratic blocks carried away by the great glacial currents and then deposited when they retreated.

Today, into all the alpine region, such evidence of the past glacial activity includes several thousands of erratic blocks with various form and dimension, and on the Lombard side of the Alps there are surely some hundreds of erratic blocks, even if a complete census of them has not been made yet.

In particular an area of Lombardy very rich of erratic blocks is the so called “triangolo lariano” (that is the triangle of the lake Larius, the ancient name of the lake of Como), a group of mountains (culminating at the 1686 m of Mount San Primo and divided by the upper valley of the river Lambro) situated between the two south branches of the lake of Como and bordered southward by the morainic hills of the Brianza region.

On the whole, into the “triangolo lariano” there are nearly half a hundred of erratic blocks, among them we can remember some of the most famous, as the so called Sasso di Pregùda, celebrated in a little poem by the abbey Antonio Stoppani, an authoritative geologist of the XIX century.

In the present work the most significant and typical erratic blocks of the “triangolo lariano” (their lithology, geographic origin, etc.) are illustrated, together with a descriptive and valuation card, followed by the suggestion of a visit-itinerary.
Our study of the geotops in the Canton of Valais was carried out according to the request of the “Service des Forêts et du Paysage” (Forestry and Landscape Service) of the canton and who wished to determine the value of its geological and geomorphological heritage. What kinds of geotops are found in the canton? At this first stage of the study, the objective is to establish a general picture of the situation detailing the threatening factors rather than determining the value of the geotops directly. The long term goal is to produce an inventory in order for the natural, scientific and heritage values of the geotops in the Valais as well as their value in terms of landscapes to be recognised and for exceptional features to finally be protected.

We believe that if we want to put an efficient geotop protection in place, it is very important to step out of the framework of strictly academic research and begin by becoming more attentive to the needs of the decision-makers. As our study is requested by the public environmental body, the results must be orientated towards practical application with the objectives clearly defined and the costs mastered. While carrying out this project, we observed that the decision-makers and administrators of environment and landscape protection had difficulty in defining what kind of geotop deserves protection due to the notion of geotops being particularly vague. Indeed, we could say that the entire canton of Valais is a geotop worthy of protection due to the geological and geomorphological heritage this prestigious alpine region presents. This heritage is extremely varied and imposing, however another factor would be the importance this region has in terms of the Earth's history and that of the Alps. This option is of course absurd as it is impossible to put into place and impractical in terms of nature protection and land planning.

We have therefore chosen a restrictive definition of geotops, which considers the geotops as geological and geomorphological objects, which present an impressive scientific value for the understanding of the Earth's history, living creatures and the climate. According to this perspective, the evaluation and selection of the geotops can only be carried out on the basis of their intrinsic scientific value. A larger definition considering all geological or geomorphological objects presenting a scientific, cultural, historical, aesthetic or socio-economical value would be in our minds impractical. Indeed, the economic cost of the project would be too large. To survey such a diverse range would lead to confusion for the decision makers who would then lose sight of the intended objective, which is to identify the geological and geomorphological values that must be protected and managed on a given territory.

We hope that this survey project will be carried out efficiently and that the decision-makers will remain motivated. The second phase of this study consists in choosing one or several methods for evaluating geotops. The most important criterion we will consider in the selection of the evaluation method will be the simplicity of utilisation so that we will be able to propose an inexpensive study method. This criterion is the most determinant factor for the decision-makers. Therefore we depend especially on the current academic research for evaluation methods which are easily put into place and directly applicable for a natural alpine space such as the Valais.
The aim of this study is to produce a set of techniques (or 'tools') that may be used to identify and discriminate between different surface forms. The form of surface model used for this study is that of the Digital Elevation Model (DEM), while information extraction from 2-dimensional raster representations of reflectance surfaces is used to characterise lithological and morphostructural units. A geomorphological landscape can be appreciated in terms of its measurable surface form (geomorphometric), the materials that make up the surface and sub-surface (material), and the processes that give rise to the geomorphometric and material characteristics (process). Of course, it should be recognised that a substantial part of geomorphological research has been devoted to relating these three elements together.

During this work it has been recognised that many of the tasks confronted by the image processing community have similarities with those facing geomorphometry. The study area is in Shoa Region (Central Ethiopia), 250 km west from Addis Ababa. The Caldera Complex of Wonchi-Dondi is located out of the main Ethipoian Rift. The well-known Ambo Fault System was only marginally at the origin of the volcanoes, aligned on 60°E direction. The geological setting is composed by basalts of Trap series magmatic cycle and by trachytic acid volcanics of Aden Volcanic series. The Holocenic and Pleistocenic volcanic activities, some of which are really recent, are connected to the deposition of pyroclastic materials, dioritic lavas and the genesis of Wonchi and Dondi calderas.

The interpretation keys applied on satellite data were been used studying the drainage network and spectral response to extract features about structural settings and to analyse the different phases of the morpho-evolution of the relief. Digital elevation model was built from digitalisation of topographic maps at the scale 1: 50,000 and the interpolation method created a grid with 30 metres of resolution.

The geomorphological characterisation proposed in this work classify the area in two broad systems: the basement morphostructural units and the recent volcanics morpho-units.
The Ministero dell’Ambiente has financed a programme oriented to the assessment and census of submerged geomorphosite included in the Marine Protected Area of Capo Carbonara (Cagliari, Italy), in order to plan strategies of protection and tourism improvement. The programme starts off with a census of “morphosculptures” of pericoastal granites, erosive forms which characterize shallow water, where some snorkeling can be made. These coastal areas are extremely indented; it’s possible to follow, along the shore lines, abrasion troughs and channels deeply engraved along the main joint. The summit zone of the faces is marked by basic dikes eroded by differential erosion. Quadrangular blocks are cut off from the net of fractures.

In this area, the bioconstructive function is done both by vegetables, red-calcareous seaweeds and by animals, vermetidi, gastropoda. It’s also possible to point out coastal bioconstructions with *lithophillum lichenoides* in shape of small terraces (encorbellement), in association with other red-seaweeds.

In the bathimetrical zone included between 5 and 15 m., it’s possible to see a lot of “tafoni”: subaerial relict forms, which evolution is due to a processes of exogenous alteration, provoked by complex actions; over the vaults it’s possible to touch an harsh surface with quartz-crystall highlighted by alteration. The morphogenetic key-factors are a sharp structural control which, according to particularly important lines of discontinuity, is mixed with an exposure to a greatly high wave energy. In the intertidal zone some mechanical and alolastic erosions take place; among the macroforms are noticeable some trench of tidal notch, while among the microforms, made by means of the tipical alteration of crystalline lithotypes, some alveolus and “microtafonature” hold sway. In the shallow erosion shelves is dominant the form of pothole erosion.

It has been selected some phisiographic fields particularly meaningful under the follow outlines: *Model of Geomorphological evolution* (big residual forms of granites as iselberg and tor; beach-rocks etc.), *Object used for educational purposes* (cliffs of fault; mega-sedimentary structures, sand-waves and hydraulic dunes), *Paleogeomorphological example* (deposits of paleo-lagoon paleo-slip plane and paleo dunes), *Naturalistic rarity-geo-diversity index* (flooded “tafoni”, residual granites needles), *Ecological support* (growth of bioconenosis in sponges and coelenterates in sub-vertical walls and “tafoni”; concentration of big den fishes in isolated remains, etc.)

From the analysis of geomorphological dynamic, and expecially from the interactions amongst underlying biocenosis and physical active processes, some fields have been shown for their high sensitivity and vulnerability, mostly identified in flooded beaches and in meadowland of marine fanerogane.

The damages which depend on communities at coelenterata are more frequent in zones mostly frequented by scuba divers, direct mechanical deterioration (pushes of pinna or removal) and consequently death of colonies because of air bubbles trapped into the vault of the cavity. Moreover, is to be pointed out the remarkable fragility of some forms and microforms of granites as regards to impacts, as well of modest entity, which are due to the anchorage of little boats and to scuba divers’ pinna too.

Similar situations of sensitivity have just been produced in protected Marine Areas in the Mediterranean Sea (Spain, French, Greece), where the exponentional increase of turistic fruition of
flooded fields have been fed processes of decay (RIBERA SIGUAN, 1992) which, sometimes, have led to the whole deterioration of the “Environmental resources”.

The arrangement of practises for a controlled fruition (in the anchorage of crafts, in the modality and instruments for immersion, in the number of visitors, etc), could consequently estimate with the greatest attention the arguable levels of “carrying capacity”.
GEODIVERSITY AND GEOSITES: THE VALUE OF “LOCUS”

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In western culture there always seems to have been an inherent difficulty in acknowledging that diversity (whether it be geodiversity or biodiversity) is a distinctive manifestation of Nature. This is why a mentality has developed which tends towards standardisation, obstinately substituting homogeneity for heterogeneity. In the twentieth century, particularly during the last few decades, there has been a reversal of this tendency which has given rise to the idea of a whole new multicultural world, because “the world is diverse and is interpreted diversely in every corner of the Earth” (Kapuscinski, 2003).

Today there is an awareness of new needs which, paradoxically, are among the most natural and primordial: air, sun, landscape, silence, the pleasure of feeling: the locus and consequently geodiversity become symbolic in their topological identity, embodying also what cannot be seen but can be felt intuitively: so the visible lives also through the invisible.
Since a couple of years, the Italian Speleological Society (SSI) is carrying out a project for the realisation of a national inventory of Hypogean Natural Geosites (Geositi Ipogei Naturali = GIN). A GIN can be defined as "every subterranean natural void that represents exceptional naturalistic and/or cultural value, in the widest sense, in at least one of the following features: its intrinsic environmental characteristics, its geological, geomorphological or hydrogeological context, its morphodynamic significance, its content of hypogean landscape elements or significant materials that allow palaeo-environmental reconstructions or, finally, for the use Man has made of it in time". The exceptionality mostly regards the scientific interest of the already performed or potential researches (global, European, national, regional or local importance of the acquired or acquirable information), the historical and cultural interest and elements such as beauty, dimension, rarity, representativity and didactic or cultural interest.

As a GIN, entire cave complexes, single caves or single passages of caves can be chosen. Five types of GIN have been identified.

GIN for the intrinsic characteristics of the cave (GINCI): concerns particularly well preserved parts of caves and their morphologies (erosion and corrosion forms), but also caves derived from particular speleogenetic processes (e.g. hyperkarst caves) or formed in special types of rock (e.g. gypsum caves).

GIN for the interest of the hosting karst area (GINAC): in this type caves with no special interest but representing important karst areas can be inserted.

GIN for the nature of the outcropping rocks (GINRA): regroups caves that allow a better understanding of petrography, mineralogy, tectonics, stratigraphy or palaeontlogy of the area.

GIN for the material contained in them (GINMC): concerns caves with scientifically important sediments, speleothems, evidences of paleo-seismicity, paleo-environmental indicators, archaeological or palaeontological deposits.

GIN for the importance in Man’s history (GINAN): contains caves used by Man in prehistory, but also the ones used more recently as places of cult, or caves important for the development of the speleological and karst studies.

For all these types of GIN, that also can coexist in the same site, the exceptional conditions of the phenomena have to be maintained, having different scales ranging from local up to global importance. A first list of Italian GIN has been compiled by a Working Group that has been instituted by the Italian Speleological Society, composed of the Regional Responsibles of the Cave Registers and several experts. For every Italian region no more than 1% of the total amount of natural caves has been identified as GIN.

In this paper a preliminary overview of the Italian GIN is given, reporting their names, distribution, type and importance. This provisional list already shows the exceptionality of the Italian hypogean heritage on a European and global scale and these results encourage the Working Group to continue this research that aims for a better understanding and a growth of public awareness of this incredible speleological heritage.
PROPOSAL FOR ASSESSING THE TOURIST VALUE AND THE KIND OF EXPLOITATION OF GEOSITES IN A TOURIST AND RECREATIVE CONTEXT

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According to Panizza and Piacente (1993), geosites are defined by four different values: scenic/aesthetic, scientific, cultural/historical, and social/economic ones. In a tourist and recreative context, it may be useful to have tools to quantify and to qualify all these values and their use in order to understand and, if necessary, to correct the exploitation of geosites. In this way, our poster presents two linked methods of assessment.

The first method tries to assess the tourist value, which may be a balanced addition of the four different values. Thus, some criteria have been defined for each constitutive value. For instance, the scenic value is considered in relation to the criteria of area, elevation, view points number, average distance to view points, «site-surroundings» position and contrast. Concerning the economic value, accessibility, number of inhabitants, natural risks, property rights and institutional level of protection have been taken into account.

The second method tends to assess the kind of exploitation, which depends on the use of the tourist value and its constitutive values, understood in terms of degree and modality. In fact, these concepts allow to precise the notions of intensive and extensive exploitation. Thus, the degree is defined as a space and time concentration and involves the following criteria: number of infrastructures, used area, daily and seasonal occupancy. The modality, defined as the use of two contrary and main poles of values (scenic and economic use against scientific and cultural use), considers these dichotomous criteria: didactic use of scientific and cultural values, business use of scenic and economic values.

In an Earth sciences point of view, a sustainable exploitation has to find a balance between the preservation and the use of the economic value and the safeguard and the use of the scientific value, respectively in order to protect visitors against geosites related risks (for instance, by direct protection measures as marking, ducting of tourists and/or access restrictions) and geosites against visitors impacts (for instance, by indirect protection measures as implementation of view points, didactic information and/or absence of fixture/advertising).

Thus, the interest and the aim of these two methods are, on the one hand, to allow to propose a comparison of the tourist value of different geosites and categories of geosites (see Pralong & Reynard, submitted), and on the other hand, to compare the tourist value and its constitutive values with their exploitation in a tourist and recreative context. This second comparison allows to underline factors of explanation (public policy, regulation system, kind of offer, actors behaviour, etc.), when the scores of the tourist value and the exploitation are different.

Pratically, these two methods of assessment have been developed, tested and applied in the areas of Sierre-Crans-Montana (Valais, Switzerland) and Chamonix-Mont-Blanc (Haute-Savoie, France), in relation to some glacial (Mer de Glace and Bossons glacier) and karstic (underground lake of St-Léonard and cave of Vaas) case studies.
GEOMORPHOLOGIC ITINERARIES IN THE GEOMORPHOSITE OF MONTI DEL FURLO (NORTHERN MARCHE APENNINES)

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The anticline mountains of Pietralata-Paganuccio mountains (here called “Monti del Furlo”, according to a local denomination) are primarily well-known for housing the famous Furlo Gorge. This striking landform is deeply cut by Candigliano River (Metauro River basin) across the Jurassic-Paleogene calcareous and marly-calcareous formations of the autochthon Umbria-Marche succession and, similarly to many others in the Umbria-Marche Apennines, cross-cuts an anticline mountain ridge. The comprehension of such a river strikingly bypassing an important topographic barrier proves to be a matter of the utmost importance for both scientific and educational purposes, in order to enlighten the evolution history of the territory. The Furlo Gorge together with the Frasassi one (which is famous for its amazing caves above all), is certainly one of the best examples of such kinds of Apennine landforms. Moreover, it is of a significant naturalistic (e.g. occurrence of floristic and faunal peculiarities), landscape (e.g. the gorge itself and many associated landforms) and historical/archaeological (e.g. the Roman Via Flaminia remnants) relevance as well. These very essentials of both the Furlo Gorge and its vicinity have recently made this area become a National Natural Reserve (Riserva Naturale Statale della Gola del Furlo), thereby arousing a renewed, significant interest of both national and international communities. In the framework of the MIUR co-financed project “The geosites of the Italian landscape: research, evaluation and enhancement” the Urbino Research Group, taking its cue from such basics, besides adopting the Furlo Gorge and its neighbour areas both as a main geomorphosite as a whole and as a sample-area for a targeted geomorphologic mapping, has made for this area some tour-itineraries of geomorphologic significance. The proposed routes allow for a close view of groups of peculiar landforms such as the sheer cliffs of the gorge, the series of flatirons on the anticline flanks, fault scarps and “walls”, fluvial terraces and terraced alluvial fans. Moreover, the itineraries have been framed in order to highlight the geomorphologic arrangement of the Furlo Gorge area from both a scientific and an educational standpoint, as well as to accustom visitors to the geomorphologic evolution basics of this sector of the Marche Apennines.
The present work suggests an example of environment planning in a middle western Sardinian area, destined to become a natural park, where goods and resources of geologic and geomorphologic interests have developed a meaningful role not only in the definition of a knowledge linked to the singleness of this area, but even in the spotting of forms and means of management and fruition. It has been pointed out how, in the “construction” of landscape, geosites can be considered so with regard to the typicalness of field, as to the scientific/cultural, stage and economic worth. These aspects are being faced up also from a methodological point of view in order to underline that the G.I.S. applied thematic-cartography can help to outline some aims concerning environmental operation and integrated improvement of natural resources, besides, to underline the rule of geological-geomorphological knowledge in the formulation of projects of plan based on a reticular consideration among field with a different territorial valency and local cultural sistems, from a new way of raising of economic activities just based/based indeed on a fusion between resources and economy.
GEOMORPHOLOGY AND LANDSCAPE ANALYSIS OF THE NATURAL PROTECTED AREA OF EBRO AND RUDRÓN CANYONS (CASTILLA Y LEÓN, SPAIN)

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The studied area is located in the South side of Cantabrian Range, at North of Spain. It is a folded relief formed in the Cretaceous sedimentary cover, with wide synclines built by limestone and marls. On the folded relief the Ebro River has cut through the bedrock and syncline platforms to shape the deep canyons and gorges and a karstic landscape. The climate is transitional between the Atlantic and Mediterranean conditions. The whole Natural Protected Area of Ebro and Rudrón canyons had suffered a strong human use and natural changes induced by Man, building a rural landscape characterised by the plain and terraces field, and the intense woodlands use (holm-oak woods, beechwoods and oakwoods), related to topographic, geomorphologic, ecological and anthropic factors. The traditional farming system has played an important role in the transformation of landscape, with new geomorphologic and hydrologic dynamic of slopes and catchments. Today, the traditional farming system has been partially abandoned and for thirty years the study area has supported a strong depopulate and damage on rural structures, with abandoned field and woodland, afforestation and land use changes. The territory is becoming to a natural and touristic area (hiking, hunting, speleology, thermal and health resorts) with village and building reoccupied and renewed.

The methodology is based on geomorphologic map at different scales.
- A general map, 1/25.000 scale, to know shapes, landforms systems and landscape evolution.
- We have inventoried and classified all geomorphologic sites and we have made a fill, a detailed geomorphologic map, and a assessment of each site. The fill and assessment include different fields: identification, classification, assessment, associations with other elements, impacts, potentiality, management, legal regime and property, and fragility. In this work we have selected, classified and assessment eight geomorphologic sites of different sizes. Ebro Canyon, Rudrón Canyon and Valdelateja cut-off entrenched meander, Rudrón spring karstic system, Tubilla del Agua tufa complex, Pozo Azul upwelling spring, Orbaneja del Castillo Tufa and Valdelateja-Ebro tufa complex. The first ones have an important landscape role, but the second ones have a concrete role on hydrographic system and local landscape.
- We have made a geomorphological units map that, joint to the vegetation, phisiographic and land uses let us stablish the landscape units of Natural Protected Areas. In this work we have selected five geomorphologic units: 1. Ebro and Valdelateja Canyons. 2. Rudrón Gorge. 3. High surfaces on perched syncline. 4. Structural crests and palaeovalleys. 5. Perched syncline. The assessment of each geomorphologic unit includes an inventory of elements, a fill and a detailed map. The inventory of elements is composed by all elements of geosystem: geomorphology inheritances, morphogenic system, number of elements and agents, processes, total number of landforms, and the size and roughness of the unit. The fill includes the most important features to define the unit: Morphostructures, bedrock, landforms, dynamic, vegetation, singular elements, management, past human and cultural features, natural fragility, today land uses and cultural values, affections and unit vulnerability.

The objective of this work is to show the first part of a landscape analysis to incorporate and improvement the geomorphologic analysis in landscape studies of natural protected areas. We are trying to include the geodiversity in the assessment of landscape units and the geomorphology in areas with a great importance of geomorphologic values and human land uses on landscape.