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# GEOMORPHOSITES IN TRENTINO: A FIRST CENSUS

**Marco Avanzini[1], Alberto Carton[2], Roberto Seppi[1,2] & Riccardo Tomasoni[1]**
[1]Museo Tridentino di Scienze Naturali, Via Calepina 14, I - 38100 Trento.
[2]Dipartimento di Scienze della Terra, Università di Pavia, Via Ferrata 1, I - 27100 Pavia; email: carton@unipv.it

ABSTRACT: M. Avanzini *et al*., *Geomorphosites in Trentino: a first census*. (IT ISSN 0394-3356, 2005).
In the research project co-financed by MIUR COFIN 2001 "Geosites in the Italian landscape: research, evaluation and exploitation", a first census was made of the geomorphosites in Trentino. The identification criteria were those already well established at a national and international level. A total of 110 sites of geomorphological interest were identified throughout the region. These are all parts of the main structural units, which characterise the Trentino region from a geological point of view, and include the most important Quaternary deposits. The reasons for their choice and possibilities of exploitation are discussed. The geomorphosites identified are briefly described in a summary list. This list includes not only the muncipality location, but also the reason for the choice of the site. Also indicated are sites or naturalistic itineraries already existing in the region or mentioned in explanatory guides or brochures. Finally, there is a complete description of a geomorphosite, as an example of the content of the final monography on the geomorphosites of Trentino, currently in progress.

*RIASSUNTO: M. Avanzini* et al., Geomorfositi in Trentino: un primo censimento*. (IT ISSN 0394-3356, 2005).*
*Nell'ambito del programma di ricerca co-finanziato dal MIUR COFIN 2001 dal titolo "Geositi nel paesaggio italiano: ricerca, valutazione e valorizzazione", è stato effettuato un primo censimento dei geomorfositi del Trentino. I criteri di identificazione sono quelli utilizzati già da tempo in campo nazionale ed internazionale. Sono stati individuati 110 siti di interesse geomorfologico distribuiti su tutto il territorio regionale e scolpiti nelle principali unità strutturali, che caratterizzano dal punto di vista geologico la regione trentina, e sui più significativi depositi quaternari. Vengono discussi i motivi delle scelte e le possibilità di fruizione che offre la regione. I geomorfositi individuati sono brevemente descritti in un elenco riassuntivo, nel quale oltre all'indicazione del comune di appartenenza, appare anche il motivo della scelta. Sono indicati anche siti o itinerari naturalistici già realizzati sul territorio o segnalati da guide o brochure esplicative. Infine viene riportata una descrizione completa di un geomorfosito, come esempio di quanto verrà effettuato nella monografia finale sui geomorfositi del Trentino, attualmente in fase di allestimento.*

Keywords: Geomorphosites, Census, Trentino.

*Parole chiave: Geomorfositi, Censimento, Trentino.*

## 1 INTRODUCTION

The landscape is a complex combination of landforms that we observe from day to day, forms for which we have probably never considered in terms of their origins or differences. Some of these features instinctively attract our attention, like a gorge for instance, or an earth pillar. Others instead, are less striking but when appropriately explained they open up infinite chapters in the history of the earth, which would be difficult to imagine otherwise. These are the forms of the geosphere which, due to some particular characteristic[1] are classified as "geomorphosites" (Panizza, 2001). They represent elements of the landscape worth being singled out and safeguarded because they are natural resources. They also represent important evidence of the history of the earth and enable us to understand the evolution of the landscape.

Geomorphosites are part of the larger category of geosites known as geotopes, already object of the European scientific community's[2] initiatives since 1988 to promote their conservation. In 1995 Pro Geo started the compilation of a list of European geosites. Towards the end of the same year the IUGS (International Union of Geological Sciences) set up the project "Geosites", with the aim of producing an up-to-date inventory of world geosites, some of which today are UNESCO cultural heritage sites. On the basis of these experiences, various research projects have been started in the EU member states. In Italy universities, research centres, regional governments, local municipalities and scientific institutions have activated, in diverse ways, initiatives aimed at familarisation, precise census and exploitation of geological features (D'Andrea & Di Leginio, 2002). Currently the National Geological Service manages the project "Conservation of the Italian Geological Heritage", a census of sites of national interest.

In this same context we also have the COFIN 2001 research programme, co-financed by MIUR (Italian Ministry of Education, University and Research), entitled "Geosites in the Italian landscape: research, evaluation and exploitation", which involves five universities (Panizza & Piacente, 2002). This research is aimed at the comparative study of some Italian areas in order to identify geological features with specific reference to geomorphological phenomena. In particular, this national project proposes techniques for surveying, selection, cataloguing and evaluation of features. Finally, it also proposes the planning of itineraries pro-

[1]The attributes that can give value to a landform are of a scientific, cultural, socio-economic and scenic type (Panizza & Piacente, 1989).
[2]The first European association for the promotion of geoconservation was the European Working Group for Earth Science Conservation which in 1993 became Pro Geo (European Association for the Conservation of the Geological Heritage).

moting the knowledge, protection and exploitation of some selected sites. It is within this initiative that the first census of geosites of geomorphological interest in Trentino has been carried out. The project of the research unit which operated in the Trentino region, coordinated by the University of Pavia, is in collaboration with the Museo Tridentino di Scienze Naturali (Trento Museum of Natural Sciences), which also co-financed the project. Various groups are involved, including personnel of the Dept. of Earth Sciences of the University of Pavia, who have already been working in the region, researchers of the Museo Tridentino di Scienze Naturali and officials of the Geological Service of the Autonomous Province of Trento. This combined organisational effort has ensured the maximum efficiency in identifying and selecting the geomorphosites of the area, using to the full its experience of the territory previously acquired for institutional and scientific reasons.

The experience gained has shown that a correct choice of geosites, free from personal choice and in line with the well established international criteria, can only be made by those possessing a global knowledge of the regional reality, above all as regards those aspects related to the degree of interest of the site.

As regards the philosophy and motivations that govern the identification of a geosite and in particular a geomorphosite, we can refer to the complete specific bibliography which contains some monographies on the topic published for important scientific meetings (Various Authors, 1999; Poli, 1999a; Various Authors, 1999b; Various Authors, 2002; Piacente & Poli, 2003).

## 2. GEOLOGICAL REALITY OF THE TRENTINO REGION

The landforms belonging to a landscape can be more or less "active" or "significative" depending on the structural characteristics of the region and on the type and age of the phenomena of endogenous and esogenous dynamics. The Trentino region from this point of view offers spectacular scenery. It is located wholly within a region of recent orogenesis, and therefore of high relief energy, characterised by sedimentary, eruptive and metamorphic rocks. In some cases, as for example in the Dolomites, where there are frequent heterotopies of facies, sedimentary and volcanic rocks lie in stratigraphic relationships such as to create landscapes which are unique in the world. Furthermore, a great deal of recent modelling belongs to a the natural process which, in a relatively brief geological time, has effected the whole region and has left profound and clear signs on the landscape: glaciation.

The relief complex of the Trentino region, whose rocks belong mainly to the structural unit of the Southern Alps (Subalpine) and partly to the Austrian Alps (Austro-alpine), is cut through by large valley depressions, some of which are clearly tectonic in origin. Among the most evident, in western Trentino the Sole, Giudicarie, Rendena and Meledrio valleys separate the Austroalpine block from the Southern Alps and the Adamello batholith. In the south-eastern sector the Valsugana separates the Permian Tertiary cover in the south from the crystalline basement, vulcanites and Permian granitoids in the north. The wide incision of the Adige river shows clear traces of glacial and fluvial morphogenesis, with extensive sectors filled with alluvial materials, and it geographically separates the so-called eastern Trentino from western Trentino.

These natural subdivisions identify zones with particular characteristics, especially regarding the modelling of the landscape. These sections are controlled by the structure and mechanical behaviour of the substrates being incised. It is in these areas that the geomorphosites are located. They are expressions of metamophic and tonalitic substrates (Ortles-Cevedale massif, Adamello batholith), vulcanitic and granitoid substrates, (Lagorai and Cima d'Asta massifs) and volcanic and carbonatic substrates (Brenta Group, middle and low Adige Valley, Valsugana and Dolomites) (Fig. 1). The Dolomites, where the sedimentary rocks form summit plateaux or hollows, or where alternation between competent and incompetent basin beds exist side by side with Middle-triassic vulcanites, give the most spectacular and characteristic geomorphosites[3], such as the karst scenery of the Brenta Group or the morphoselective landforms of the Dolomitic groups.

On all these substrates glacial modelling has indistinctly left its imprint in the shape of erosional and depositional landforms. Some of these features are still well preserved and worth counting as geomorphosites in terms of paleogeographical evidence or models of geomorphological evolution, like the moraines of the La Mare Glacier. Lastly, on the rocky substrates and Quaternary coverings the many water courses, through their modelling action, have left clear impressions of a series of spectacular and rare landforms such as the potholes, natural bridges and earth pillars.

In the space of 6207 $Km^2$, through the evidence of its geotopes, the Trentino region can therefore narrate a story of little less than three hundred million years and show us in greater detail, by means of its geomorphosites, the most recent events of the Quaternary period. The perfection with which many landforms have been shaped by nature, their fine state of conservation and the spectacular nature of many geological sections enable us to relive great alluvional plains, carbonatic platforms, cliffs, lagoons, ocean floors and intrusive and effusive volcanic events. In this way most of the Trentino geotopes are fully qualified cases for didactic exemplification and paleogeographical evidence in general.

## 3. REASONS FOR THE CHOICES

Geosites are elements of the landscape that document clearly a past event in the history of the earth or of the climate and that enable us to understand the evolution of an area. With this premise in mind, in the choice of Trentino geosites we have tried to evaluate those elements of the landscape which, besides being spectacular, can give a significant contribution to our understanding of the geological history of the region. The priority criteria for the choice of sites have however taken into account various factors. These include the

[3]From the point of view of naturalistic rarity and didactic exemplification.

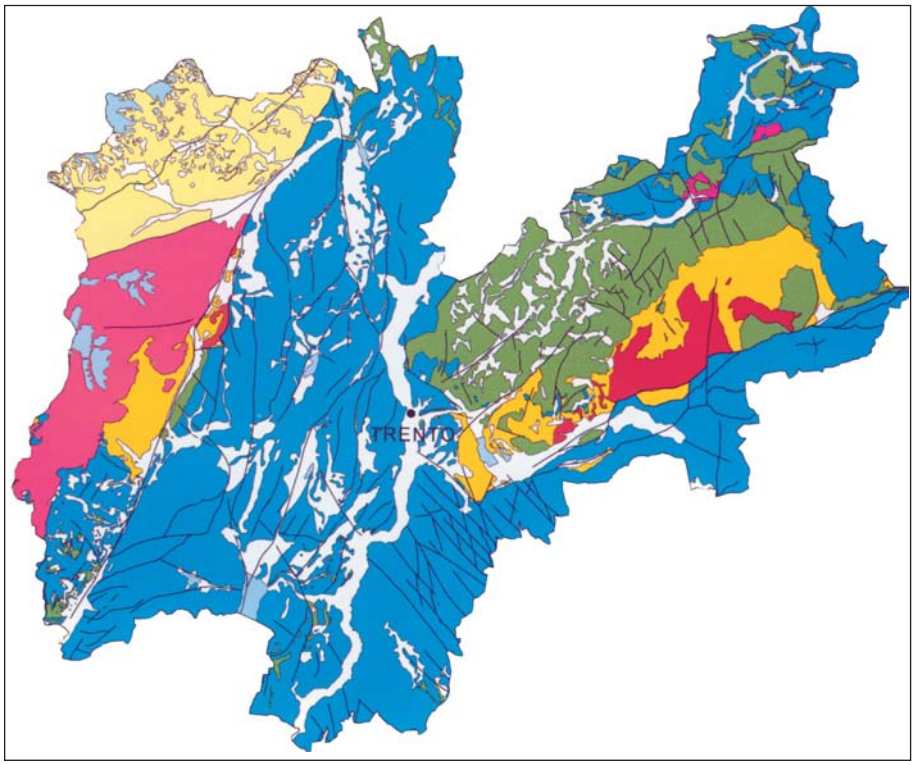


Fig. 1 - Schematic geological map of the Trentino region (Geological Service Autonomous Province of Trento). Lakes and glaciers (blue); effusive volcanic rocks (green); intrusive volcanic rocks (red); metamorphic rocks (yellow); sedimentary Rocks (dark blue); covering soils (light blue); faults (black lines).

*Carta geologica schematica del Trentino (Servizio Geologico Provincia Autonoma di Trento). Laghi e ghiacciai (azzurro); rocce vulcaniche effusive (verde); rocce vulcaniche intrusive (rosso); rocce metamorfiche (giallo); rocce sedimentarie (bleu); terreni di copertura (azzurro chiaro); faglie (linee nere).*

completeness of the site, its rarity within the regional context, its representativity and exemplification, its state of conservation and naturalness, its value (that is as evidence of geological history) and its scientific interest, didactic value and possible particular interest in terms of ecological, scenic, historical, cultural and touristic value etc. (Gruppo di lavoro Protezione dei Geotopi in Svizzera, 1995).

The list of geomorphosites proposed here is certainly not exhaustive in terms of all that the Trentino region offers. However it can be considered a starting point for a more capillary future census which could be used in regional planning, both in terms of safeguarding valuable elements and in the sustainable management of geosites in general. It is important to note that the proposed list, given the aims of this specific research project, does not consider the particular well established geosites that are witness to the oldest history of the Trentino region, those which enable us to relive alluvial plains, lagoons, ocean floors, coral reefs and volcanoes. An analogous study must be dedicated to these features which, in view of the unique geological history that has characterised this alpine region, promises to be extremely stimulating.

At the present time, the census includes 110 sites of geomorphological interest (Fig. 2). Of these, most are mentioned for the first time. Some are traditionally well known, such as the Pyramids of Segonzano or the giant's kettles of Vezzano, while others, perhaps less well known, appear partly described in popularised tourism publications. In this respect, it should be underlined that in the identification of the geomorphosites, besides the choices dictated by the specific competences of the proposers[4], consideration was also taken of all indications in both scientific and more popularised bibliographies (Carton *et al*., in press).

In particular, the research and analysis of the existing bibliographical information represented an important moment in the phase of selection of the geomorphosite because it made us aware of that geological and geomorphological evidence already existing from the "pre-geosite past". The repeated mention and/or description, or otherwise, of a site of particular geological interest represents a historical value and can be an indication of its importance. It is therefore an element of preference in the choice of a site. A clear example is the giant's kettles, one of the most mentioned and cited landforms. In some cases, the choice at a local level as to which landforms should be chosen as geomorphosites would have been problematic if the "historical value" of the indication had not been taken into consideration.

In other cases preference has been given to indications of geomorphosites which, even though they do not satisfy the requisites to be inserted in the regional list, are already fully used from a tourism point of view with well established routes, itneraries or explanatory guides. An example of this is represented by the many torrent gorges and canyons in the Valle di Non which the local Tourist Board has exploited by equipping them with walkways and publicising with explanatory brochures (Fig.3).

The geomorphosites indicated here will be exhaustively described (cf. Tav. I at the end of this article)) in a future publication. Their origins will be explained, together with their importance in the regional geological

[4]Besides the authors of this note, also Dr. Andrea Borsato of the Museo Tridentino di Scienze Naturali and Dr. Luca Tommasi of the Geological Service of the Autonomous Province of Trentino collaborated in the identification and description of the geomorphosites.

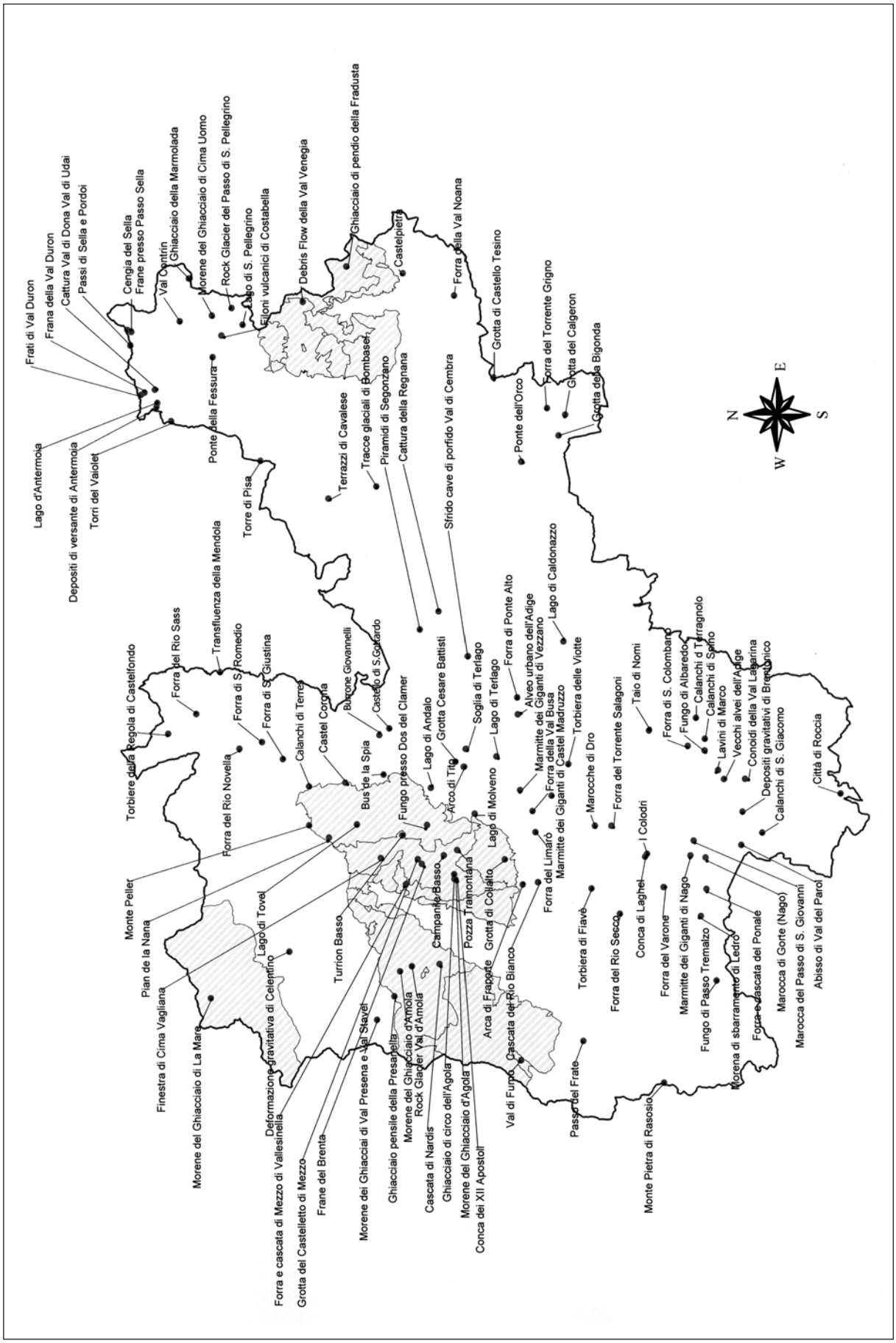


Fig. 2 - Map of Trentino geomorphosites. Lined zones represent conservation areas (parks).
*Carta dei Geomorfositi trentini. Le aree in rigato rappresentano le zone a Parco.*

history and the reasons for their choice as geomorphosites. Appropriate maps will indicate their location, the best internal or external viewpoints of each site, access routes and the best daylight conditions for the visit.

## 4. GEOSITES IN THE TRENTINO REGION

In the policy of geoconservation the possibility of educating the general public on the scientific significance of geosites is of fundamental importance. Among the various ways of doing this, the most efficient is the direct approach with the territory or with its particular features that document the history of the earth, the evolution of life, of the climate and the landscape.

Among the various initiatives in this direction, it is the direct observation on the ground of natural phenomena which is most striking for the observer. It follows that a naturalistic itinerary or simply identification of a single geosite are the best ways of making the general public aware of these features. The activation of these kinds of initiatives, their management and development involve however a series of operations that the existing structures are not always able to carry out efficiently, both for economic and cultural reasons. The problems include defining the limits of the protected area, the building of car parks, preparation and maintenance of footpaths and viewpoints, and the preparation of public notices, informative documentation, leaflets and brochures.

In this regard, the Trentino region is well prepared for the logistic management of its geosites, in that its natural tourist vocation ensures a wide range of structures that can already be used. One example is the capillary network of footpaths[5] which crosses the entire region and enables visitors to reach any locality where normal viability is not present. There are numerous ski lifts which transport excursionists to apparently inaccessible locations where there is evidence of the earth's history. There is a dense accommodation infrastructure (hotels, refuges etc.) located at the valley bottom or high up in the mountains. These facilities, together with the initiative and experience of the local Tourist Boards of the various valleys, ensure that there is an increasing offer of tourist packages of a naturalistic kind. As an example, already in the second half of the 1970s the Sentiero Geologico del Dos Capel " was created in eastern Trentino, the first of its kind in Italy. Twenty five years on we now have the Geological Museum of Predazzo and the Val di Fiemme Tourist Board which have revitaliseed the itinerary (Fig. 4) (Dell'Antonio & Roghi, 2001) combining with other similar initiatives.

As a further example of the sensibility of the Trentino region towards promotion of initiatives regar-

[5]In Trentino the institutional management of footpaths is the responsability of the *Società degli Alpinisti Tridentini* (SAT) which, from its beginnings, has encouraged and increased tourism in the Trentino valleys, maintaining paths, placenames and producing the regulatory plan of the alpine footpaths, created in 1932-33. In the choice of marked and proposed footpaths SAT does not only take into account the excursionistic aspects of an itinerary, but also the environmental and cultural implications


Fig. 3 - Detail of the brochure published by the Tourist Board of the Val di Non which illustrates equipped footpaths along some valley canyons.

*Particolare della brochure edita dall'Azienda di Promozione Turistica della Val di Non che illustra itinerari attrezzati attraverso alcuni canyon della valle.*


Fig. 4 - Detail of the guide of the *Sentiero Geologico del Dos Capel* (Dell'Antonio & Roghi, 2001).

*Particolare della guida del* Sentiero Geologico del Dos Capel *(Dell'Antonio & Roghi, 2001).*

ding the history of the earth, the Geological Service of the Autonomous Province of Trento and the Museo Tridentino di Scienze Naturali, authoritative regional institutions with specific scientific responsabilitites, have published a series entitles “Notebooks of the geosites”. The first number (Fig.5), published in 2002 (Avanzini, 2002) deals with the spectacular dinosaur tracks discovered on the Lavini di Marco landslides at the end of the 1980s. This series, which came out of a common commitment of the two institutions to catalogue the geosites and promote the resources connected with them, is, at a national level, the only co-ordinated and systematic regional effort by institutions responsible for territorial management and similar matters.

The following table (Tab. 1) proposes a list of geomorphosites of regional interest, selected according to the above mentioned criteria and located throughout the region. For each site there is a brief description and reasons for its choice. Where possible, the local or most commonly used name has been used.

From the analysis of the specific bibliography, it has also been possible to produce an informal inventory of “naturalistic” itineraries and sites that can be visited (Tab. 2), supported by a more or less detailed written comment. They are not, except in a few cases, itineraries or isolated points, helped on the ground by panels and specific guides, but simply a series of routes or single landforms described and commented on. As a co-ordinated intiative of this sort has never been attempted, the landforms taken into consideration vary greatly, above all as regards the scientific information available. The summary table containing these landforms shows the type of route, and an explanatory description of the features according to the key indicated in the table.

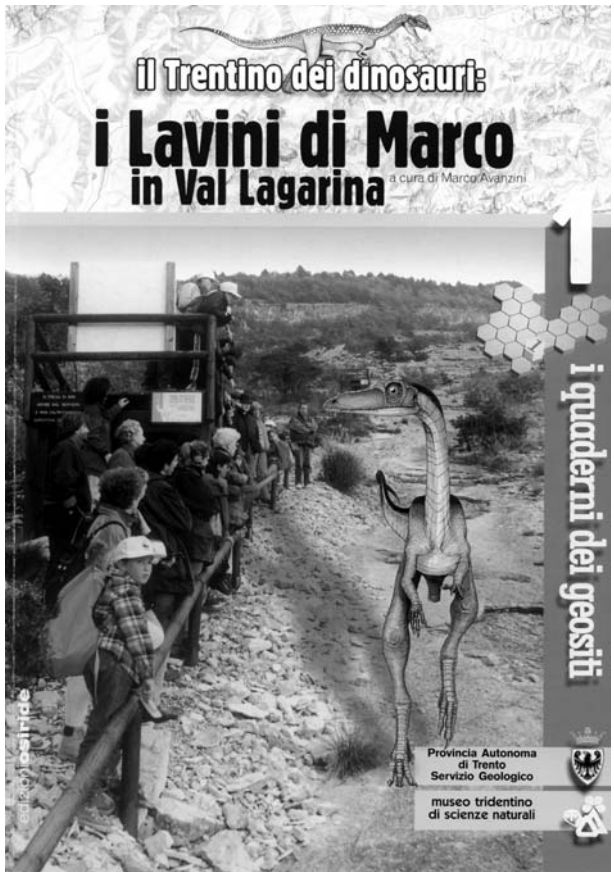


Fig. 5 - Cover of the first notebook of Geosites (Avanzini, 2002).

*Copertina del primo quaderno dei Geositi (Avanzini, 2002)*

Tab 1 - List of Geomorphosites of Regional Importance. Key: NR = Naturalistic rarity; ME = Model of evolution; DE = Didactic example; PE = Paleoenvironmental evidence, EV = Ecological value; SHV = Scientific historical value.

| Italian name | Name | Municipality | Reason | Notes |
|---|---|---|---|---|
| **Abisso di Val del Parol** | **Val del Parol chasm** | Brentonico | NR-DE | Karst cavity in the Calcari Grigi Formation, vertical potholes and tight meanders. |
| **Alvei abbandonati dell'Adige** | **Riverbed cut-offs of the Adige** | Rovereto Mori | DE-EV-SHV | Well conserved remains of riverbed stretches of the Adige river, cut off following an artificial diversion. |
| **Alveo urbano dell'Adige** | **Urban riverbed of the Adige** | Trento | PE-SHV | Trace of an ancient stretch of river axis of the Adige river in the town of Trento, shown up by the particular arrangement of present day street patterns. |
| **Arca di Fraporte** | **Arch of Fraporte** | Stenico | NR-ME | Natural arch modelled in the Calcari Grigi Formation, about 15 metres in height. |
| **Arco di Tito** | **Arch of Titus** | Terlago | ME | Natural arch in the Calcari Grigi Formation, probably originating from karst erosion phenomena. |
| **Burrone Giovannelli** | **Giovannelli ravine** | Mezzocorona | ME | Torrent gorge along a tectonic fracture in the Dolomia Principale Formation. |
| **Bus de la Spia** | **De la Spia cavern** | Sporminore | NR-DE | Horizontally developed cavern; characteristic due to a periodical rise of waters |
| **Calanchi di S. Giacomo** | **St. Giacomo gullies** | Brentonico | SHV-DE | Erosional forms cut into the higher glacial deposits of the northern sector of Mt. Baldo, corresponding to the last maximum expansion of the Adige glacier. |
| **Calanchi di Spino** | **Spino gullies** | Rovereto, Trambileno | PE-DE | Erosional gully landforms cut into fluvioglacial deposits. |
| **Calanchi di Terragnolo** | **Terragnolo gullies** | Terragnolo | PE-DE | Erosional gully landforms cut into fluvioglacial deposits. |
| **Calanchi di Terres** | **Terres gullies** | Terres | DE | Erosional gully landforms in marly deposits. |

Segue Tab 1 - List of Geomorphosites of Regional Importance. Key: NR = Naturalistic rarity; ME = Model of evolution; DE = Didactic example; PE = Paleoenvironmental evidence, EV = Ecological value; SHV = Scientific historical value.

| | | | | |
|---|---|---|---|---|
| **Campanil Basso** | **Campanil Basso** | Ragoli | DE-SHV | Dolomitic monolith about 250 m high, typical example of morphostructural evolution and well known in the history of mountaineering in the Brenta Group. |
| **Cascata di Nardis** | **Nardis waterfall** | Giustino | DE-PE | Spectacular waterfall connecting a lateral hanging valley and the main valle y fed by meltwater of the Nardis cirque glacier. |
| **Cascate del Rio Bianco** | **Rio Bianco waterfall** | Stenico | EV | Waterfall fed by karst spring emerging from rock fracture. |
| **Castel Corona** | **Corona castle** | Denno | SHV | Large natural niche in rock carved on a vertical wall, in which there is a fortified castle of XII century. |
| **Castello di San Gottardo** | **San Gottardo castle** | Mezzocorona | SHV-DE | Castle located on a ledge carved by morphoselective processes. |
| **Castelpietra** | **Castelpietra** | Tonadico | SHV | Fortified building located on a sharp rocky projection in panoramic position towards the St. Martino cliffs. |
| **Cattura della Regnana** | **Regnana drainage capture** | Bedollo | PE-DE | Head retreat of the Rio di Regnana torrent which has captured the drainage of the Brusago – Piazze valley trench. |
| **Cattura Val di Dona Val di Udai** | **Val di Dona Val di Udai river capture** | Mazzin | PE-DE | Fluvial diversion caused by erosive process that has caused head retreat of the torrent Rio di Udai capturing the drainage of the summit part of the Val di Dona. |
| **Cengia del Sella** | **Sella ledge** | Canazei | DE | Morphoselective surface, located in the summit part of the wall of the Sella Group in corrispondence of the Raibl Formation, which separates the Cassian Dolomites from the Dolomia Principale Formation. |
| **Città di Roccia alla Sega di Ala** | **Sega di Ala rock city** | Ala | DE | Karst landscape made up of calcareous boulders of Rosso Ammonitico Formation, variously rounded, generated by karst corrosion. |
| **Conca dei XII Apostoli** | **Hollow of the XII apostles** | Stenico | ME-NR | Glacial karst holow, with evident surface karst forms, accompanied by recent glacial deposits belonging to the Little Ice Age. |
| **Conca di Laghel** | **Laghel hollow** | Arco | DE | Very large doline with flat floor partly cultivated, characterised on western side by steeply dipping beds. The lowest part is subject to periodic flooding in heavy rain. |
| **Conoidi della Val Lagarina** | **Val Lagarina cones** | Ala | DE-PE | Group of alluvial cones and debris flows south of Trento, emplaced by some tributaries of the Adige river. |
| **Debris flow della Val Venegia** | **Val Venegia debris flow** | Tonadico | DE | Debris flow mobilised by water that has rapidly eroded, following heavy rains, incoherent deposits. The phenomenon involves the detritus at the foot of Mt. Mulaz and influences the forest road going to Baita Segantini, in Val Venegia. |
| **Deformazione gravitativa di Celentino** | **Celentino gravitative deformation** | Pejo | ME | Series of trenches and counterslopes that denote a deep gravitational movement of the mountainous flank on which the village of Celentino is located. |
| **Depositi di versante di Antermoia** | **Antermoia slope deposits** | Mazzin | DE | Succession of cones from debris flows and avalanches side by side and superimposed which characterise the southern flank of the Antermoia valley. |
| **Depositi gravitativi di Brentonico** | **Brentonico Gravitative deposits** | Mori | SHV | Large body of gravitative accumulations (surface area of 4 km$^2$) prior to the last great glacial expansion. It is made up of a mass of plates from decimetre to to hectometre in size conserving the original bedding. |
| **Filoni vulcanici di Costabella** | **Costabella volcanic sills** | Pozza di Fassa | DE-SHV | Intrusions of volcanic rocks inside sedimentary rocks, selectively eroded. The phenomenon has generated natural trenches, used as such during the First World War. |
| **Finestra di Cima Vagliana** | **Cima Vagliana window** | Ragoli | NR | Very large natural arch located on the eastern flank of Cima Vagliana, carved into the Calcari Grigi Formation and caused by selective erosion. |
| **Forra del Rio Novella** | **Rio Novella gorge** | Dambel-Romallo | ME-DE | Succession of ravines of varying width (from 150 m to less than 10 m) characterised by stretches no longer used by the current drainage system. |
| **Forra del Rio Sass** | **Rio Sass gorge** | Fondo | DE-ME | Polygenic form, cut by subglacial water courses and subsequently subject to fluvial sinking and widening due to various degradation processes of the walls. |
| **Forra del Rio Secco** | **Rio Secco gorge** | Tenno-Fiavé | DE | Deep incision in rock of fluvial origin with particular characteristics. |
| **Forra del Torrentz Grigno** | **Torrent Grigno gorge** | Cinte Tesino | DE-NR | Deep incision in rock of fluvial origin with particular characteristics. |
| **Forra del Varone** | **Varone gorge** | Tenno | NR-SHV | Deep incision in rock of fluvial origin with particular characteristics. |
| **Forra della Val Busa** | **Val Busa gorge** | Calavino | DE | Deep incision in rock of fluvial origin with particular characteristics. |
| **Forra della Val Noana** | **Val Noana gorge** | Mezzano | DE | Deep incision in rock of fluvial origin with particular characteristics. |

Segue Tab 1 - List of Geomorphosites of Regional Importance. Key: NR = Naturalistic rarity; ME = Model of evolution; DE = Didactic example; PE = Paleoenvironmental evidence, EV = Ecological value; SHV = Scientific historical value.

| | | | | |
|---|---|---|---|---|
| **Forra di Ponte Alto (o Valle dell'Orco)** | **Ponte Alto (or Valle dell'Orco) gorge** | Trento | DE-SHV | Deep incision in rock of fluvial origin with particular characteristics. |
| **Forra di S. Giustina** | **St. Giustina gorge** | Taio-Tassullo | DE-EV-SHV | Wide and deep gorge, whose damming has caused the formation of the artifical lake of the same name. Also of interest is the ruin of an ancient hermitage. |
| **Forra di San Colombano** | **San Colombano gorge** | Trambileno | DE | Deep incision in rock of fluvial origin with particular features that point out the Jurassic stratigraphic series and Quaternary conglomerate deposits with neotectonic faults. |
| **Forra di San Romedio** | **San Romedio gorge** | Romeno | SHV | Ancient site of worship located on a rock needle isolated by the confluence of two deep gorges. |
| **Forra e cascata del Ponale** | **Ponale gorge and waterfall** | Molina di Ledro | DE | Deep incision in rock of fluvial origin with particular characteristics. |
| **Forra e cascate di Mezzo, di Vallesinella** | **Vallesinella di Mezzo gorge and waterfall** | Ragoli | DE | Incision in rock of fluvial origin associated with karst springs that generate a series of waterfalls at various levels. |
| **Forra Torrente Salagoni** | **Torrent Salagoni gorge** | Drena | DE | Deep incision in rock of fluvial origin with particular characteristics. |
| **Forre del Sarca** | **Sarca gorge** | Calavino | NR-DE | Succession of spectacular torrent gorges of varying widths depending on the lithotype crossed, located between Comano Terme and Sarche. Locally known as Gorge of Limarò and Ponte Pià. |
| **Frana della Val Duron** | **Val Duron landslide** | Campitello di Fassa | DE | Well displayed landslide body, broken away from right side of the Val Duron. It partly occupies the valley bottom, creating an upvalley marshy area due to water stagnation. |
| **Frane del Brenta** | **Brenta landslides** | Ragoli | | Large accumulations of landslide deposits generally made up of calcareous boulders, which occupy extensive slope segments along the footpath linking the Tuckett and Brentei. |
| **Frane presso Passo Sella** | **Sella Pass landslides** | Canazei | DE | Masses of large boulders coming from the walls of the sella Group; landslides presumably caused after retreat of glaciers occupying the Dolomitic valleys during the last glaciation. Large-sized rock fall deposits. |
| **Frati di Val Duron** | **Val Duron monks** | Campitello di Fassa | NR | Curious erosional forms carved into the Ladinian vulcanites. |
| **Fungo di Passo Tremalzo** | **Tremalzo Pass rock mushroom** | | ME-NR | Example of selective erosion in dolomitic rocks several metres in height. |
| **Fungo del Dos del Clamer** | **Dos del Clamer rock mushroom** | Molveno | NR | Small rock mushroom, due to morphoselection in heavily fractures calcareous lithotypes. |
| **Fungo di Albaredo** | **Albaredo rock mushroom** | Rovereto | NR | Rock mushroom located just north of great landslide of Marco, cut into large calcareous block. Belonging to landslide mass of Corna Calda. |
| **Ghiacciaio dell'Agola** | **Agola Glacier** | Stenico | DE | Small cirque glacier with an area of ca. 22 hectares; it represents well the glacier typology of Brenta mountain group. |
| **Ghiacciaio della Fradusta** | **Fradusta Glacier** | Tonadico | DE | Small sloping glacier fed exclusively by snow precipitation, currently in course of extinction. |
| **Ghiacciaio della Marmolada** | **Marmolada Glacier** | Canazei | DE-SHV | Main glacier of the Eastern Dolomits. Classified as sloping glacier. It represents the last consistent evidence of the ancient dolomitic glacial cover. The scene of numerous battles during the First World War. |
| **Ghiacciaio Pensile della Presanella** | **Presanella hanging glacier** | Vermiglio | DE-NR | Rare example of type of hanging glacier not common in the Trentino region. |
| **Grotta Cesare Battisti** | **Cesare Battisti cavern** | Fai della Paganella | ME | Cavern belonging to the karst complex of the Paganella range. |
| **Grotta del Calgeron** | **Calgeron cavern** | Grigno | ME | Cavern developed horizontally, typical for its series of internal lakes. |
| **Grotta del Castelletto di Mezzo** | **Castelletto di Mezzo cavern** | Ragoli | ME-PE | Cave opening onto the south side of Castelletto di Mezzo, consisting of four meanders which penetrate towards two halls one above the other. |
| **Grotta della Bigonda** | **Bigonda cavern** | Ospedaletto | ME | The most extensive cave complex of the Trentino region. |
| **Grotta di Castello Tesino** | **Castello Tesino cavern** | Castello Tesino | ME-DE | Karst cavity mainly horizontally developed, well known at a regionally scale, with possibility of visits. |
| **Grotta di Col Alto** | **Col Alto cavern** | Dorsino | DE-PE | Karst cavity developed in the Dolomia Principale Formation, typical due to its succession of potholes and galleries with a total length of 4900 m, with a height difference of 230 m. |

Segue Tab 1 - List of Geomorphosites of Regional Importance. Key: NR = Naturalistic rarity; ME = Model of evolution; DE = Didactic example; PE = Paleoenvironmental evidence, EV = Ecological value; SHV = Scientific historical value.

| | | | | |
|---|---|---|---|---|
| **I Colodri** | **Colodri** | Arco | ME-DE | Area with extensive karst surface phenomena such as karren, kamenitza, etc., associated with traces of glacial erosion (roches moutonnées and small kettle holes). |
| **Lago di Andalo** | **Lake Andalo** | Andalo | DE | Temporaray lake of karstic origin, located in a polje |
| **Lago di Antermoia** | **Lake Antermoia** | Mazzin | DE-SHV | Small tarn inside a glacial karstic hollow partially closed to the east by a landslide coming from the slopes of Croda del Lago. Associated with various legends of the Dolomites. |
| **Lago di Caldonazzo** | **Lake Caldonazzo** | Caldonazzo, Pergine, Calceranica | DE | Splendid example of barrier lake. Its origin is due to occlusion of valley branch caused by alluvional cones up- and downvalley. |
| **Lago di Molveno** | **Lake Molveno** | Molveno | DE-PE-SHV | Barrier lake caused by landslide. Following rise of waters it submerged a forest, conserved on the lake bottom. |
| **Lago di S. Pellegrino** | **Lake St. Pellegrino** | Moena | ME-PE | Small lake of glacial origin, supported by frontal morainic arch. |
| **Lago di Terlago** | **Lake Terlago** | Terlago | DE | Lake of glacial-karstic origin located in large depression, characterised by total lack of tributaries and effluents. |
| **Lago di Tovel** | **Lake Tovel** | Tuenno | DE | Barrier lake due to landslide; after rise of waters it submerged a forest, conserved on the lake bottom. |
| **Lavini di Marco** | **Landslides of Marco** | Rovereto | DE-SHV | Large landslip, located on bed surface of the lower member of the Calcari Grigi Formation, mentioned by Dante in the *Inferno*. On the bed surfaces freed of debris numerous dinosaur tracks have been discovered. |
| **Marmitte dei Giganti di Castel Madruzzo** | **Castel Madruzzo potholes** | Calavino | PE-NR | Small glacial potholes near Castel Madruzzo. |
| **Marmitte dei Giganti di Nago** | **Nago potholes** | Nago-Torbole | PE-NR | Large glacial potholes near the main state road for Riva del Garda - can be visited by means of well marked footpath. |
| **Marmitte dei Giganti di Vezzano** | **Vezzano potholes** | Vezzano | PE-SHV | Glacial potholes characterised by varying degrees of evolution and depth. Located in correspondence of eatern slope of Valle dei Laghi, near the village of Vezzano. Described by Stoppani in “Bel Paese” in 1875. |
| **Marocca del Passo di S. Giovanni** | **Rockslide of St. Giovanni Pass** | Nago-Torbole | DE-ME | Large landslide masses made up of calcareous boulders (Calcari Grigi Formation) emmersed in a sandy-gravelly matrix. They represent the westward barrier of the Valle di Loppio which has caused the formation of the lake of the same name. |
| **Marocca di Gorte** | **Rockslide of Gorte** | Nago-Torbole | DE-ME | Translatory landslip of a part of the Tofino Formation on underlying Calcari Grigi Formation. The detachment niche is clearly visible; landslip body of large boulders. |
| **Marocche di Dro** | **Rockslide of Dro** | Dro | DE-ME-EV | Large series of landslides, detached at various times from the eastern slope of the ridge of Mt Brento-Mt-Casale. They cover the valley floor and part of the slopes of the lower Valle del Sarca with a surface area of 13 $km^2$ and estimated volume of about 1000 $Mm^3$. |
| **Monte Peller** | **Mt. Peller** | Cles | DE-PE | Small glacial cirque, particularly well conserved and modelled. |
| **Monte Pietra di Rasoio** | **Mt. Pietra di Rasoio** | Condino | EV-ME | Elongated ridge, modelled in clastic formations of Lombardy Verrucano and Servino (Werfen). Quarried material was used as whetstone. |
| **Morena di sbarramento di Ledro** | **Ledro moraine** | Molina di Ledro | DE-PE | Frontal morainic bank that supports Lake Ledro, emplaced by a lateral branch of the Atesino Glacier that underwent counterslope advance of the Valle di Ledro. |
| **Morene dei ghiacciai di Val Stavel e Val Presena** | **Moraines of Val Stavel and Val Presena Glaciers** | Vermiglio | DE-PE | Particularly well conserved frontal and lateral moraines. They allow easy intuition of size and thickness of glaciers in the mid-1800s. |
| **Morene del Ghiacciaio d’ Agola** | **Moraines of Agola Glacier** | Stenico | DE-PE | Typical moraines of the Little Ice Age, tapered and particularly well conserved. |
| **Morene del Ghiacciaio d’Amola** | **Moraines of Amola Glacier** | Giustino | DE-PE | Tapered morainic ridges at the sides of the Amola Glacier. They indicate the size and position of the cirque glacier during the Little Ice Age. |
| **Morene del Ghiacciaio di Cima Uomo** | **Moraines of Cima Uomo Glacier** | Pozza di Fassa | DE-PE | Well conserved lateral and frontal moraines, belonging to the Uomo Glacier today almost extinct. They are rare evidence, for Eastern Trentino, of the glacial events of the Little Ice Age. |
| **Morene del Ghiacciaio di La Mare** | **Moraines of La Mare Glacier** | Pejo | DE-PE | Enormous lateral moraines deposited during the expansion of the Little Ice Age with typical knife-edge crest, double in places. The internal slope of the two moraines is heavily gully-eroded, forming a series of gullies and ridges. |
| **Passi di Sella e Pordoi** | **Sella and Pordoi passes** | Canazei | PE | Well known Dolomitic passes, cut in the Ladin formations. The depressions were mainly incised by the action of the glaciers which, during their maximum expansion, transflowed from one valley to the other. |

Segue Tab 1 - List of Geomorphosites of Regional Importance. Key: NR = Naturalistic rarity; ME = Model of evolution; DE = Didactic example; PE = Paleoenvironmental evidence, EV = Ecological value; SHV = Scientific historical value.

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|---|---|---|---|---|
| **Passo del Frate** | **Frate pass** | Breguzzo | NR-SHV | Rock pinnacle about 20 m high at the Passo del Frate (Val Breguzzo), carved in metamorphosed calcareous beds and crossed by volcanic sills subject to heavy erosion. In corrispondence with the sills there are trenches and walkways dating to the First World War. |
| **Pian de La Nana** | **La Nana plain** | Cles | DE-ME | Glacial-karstic hollow with evident karst surface phenomena (karren, furrows, karst crevices, swallow holes, dolines) and glacial modelling. |
| **Piramidi di Segonzano** | **Earth pyramids of Segonzano** | Segonzano | NR-DE | Earth pillars cut in Quaternary deposits. They are grouped in three nucleii with heights of up to 20 m; some are covered by a large boulder which protects them from erosion. |
| **Ponte dell'Orco** | **Giant's Bridge** | Ivano-Fracena | NR | Natural rock arch located near Ospedaletto in Valsugana. |
| **Ponte della Fessura** | **Fessura Bridge** | Pozza di Fassa | NR | Deep torrent gorge cut by the Rio Monzoni (Val St. Nicolò), in a landslide body of masses made up of Marmolada calcareous deposits. |
| **Pozza Tramontana** | **Tramontana pool** | S.Lorenzo in Banale | DE | Very large glacial-karstic depression closed on all sides. |
| **Rock glacier del Passo d S. Pellegrino** | **St. Pellegrino Pass rocki glacier** | Soraga | PE-DE | A large tongue shape rock glacier, made up of coarse detritus. It is evidence of past permafrost in the area. It is now a relict form and the only example worth noting in the Eastern Dolomites of Trentino. |
| **Rock Glacier Val d'Amola** | **Val d'Amola rock glacier** | Giustino | PE-DE | Active Rock glacier located on the right side of the Val d'Amola; made up of a singly swollen debris channel, with phenomena of *debris flow* influencing the front scarp. Particularly easy to reach and observe. |
| **Sfrido cave di porfido** | **Sfrido porphyry quarry** | Baselga di Piné | DE-SHV | Detrital masses of waste materials coming from the centuries-old porphyry quarrying in Val di Cembra. They make up characteristic layers near the worked areas, which form uniformly inclined slopes according to the resting angle. |
| **Soglia di Terlago** | **Terlago saddle** | Terlago | PE-DE | Saddle of transflow of the Atesino Glacier between the Adige Valley and Valle dei Laghi, characterised by typical parabolic-shaped profile and roches moutonnées. |
| **Taio di Nomi** | **Nomi cut** | Nomi | DE-SHV | Well conserved trace of ancient meander of Adige River abbandoned following an artificial diversion. |
| **Terrazzi di Cavalese** | **Terraces di Cavalese** | Cavalese | DE | Avisio River fluvial terraces. |
| **Torbiera della Regola di Castelfondo** | **Regola di Castelfondo Peat bog** | Castelfondo | PE | Remains of a Late Glacial lake located on a syncline modelled in the Scaglia Rossa marly calcareous beds. Sparsely distributed glacial deposit consisiting of large blocks of granite from Mt Croce. |
| **Torbiera delle Viotte del Bondone** | **Viotte del Bondone peat bog** | Trento | PE | Lake basin at the exit of the small local Val Mana Glacier (southern flank of the Tre Cime del Bondone). Site of paleolithic settlement. |
| **Torbiera di Fiavè** | **Fiavè Peat bog** | Fiavé | PE-SHV | Large lake basin with peat bog near the Passo del Ballino. Evidence of prehistoric settlement on marginal island in the lake. |
| **Torre di Pisa** | **"Tower of Pisa"** | Forno | NR-DE | Large monolith evident along the ridges of the Latemar. The numerous volcanic sills intruded into the Latemar white calcareous beds morphoselectively isolate rocky pinnacles, some with curious shapes. |
| **Torri del Vajolet** | **Towers of Vajolet** | Pozza di Fassa | NR-DE | Spectacular and tall rock towers well known to local mountaineers. Formed by mechanical degradation along vertical fractures that create furrows throughout the regular horizontal bedding of the ancient cliff in the Scilliar Dolomite. |
| **Tracce glaciali di Bombasel** | **Glacial traces of Bombasel** | Cavalese | PE | Combination of forms of glacial origin, easily reached, which indicate the presence of glaciation in the Lagorai mountain range. |
| **Transfluenza della Mendola** | **Transflow of the Mendola** | Ruffrè | PE-DE | Transflow saddle of the Atesino Glacier between the Adige valley and the Val di Non, with typical parabolic-shaped profile. |
| **Turrion Basso** | **Turrion Basso** | Tuenno | DE | Isolated relief form, tapered in shape, structurally controlled and modelled by glacial action in the Calcari Marnosi Formation. |
| **Val di Fumo** | **Val di Fumo** | Daone | DE-PE | Classic example of glacial valley with typical parabolic-shaped profile, with rectilinear trend and evident shoulders modelled in rock. |
| **Valle di Contrin** | **Contrin valley** | Canazei | PE-DE | Hanging valley with typical U-shaped profile of clear glacial origin. |

Tab 2 - Itineraries and single points. Key: IP = itinerary briefly described with suitably prepared sections; PD/ID = point/itinerary briefly-described; SP = single point with visiting facilities; EF = equipped footpath with stops, tables, specific guide; NF = naturalistic footpath described in places in detail;
A = article; TM = topographic map with illustrative notes on the back; L = leaflet; IS = illustrative sheet; EG = extended specific guide; RG = rapid guide (brief notes organised as a guide); www = Internet website.

| **Name** | | **Bibliographical reference** | |
|---|---|---|---|
| Arch of Fraporte | A | Benedetti & Corrà (1967); Vernaccini (1995). | PD |
| Arch of Titus | A | Corrà (1969). | PD |
| Busi - Canyon of Gorzana | L | APT Val di Non (b); APT Val di Non (2003). | |
| Canyon - Mondino Footpath | L | APT Val di Non (b); APT Val di Non (2003). | IP |
| Canyon of Torrente Sass (Floor) | L-A | APT Val di Non (a); APT Val di Non (c ); Comune di Fondo - APT Val di Non (2001); Perna & Sauro (1977). | IP-ID |
| Canyon Don - San Romedio | L | APT Val di Non (b); APT Val di Non (2003); APT Val di Non (c ); Perna & Sauro (1977). | IP-ID |
| Canyon and St. Giustina Hermitage | L | APT Val di Non (b); APT Val di Non (2003). | ID |
| Canyon Lake Smeraldo di Fondo | L | APT Val di Non (b); APT Val di Non (2003); Vernaccini (1995). | IP |
| Varone Waterfall | IS-A | Anonimo; Perna (1993 b); Perna & Sauro (1977); Provincia Autonoma di Trento (2002); Vernaccini (1995); Ortner & Majr (1996). | SP-PD |
| Tret Waterfall | L | APT Val di Non (2003). | IP |
| Vallesinella di Mezzo Waterfall | RG | Parco Adamello Brenta (1995d); PAT (2002); Vernaccini (1995). | PD |
| Laghel Hollow | TM | Comune di Arco (?); Ortner & Majr (1996). | ID |
| Pian della Nana Hollow | A | Castellarin, Chini, Perna & Sauro (1982). | ID |
| Glacial evidence of the Lower Sarca | A | Perna (1993). | ID |
| Gorge of Limarò | A | Perna (1993 b); Provincia Autonoma di Trento (2002); Vernaccini (1995). | PD |
| Gorge of Ponte Alto | A | Perna & Sauro (1977); Provincia Autonoma di Trento (2002). | PD |
| Gorge of S. Giustina | A | Polo (1986). | ID |
| Gorge of Torrente Sporeggio | RG | Parco Adamello Brenta (1995b). | PD |
| Landslide and Lake of Molveno | RG | Parco Adamello Brenta (1995c); Tabellone, sentiero naturalistico. | ID |
| Rock mushroom of Albaredo | RG | Provincia Autonoma di Trento (2002); Ortner & Majr (1996). | PD |
| Cavern of Castel Tesino | L | APT Lagorai, Valsugana Orientale e Tesino (1998a, b); Vernaccini (1995). | SP |
| I Colodri | TM-A | Comune di Arco; Perna & Sauro (1976). | ID |
| Lake Terlago and Glacial Threshold | L-A | Consorzio Pro Loco Valle dei Laghi (a, b); Perna (1993); Vernaccini (1995); Ortner & Majr (1996). | ID |
| Landslides of Marco | EG-A | Avanzini (2002); Perna (1975); Vernaccini (1995); Ortner & Majr (1996). | |
| Potholes of Nago | TM-A | Azienda Autonoma di Soggiorno Torbole - Nago; Provincia Autonoma di Trento (2002); Perna & Sauro (1976); Perna (1993b); Ortner & Majr (1996). | ID |
| Rockslide of Gorte and Lasta di Paternoster | A | Perna (1991). | ID |
| Rockslide of Dro | L-A | APT Garda – Trentino; Provincia Autonoma di Trento (1988); Perna (1975); Vernaccini (1995); Ortner & Majr (1996). | NF-ID |
| Mendola - Mt. Penegal | L | APT Val di Non (2003). | ID |
| Monzoni - Costabella | EG | Carton & de' Luigi (1980); Vernaccini (1995). | NF |
| Glacial Park of Vezzano "A. Stoppani" | A-EG-L-www | Anonimo (1965); Comune di Vezzano (2003); Consorzio Pro Loco Trentino e APT Valle dei Laghi (1991); Consorzio Pro Loco Valle dei Laghi (c); Garbari & Vaia (1968); Perna (1993 b); Vernaccini (1995); Ortner & Majr (1996). | NF |
| Margherita walk ("Sass del Coèn") | L | APT Val di Non (2003). | ID |
| Pyramids of Segonzano | A-EG | Perna (1976 a, b); Perna (1958); Provincia Autonoma di Trento (2002); Vernaccini (1995); Ortner & Majr (1996). | ID-EF |
| Giant's Bridge | A | Benedetti & Corrà (1967); Provincia Autonoma di Trento (2002); Ortner & Majr (1996). | PD |
| Canope M. Calisio Footpath | L | Comune di Trento, Museo Tridentino di Scienze Naturali (2001). | EF |
| Regole Footpath: gorge of Torrente Sorna and "Devil's Bridge" | EG | APT Rovereto Brentonico (1995). | ID |
| Dos Capel Geological Footpath | EG | Dell'Antonio & Roghi (2001); Vernaccini (1995). | EF |
| Geomorphological Footpath of Mezzomonte | www | APT Folgaria Lavarone Luserna. | |
| Val di Fumo | RG | Parco Adamello Brenta (1995a). | ID |
| Val di Tovel: the Masses | L | APT Val di Non (c ). | ID |

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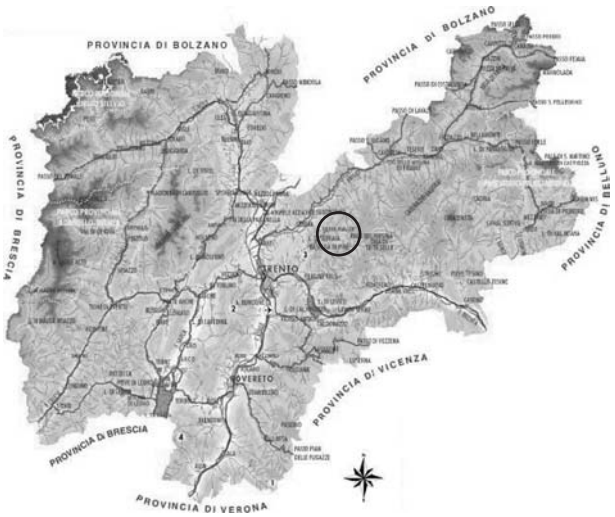
# TAV. 1: EARTH PYRAMIDS OF SEGONZANO[1]

**WHAT IT IS**

It is a series of very picturesque pink- coloured earth pillars, similar to tall columns, up to more than 30 metres in height. They are made up of detrital material on the top of which there are perched protective porphyry boulders, which can be more than a cubic metre in volume.




**LOCATION**

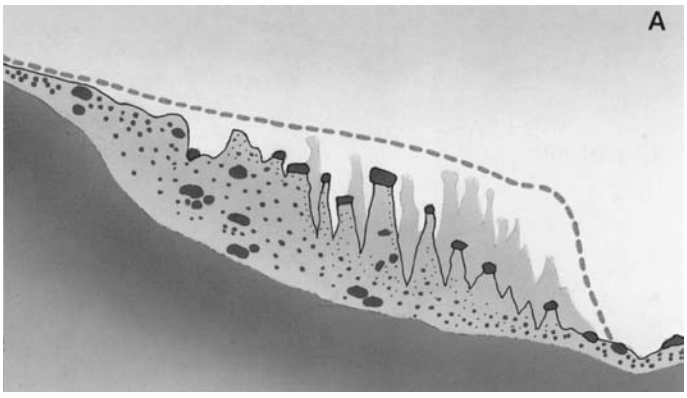
The Pyramids of Segonzano are in Val di Regnana. This is a short narrow valley, lateral left of the Torrent Avisio, which connects the Pinè plateau with the Val di Cembra. It is incised in the Permian vulcanites of the Atesina Porphyrites Platform.

**HOW TO GET THERE**

The Pyramids of Segonzano are well known not only for their classic beauty, but also for the ease with which they can be reached from Trento in twenty minutes. From Trento take the main Brenner state road n°.12 towards Bolzano. After the village of Gardolo and having reached the district of Spini di Gardolo, turn right onto the Provincial road n° 76 for Meano-Albiano and proceed as far as Lases. At the junction with Provincial road n° 71 turn left towards Fersina-Avisio: the Pyramids are close to the bridge over the Rio Regnana just before Segonzano.

Alternatively, take the State road n° 47 eastwards out of Trento along the Valsugana. Turn left at Civezzano to arrive on the same Fersina-Avisio Provincial road n° 71 mentioned above.

A good observation point, with a panoramic view over the Pyramids, is from the local road that climbs up from the district of Stedro-Sabion di Segonzano to Quaras.




**THE PHENOMENON IN NATURE**

Earth pillars (in Italian "*Piramidi di Terra*" - literally "Pyramids of earth" translated from the German “Erdpyramiden”) are a well known geological phenomenon and a spectacular feature of the landscape.

The formation of the pillars is governed by a series of combining factors, which explains the rarity of this landform. Besides the characteristics of the deposit, the climatic conditions are particularly important, especially precipitation. Of significance is also the slope position of the eroded deposits and the vegetation cover. Essentially the pillars are caused by rain run-off on heterogenous incompetent rocks containing large blocks.

The flowing waters make incisions which gradually deepen into a dense miniature hydrographic network which, especially in the steepest points, furrows into the deposits. The deposit is in this way divided up into a series of ridges where the rain has a high erosive action. The rainfall impact initially takes away finer materials, then the coarser particles. Only large blocks or pieces of grassy turf resist, protecting the sediments directly below from the run-off erosion. With time, the first pillars emerge from the detrital deposit. These become thinner and higher until the boulder falls from its perch. Successively in a short time the trunk of the pillar is itself demolished.

[1]The description of the Pyramids of Segonzano Geomorphosite is by Karim Biasioli.

**DESCRIPTIONOF THE SPECIFIC CASE**

An admirable example of this relatively widespread form of erosion in the Alps are the pillars to be found in Val di Cembra, near Segonzano, and which are locally known as the "*Òmeni de Segonzàn*" (Men of Segonzàn)

The more widespread type of earth pillar seen at Segonzano is a pinkish-coloured tall column (sometimes higher than 30 metres) of detrital material on which there is perched a large protective block of porphyry (often more than a cubic metre in volume). This "hat" generally juts out, is slab-shaped and inclined downvalley. The column stands free on all sides and has the shape of a pillar tapered towards the top. The lower part of the stem is almost always covered with a tough centimetre-thick concretionary deposit, made up of a silty material. The pillars are cut out from a Quaternary deposit of glacial origin which outcrops in the middle-low part of the right orographic side of the Valle di Regnana. This deposit lies directly on the rocky substrate and shows an evident bedding that dips downvalley, shown by alternation of layers of different grain size and colour (from brown to reddish-pink). The arrangement of the detritus indicates that the original sediment was remobilised by channelling and mass transport and rideposited in form of *glacis*. The deposit, with a maximum thickness of around forty metres, thins upwards and its upper limit is at an altitude of about 900 m, at the same level as the road going from Segonzano to Bedollo.

The grain size of the deposit varies from silt to coarse gravel and has an upper limit of metre-sized bouders.The main lithology is ignimbritic clasts coming from the break-up of adjacent porphyrites; there are very few carbonatic facies. The sediment making up the pillars is extremely compact, resistant but easily eroded. Sediments are not cemented but hardened by a certain amount of clay.

Together with the classic form there are also pillars with long and deep grooves running down the stem. This occurs when the covering boulder is very rounded, so allowing the rainwater to go round it. The pillars with a vegetation cover at the top are quite rare. On the other hand, quite widespread are those without a protective block: numerous those with a sharp point (*spire*), with a conical trunk and wide base and those with a crest, like a serrated knife (in some cases very long) arranged along a line of maximum gradient of the stratum. Besides the isolated forms there are also composite forms, made up of various pillars side by side and known as *organ pipes*. However, the main form is that of groups of pillars of the types already described, attached to the deposits lying behind and linked to one another by a thin crest representing the residue of the original watershed.

## REASONS FOR THE CHOICE

The Pyramids of Segonzano were chosen as a geomorphosite of national importance for three reasons. Above all they represent a **naturalistic rarity** of notable interest due to their spectacular appearance, the perfection with which they have been carved and the particular landscape atmosphere that they create. Phenomena of this kind, although present in other areas of Italy, are rarely as extensive or morphologically various as those of Segonzano. They are also excellent as **didactic exemplification** in that they show, in all its phases, the process of degradation of slopes by both diffuse and channelled run-off. Finally, they represent evidence of the past **geological history** of this region because their existence is associated with particular morphological and tectonic events. The great amount of detrital material in which they are carved comes from the break-up of ancient glacial deposits that were in the surrounding areas. Besides the Rio Regnana, considered as the base level of the waters that erode the pinnacles, owes its existence along its present axis to the river capture that decapitated the upper Pinè valley. This capture, which is another geomorphosite of Trentino, corresponds to a long structural feature that cuts transversely across the Val di Cembra.

## CURIOSITIES AND VARIOUS NEWS

The same erosion that creates the pillars also destroys them. In the specific case of the Pillars of Segonzano part of their break-up can be put down to human intervention. Deforestation to make way for cultivation of the slopes and the construction of the road to Quaras has accelerated the erosive process. In particular, the drainage ditches built along the roadside take rainwater into the middle of the pillars.

During the First World War these natural spires were used as targets for artillery practice and were severely damaged by the 6 May 1976 Friuli earthquake. The rapid rate of degradation is evident when looking at photographs from different time periods. In sixty years (1898-1957) more than half of the pillars have disappeared. There are even significant differences comparing photos from the mid-1970s with those of today.

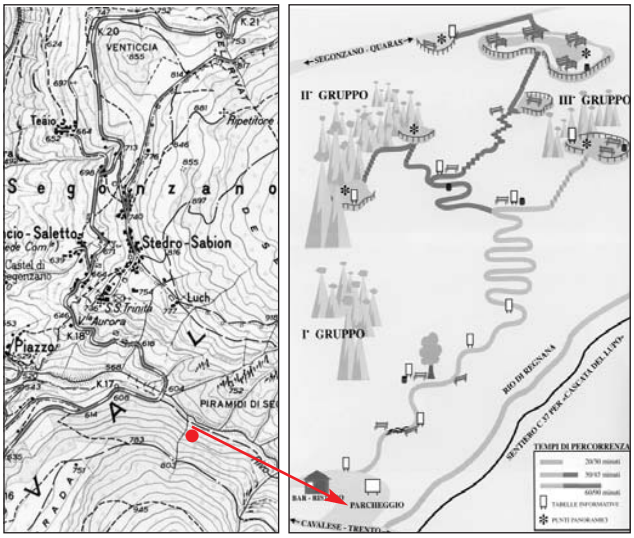
The first scientific contribution regarding the Pyramids was by Battisti & Trener. The work contains, besides photographic documentation dating to the last years of the 1800s, a precise description of the phenomenon which was successively expanded upon by Perna with the publication of monographies and articles on the subject. The fame of these pillars however certainly dates back to previous centuries: the German painter and artist Albrecht Dürer immortalised them in his 1495 watercolour “Alpine landscape”.

Piramidi di Segonzano fine 800

Piramidi di Segonzano fine anni ‘70

## OTHER SIMILAR EXAMPLES IN THE REGION

Such particular geomorphological features are very rare in the Province of Trento: Perna indicates landforms at Lover (Val di Non) and others in the valley of the Rivo Gaggio. This last form is an incision between that of the Rio Regnana and that of the Rio di Brusago (respectively to the SE and NE of Segonzano) and which stops before the watershed between the Val di Cembra and the Valle di Pinè. Mosna instead refers to the “*pulpit*”, an earth pillar on the scarp of the great morainic terrace of Cembra cut by the Avisio, at 587 m of altitude, at the same height as the pillars of Segonzano. In Alto-Adige most of the pillars are concentrated in a limited zone of the Adige river basin: there are some on the Renon and Avelengo plateaux, in Val d’Ega, in Val di Tires, in the high Val Pusteria, in Val Venosta, near Merano and north of Bressanone. As already mentioned, earth pillars are widespread in the Alps, where their local names often reflect local legends: “*Fées”, “Demoiselles”, “nonnes”, “dames” in France and* "*Muraglie del Diavolo*" *(devil's walls)* in Val d’Aosta. For the habitants of the Varese - Como district they are simply “*i fung de tèra*” (the earth mushrooms) whilst for the inhabitants of Brescia they are “*the grottos*”.




## USE OF THE SITE

Within the complex of the Pyramids of Segonzano four main groups can be distinguished which stand out from the mixed conifer and deciduous wood surrounding them, particularly in summer, plus a few minor forms. Various points of the Valle di Regnana allow a clear panoramic view of all the groups, but for a rational visit it makes sense to follow the equipped footpath that starts at the bridge on the Rio di Regnana, on the road connecting Lases and Segonzano. At the departure point there is an area with car park, refreshment facilities and an information board. The visiting route proposed takes in the pillars of three groups. The excursion is easy and short: it can be completed in 90 minutes on a clearly marked footpath with plenty of rest stops. The itinerary has an altitude difference of about 270 m and goes from 604 m at departure to about 875 m.

Today the pillars are visited and admired by student groups, by researchers from all over the world and for tourists they have become a cultural itinerary recommended by specialised journals and brochures prepared by the local Tourist Board of Altopiano di Pinè - Valle di Cembra.