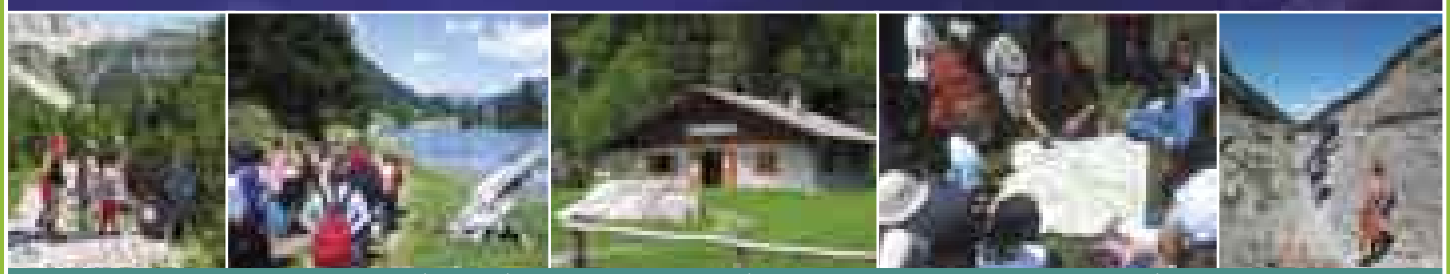
ADAMELLO BRENTA

APPLICATION DOSSIER



EUROPEAN AND GLOBAL UNESCO GEOPARK

ADAMELLO BRENTA
GEOPARK

APPLICATION DOSSIER FOR THE NOMINATION OF THE TERRITORY OF THE ADAMELLO BRENTA NATURAL PARK AS

EUROPEAN AND GLOBAL UNESCO GEOPARK

Museo Tridentino Scienze Naturali

Geological Service of the Autonomous Province of Trento

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Adamello Brenta Geopark

A	**DEFINITION OF THE TERRITORY OF THE EUROPEAN GEOPARK**	**2**
A.1	Adamello Brenta Geopark	3
A.2	Location	3
A.3	Surface areas – human and geographic elements	3
A.4	Organization in charge of the European Geopark zone (Ente Parco Adamello Brenta)	4
A.5	Attachments	5

B	**SCIENTIFIC DESCRIPTION OF THE EUROPEAN AND GLOBAL UNESCO GEOPARK TERRITORY**	**6**
B.1	Definition of the geographical region where the territory is located	7
B.2	General geological description	8
B.2.1	History of geological studies and knowledge	8
B.2.2	Geomorphological and geological description	10
B.2.2.1	A brief picture of the geodynamic evolution	
B.2.2.2	Geology of the future Adamello Brenta Geopark	
B.2.2.3	Geomorphology of the future Adamello Brenta Geopark	
B.3	List and description of the geological sites existing on the Geopark territory and details of their importance (scientific, educational, historical, cultural, popular)	16
B.3.1	Glacial and peri-glacial morphologies	17
B.3.2	Karstic morphologies	21
B.3.3	Sites of geological importance	24
B.4	Existing or potential pressure on the territory and on these sites	28
B.5	Existing measures for the preservation of these sites	28
B.6	Data on the management of these sites	30
B.7	List and description of non-geological sites in the territory, that can be connected to the sites of geological importance	31
B.7.1	Sites of demo-ethno-anthropologic importance	31
B.7.2	Non-geological sites of floristic and faunistic importance	34

C	**ARGUMENTS FOR NOMINATING THE TERRITOTY AS EUROPEAN AND GLOBAL UNESCO GEOPARK**	**36**
C.1	Comprehensive analysis of the territory for the development of geo-tourism	37
C.2	Overview of the geo-instututions and of the geo-activities existing in the Geopark area	39
C.3	Policy for preservation, enhancement, and economic development of the existing geological heritage	40
C.4	Interest of the territory to become part of the European and Global UNESCO Network of Geoparks	41

D	**GENERAL INFORMATION ABOUT THE TERRITORY**	**42**
D.1	Economic field. Description of the principal structures responsible for the policy of sustainable development and for the main economic sectors within the territory	43
D.2	Future prospective for territorial protection	45
D.3	Degree of protection of the territory	45
D.4	Existing services	46
D.5	Future services	47

A Definition of the Territory of the European Geopark

A.1 Adamello Brenta Geopark

The name of the area proposed for inclusion in the European and Global UNESCO Network of Geoparks is the "Adamello Brenta Geopark". This area includes the whole territory of the Adamello Brenta Natural Park plus an external portion on the borders of the protected area which includes the remaining territory of the municipalities partially located inside the boundaries of the Natural Park.

A.2 Location

The area proposed as a Geopark is located on the west side of Trento Province, in north-eastern Italy. Located between Valli Giudicarie, Val di Non, and Val di Sole, the area includes the Trentino portion of the Adamello Presanella Massif and the Brenta Dolomites. Between the two mountain ranges, which provide the name of the Natural Park and the future Geopark, is Val Rendena, with the Sarca river running from north to south.
There are also many side valleys of great aesthetic and naturalistic value, and thus of considerable tourist appeal. Particularly worthy of mention are Val Genova, Val di Tovel, and Vallesinella, which have access roads regulated by the Natural Park with special minibuses that, during summer season, provide alternative transport for tourists.
The area of the future Geopark is easily accessible by state road no. 237 from Brescia (70km), or by state road from Trento or from S. Michele all'Adige, driving for about 40 km west of the A22 motorway exit. A good range of main and side roads is available inside the area: together with a full range of paths covering the future Geopark for a distance of 900km. The eastern and the northern sides of the area are served by a local railway, the Trento-Malè line and a bus service linked to the railways is available.
In a larger scale, the area proposed as European and Global UNESCO Geopark is located in a strategic position, on the north-south axis that links Italy with Europe. This is an extremely positive element for eventual admittance in the European and Global UNESCO Network of Geoparks, and also to support the important target of "establishing a network".

A.3 Surface areas - human and geographic elements

The area which is proposed to the European and Global UNESCO Net of the Geoparks, includes, as above mentioned, the whole protected territory of the Natural Park Adamello Brenta, that involves a total surface of 62052 ha, and the territory that is functionally linked to it.
The borders of the future Adamello Brenta Geopark include a total surface of 114.645,62 ha.
The area proposed as Geopark, includes the whole administrative territory of the 38 municipalities of the Natural Park and is totally included in the Provincia Autonoma of Trento (Trento Autonomous Administration). The municipalities are divided into 4 districts: Valle dell'Adige district (C5, the east side of the Geopark), Val di Non district (C6, the east side), Valle di Sole district (C7, the north side) and Giudicarie district (C8, includes Val Rendena and the south side of the Geopark), for a total range of 41603 inhabitants (2006).
The populated areas are completely external to the protected area, located on the valley floors where there is the main population density. During the tourist season (summer and winter), the north side of Val Rendena, that has a strong tourist appeal, and some areas in Val di Sole and on the Paganella upland, are subjected to a big increase of population. (for a deeper investigation concerning the economy of the area see paragraph D.1; for the geographic description see paragraph B.1).

A.4 Organization in charge of the European Geopark zone (Ente Parco Adamello Brenta)

The request for admission to the European and Global UNESCO Network of Geoparks is presented by the Adamello Brenta Park Authority, a functional body of the Provincia Autonoma di Trento (Autonomous Province of Trento). It enjoys full legal status in public law, instituted in 1988 with the provincial law 6.5.88, n.18: "Natural Parks Regulations". The Adamello Brenta Park Authority manages the largest protected area in Trentino, the Adamello Brenta Natural Park, with its 620.52 square kilometers. The bodies of the Authority comprise: Management Committee, Executive Committee, the President, the Director and the Audit Staff.

The purpose of the Natural Park, defined in the first article of the provincial law, is *"The protection of natural and environmental characteristics, the promotion of scientific study, and the social use of environmental resources"*. Thanks to this purpose, the Natural Park has promoted an active protection of the environment, the spreading of an environmental culture, and sustainable development of local communities since its institution. In order to achieve these targets, in recent years the Natural Park has promoted numerous projects, under the following strategic lines:

• **Environmental and Biodiversity Protection**: with the protection of species and habitats, not only as an institutional duty, but also as an opportunity for economic and civil improvement for the population, representing an additional value for the territory.

• **Territorial Maintenance and Landscape Protection:** the Authority devotes substantial logistic and financial resources in order to achieve this target, being aware that a well managed territory becomes a fundamental resource, also for appropriate and lasting development.

• **Scientific Research:** fundamental for the enrichment of collective knowledge, the Natural Park assigns special importance to this functional aspect, in terms of stimulations and ideas, as guidelines for steering its decisions.

• **Environmental Education:** a very important target, increasing daily and becoming for the Natural Park an extraordinary means for spreading its culture and its deepest sense. This is closely tied to the training, that increases professionalism and competence, creating a high level occupational opportunity as part of the social and economic development for territorial protection.

• **Territorial Improvement:** referring, besides the landscape and environmental qualities, to the aspects concerning the culture, tradition, and history, all basic elements of territorial identity.

• **Sustainable Development:** in order to become a model and involve local communities in singling out new paradigms for the Human-Territory-Economic Improvement chain. The projects regarding sustainable mobility and energy conservation are important in this respect.

It is necessary to add, to these six strategic targets, three main values, that affect the way the Natural Park works:

• **Participation:** necessary requirement and main condition for the sustainability of the development. The Natural Park has promoted strategies, in agreement and with the support of local communities, as per the European Charter for Sustainable Tourism obtained in 2006. Participation extends outside its territorial limits, aiming to establish strategic alliances for a global environmental policy.

• **Communication:** as the ability to spread ideas and initiatives in order to demonstrate the importance and the utility of the Park, an in order to transmit values and appropriate

Excursion in the future Geopark – Photo Archive Pnab

behaviour patterns.
• **Quality:** as a philosophy and working method that must inform every action of the Park, with the objective of extending this kind of purpose to the surrounding territory and to users, making them aware of it. First Park in Europe to obtain ISO 14001 certification (in 2001), since 2006 the Park is registered as EMAS.
The strategic purposes, together with their values, are realized thanks to the many projects that the Park promotes with constant and coherent activity, being aware of the possibility of uniting the necessities of protection, research, and education with those of increasing and sustainable development.

Identity Card of the Adamello Brenta Natural Park
• **Authority:** Adamello Brenta Park Authority
• **Administrative office:** Via Nazionale, 24 – I 38080 Strembo - ITALY
• **Tel:** +39 0465 80 66 66
• **Fax:** +39 0465 80 66 99
• **Web site:** http://www.pnab.it/
• **E-mail:** mailto:info@pnab.it
• **Province:** Trento
• **Municipalities** (39): Andalo, Bleggio Inferiore, Bocenago, Breguzzo, Caderzone, Campodenno, Carisolo, Cavedago, Cles, Commezzadura, Cuneo, Daone, Darè, Denno, Dimaro, Dorsino, Flavon, Giustino, Massimeno, Molveno, Monclassico,. Montagne, Nanno, Paspardo (Brescia province), Pelugo, Pinzolo, Ragoli, San Lorenzo in Banale, Spiazzo, Spormaggiore, Sporminore, Stenico, Strembo, Tassullo, Terres, Tione, Tenno, Vigo Rendeva, Villa Rendeva.
• Instituted with Provincial law no. 18 of 6th of May 1988.
• **Park Plan:** approved with the deliberation of the provincial committee no. 6266 of 23rd of July 1999.
• **Management Committee:** 69 members; 39 are municipalities, 20 are main local bodies (Districts, ASUC, Comunità delle Regole Spinale e Manez), 10 are divided between Services of the Provincia Autonoma di Trento (Autonomous Province of Trento), Museum Tridentino of Natural Science, and other associations.
• **Executive Committee:** 11 members; 8 are representatives of the local communities and 3 are representatives of the Provincial Services: Antonello Zulberti (president), Paolo Ciardi (vice-president), Daniele Bolza, Federico Brunelli, Nicola Campidelli, Antonio Caola, Michele Cova, Alberto Flaim, Ugo Pellizzari; as provincial representatives: Giuseppe Sevignani, Lucio Sottovia, Roberto Zoanetti.
• **Director:** Claudio Ferrari

Referring person:
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Role: Director
Authority: Adamello Brenta Park Authority
Address: Via Nazionale, 24
Town and Postcode: Strembo (TN), I - 38080
Nation: Italy
Tel:+39 0465 80 66 66
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A.5 Attachments

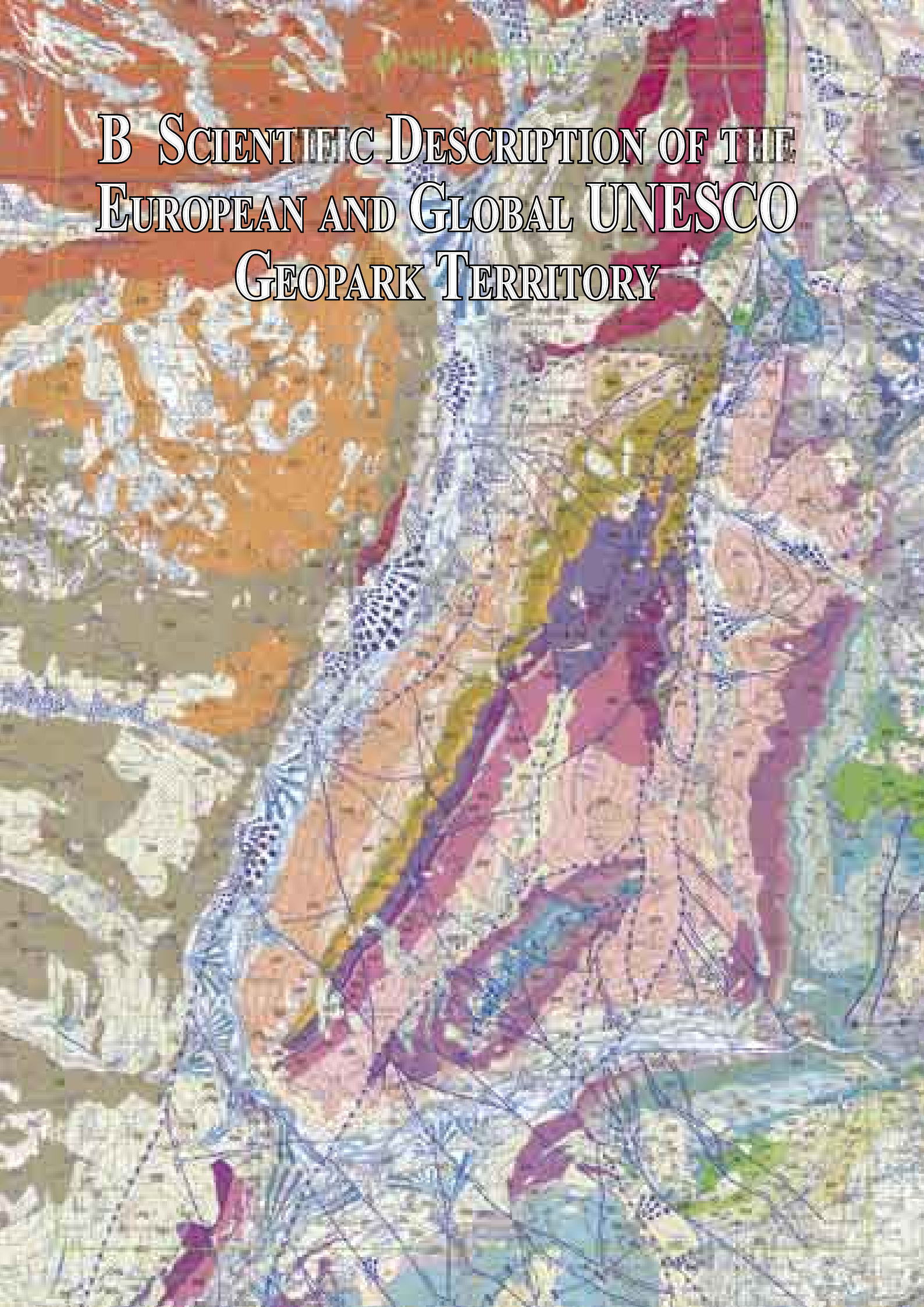
Attachment 1:
Map, list and description of geosites.

Attachment 2:
Supporting letter of the local bodies (Municipalities, APT – Tourist Promotion Agency, SAT – Tridentina Alpinists Society, and other involved bodies).

Flavona Mountain Hut – Photo V. Masè

School activities in the future Geopark

B Scientific Description of the European and Global UNESCO Geopark Territory



B.1 Definition of the geographical region where the territory is located

The area proposed as Geopark is located on the Retiche Alps, in the mid-southern Italian sector of the Alpine Range, including within its borders the Trentino portion of the Adamello-Presanella range and the whole Brenta Dolomitesrange .
The core of the future Geopark is constituted by these two mountain ranges that, thanks to their uniqueness and geological-naturalistic peculiarities, represent its main elements. To this extended territorial portion, included in the Adamello Brenta Natural Park, it is necessary to add wide ramifications of the Adamello and Brenta to achieve a total dimension of 114,645.62 ha.
This would mean substantially increasing the dimensions of the existing protected area. While the "administrative" borders of the Geopark seem to be "frayed", the physical and geographical ones are based on well defined morphological and structural elements that coincide with the main valleys of the area. This can be seen by looking at the external perimeter of the 38 municipalities involved in the Natural Park. These valleys represent the structural grid that has guided the shaping of this territory, located where the structural NE-SW group of the Giudicarie district, crosses the Insurbic line with an E -W orientation.
The north-eastern limits of the future Geopark are represented by the two valley axes followed by the Noce river, one of the main affluents of Adige river. These are the Val di Sole, which from 1880 mt. a.s.l. (Passo del Tonale) descends with a E-W orientation to the Stretta di Mostizzolo (594 mt. a.s.l.), and the Val di Non, that from this point defines, with an eastern orientation, the north-eastern portion of the Brenta Dolomites.
The south-eastern borders are delimited by the north-south orientated depression, containing Lake Molveno, and by the Upper Valli Giudicarie, followed in this area E-W, by the Sarca river.
The south-western portion borders on Val di Fumo and on Valle di Daone.
The west border of the future Geopark is the N-S ridge that divides Val di Fumo from Valle di Adamè; it coincides with the administrative limits of the Provincia Autonoma di Trento and the Adamello Brenta Natural Park.
Extensive mountain ranges surround this territory, in particular the impressive Ortles-Cavedale range, to the north of Val di Sole, and the Paganella-Monte Gazza range to the east.
The area proposed as Geopark is distinguished by its rigorously mountainous morphology, with ridges separated by deep incisions, flowing into the main valleys. An example is Val Rendena which, with its NE-SW course, separates two contrasting geological and geomorphological "worlds": the Adamello-Presanella and the Brenta Dolomites. Its flanks are intersected by wild tributary valleys, (Val di Borzago, Val S. Valentino, Val di Genova, Val Brenta, Valagola).
There are numerous peaks of above 3000 m, with Cima Presanella the highest peak in the Geopark at 3558 m, Crozzon di Lares (3406 m), Carè Alto (3563 m) and, in the Brenta Dolomites, Cima Tosa (3159 m), Cima Brenta (3150 m). and Crozzon di Brenta (3135 m).
In contrast with the peaks and ridges that dominate the Brenta and Adamello Presanella ranges, there are the gentler, more rolling features of the morphological terraces of Val di Non, Bleggio, and Banale. These features represent the eastern and south-eastern limits of the future Geopark.
From the heart of the two mountain ranges flows the Sarca river, formed from the union of the tributaries of Nambrone, Genova, and Nambino, that are fed by the the glaciers of Adamello-Presanella and by the Vallesinella tributary, that gushes out from the karst springs of Brenta.
The Sarca, a tributary of Garda Lake, before entering into the most extended Italian river system, runs through the whole of Val Rendena and, when it reaches the Conca di Tione, diverts to the east flowing into a deep curving gorge, before flowing south into the "Sarca"valley and finishing its course near Torbole sul Garda.
The Chiese river is the second main water course of the area arising from the Lobbia glacierand running the entire length of Val di Fumo and Valle di Daone before entering into Lake Idro.
The area proposed as Geopark is an extremely articulated and diversified zone, withthe spectacular uniqueness of its mountain landscapes at its heart and the remarkable geological and geomorphological diversity of the two mountain ranges that dominate it. The peculiarities and diversities of the bordering sectors are distinctive and characterizing factors that in the past had a dermining influence on the lives of the people in these areas. This interaction underlines the indissoluble union between human activities and their geological-environmental context.

B.2 General geological description

B.2.1 HISTORY OF GEOLOGICAL STUDIES AND KNOWLEDGE

At the beginning of 19th century, Geology was an established Science. Many scholars studied the valleys in order to discover the mechanisms that had formed so many varied and dramatic landscapes. In 1836 the *"Mineralogisch-geognostische Verein in Tirol"* (Tirol mineralogy and geology Association) was established, the third geological association after London (1870), and Paris (1830). A few years later, in 1849, the "Wien Imperial Geology Institute" was established, and in a short time this city had became the centre of Geological Research for South-Tirol.

In the second half of the 1800s Ferdinand Freiher von Richthofen, worked out one of the boldest theories of the History of Geological Research: the theory that the tropical cliffs in the South Seas and parts of the Dolomite Mountains, would have had the same origin: corals, sponges, alga, and other sea animals had created rocky elements that later rose from the sea floor.

Richthofen was convinced that a large part of the most important changes in the formation of the Dolomites were traceable to some slow movements of the earth's crust and to a slow lowering of the sea floor and consequent rising of the reef. While Richthofen was working in the eastern Dolomites, H.Wolf (1856-57), R.Lepsius (1875-78), G. Stache (1879), and Bittner (1881,1883), began to explore the mountains in Val di Non and in Val di Sole, examining their many interesting features and considering how those valleys might represent a key zone for the union of eastern Trentino with the Lombardia area (west), where, in the same period, the first Italian geologists were beginning their activity.

Geological Map of Brenta Dolomites – Trevisan, 1939

The first specific studies on the Adamello-Brenta Range, are attributed to Gumbel who, around 1870, began his studies on the Mendola walls and on the Brenta Range, in order to relate them with the Dolomites Peaks. In the same years Richthofen concludes that these territories had a similar geological history.

A few years later, G. Loss used the data of the Geologists of the Wien Federal Geological Institute and added it to his own, in order to describe the geological history of Val di Non. These studies are, overall, still valid.

The studies of M. Vaceck and W. Hammer are older still, and aimed to realize the "Geologische Spezialkarte der Osterreichische-Ungarischen Monarchie", published in 1903 (scale 1:75,000).

The approach to the study of the glacial and morphological environment of the Park was different, and began with the start of mountaineering on the Adamello and Brenta Ranges, even if several authors have already named these mountain landscapes as early as 1700 (Roschmann, 1738). The first citations of the Mandrone and Lobbia glaciers are found in the 1800s (Suda, Merciai,1925).

It was only after the conquest of Cima Adamello by Julius Payer that

it was possible to see the first cartographic descriptions of the massif's glaciers.
The valuable cartographic surveys that describe most of the main glaciers in the Adamello range are attributed to Payer (1863), Sonklar, Loretz, and Richter.
After a break during to the First World War, Schubert started his studies on foraminifers of the Mesozoic formation, and Salomon, Heiritsh, Spitz, and Klebersberg outlined a general stratigraphic and structural picture of the area. J.Pia extended his studies on Triassic formations in the Dolomites to the Ranges located on the west side of Valle dell'Adige. On the strength of this work he confirmed Richthofen's intuitions. When these territories become Italian, the Italian geologists also started studying this area. The first studies were probably by Fabiani, dealing with the Tertiary features in Val di Non. This was the forerunner for the surveys of the new geological maps (scale 1:100,000) of the Italian Geological Service. At the beginning of the 30's, Trevisan worked on a monumental monograph about the Brenta Range, published in 1939. The author established the main geological formations, that are still accepted, and underlined the clear diversity between the right side, completely included within the Massif, and the remaining section of Val di Non, with its own characteristics.
In the same years, the new scientific understanding of structural geology, led to further investigation regarding the tectonic aspects of this area.
In the same period the possibility of defining with close precision the nature of the intrusive rocks of the Adamello Range, and the possibility of correctly defining them in a chronological and evolutionary perspective become realistic. In the 50's the first studies on natural radioactivity began in some sectors (ex. Val Genova) and the first explorations in order to find uranium mineralisations in the southern sector of Adamello (Val di Daone).
In the same period the studies on glaciers were continuing, highlighting the variations of the glacial mass, and suggesting research into the mechanisms that, clearly, were leading to a progressive contraction of the glaciers (Merciai, Morandini, Castiglioni). In the second half of the 1900s, constant monitoring activity began by the Italian Glaciologic Committee, at the same time with the regular studies, which are supported by the Park. The information acquired (frontal measurements and pictures), have become an important database that is held at the headquarter of the Trento Alpine Club (SAT).
After this first step, long term monitoring activities were instigated, with the aim of studying the main characteristics and distribution of rock glaciers in the Park area. Again in the 50's, the superficial water resources became a subject of study, to plan hydroelectric plants on the massifs surrounding the valleys. Almost simultaneously studies began on Karst formations in the carbonate massifs. These studies underlined, firstly the great potentialial of this scientific field, and, secondly, they analyse in a detailed way the karst formations as they were identified.
The beginning of the 60's saw the first absolute dating of Adamello tonolite rocks, a process that was continued in later years and refined in recent times.
In the 70's and 80's the basic knowledge of the geological structure of the territory was established. Attention was concentrated to achieving detailed descriptions on specific aspects of particular geographic zones.
From the 80's onwards, attention was given to the geology and geomorphology of the Quaternary period, with the creation of detailed geomorphological maps of Adamello, and the reconstruction of the modelling processes that had transformed the area into its present form.
Today this extended area undergoing surveying in order to produce new maps for the Provincia Autonoma di Trento geological survey (National Project CARG).
These studies have provided a convincing description of the processes that shaped the present day territory, with the merit of exhaustively covering all the geological aspects of the area. Also worthy of note is the work carried out for the creation of a map for the educational landscapes of the whole Park area, thanks to the cooperation between the Adamello Brenta Natural Park and the Museo Tridentino Scienze Naturali; the studies on Rock glaciers with the collaboration of the SAT Glaciological Committee, and the recent studies into deep water circulation promoted by the Museum and Trento Province.

Lobbia and Mandrone Glaciers, as in J. Payer topographic map, 1965

B.2.2 GEOMORPHOLOGICAL AND GEOLOGICAL DESCRIPTION

The territory proposed as a European and Global UNESCO Geopark covers a key area in north-west Trentino, characterized by the presence of the tectonic border between the Austroalpine and Southern Alps, and by the union of three segments of the Periadriatic Alignment (Salomon, 1910; Dal Piaz e Bianchi, 1934; Exner, 1976; Schmid and others, 1989; Bigi and others, 1990). The territory extends to the northern limit of Southern Alps, in contact near Tonale with the internal area of the Alpine orogenic prism of European vergence, represented by Upper Austroalpine units. Both cases involve continental crust derived from the passive edge of the Adriatic plate, inverted during the alpine orogenesis, the Austroalpine close to the Mesozoic ocean, and the Southern Alps in a distal position. During the middle to upper Oligocene the Periadriatic Alignment generated the uplifting of this section of the chain, exposing the deep Austroalpine crust to erosion.

In the area described above , the Southern Alps are divided into two different blocks, bordered by the fault system of the Giudicarie and Sabion, with NNE orientation, and characterized by contrasting lithologies:

• In the eastern lowered block, the Mesozoic coverage of the Brenta Dolomites and the Insubrico Flysch.

• In the western raised block, the Baiolite of Adamello, with the oligogenic plutons of Presanella and Nambrone, the metamorphic base, some intrusive Permian bodies and few shards of the original Permo-Triassic coverage.

B.2.2.1 A BRIEF ANALYSIS OF THE GEODYNAMIC EVOLUTION

The existing units of the Park territory and of the surrounding areas are proof of a long and complex geological evolution originating in the Lower Paleozoico. The main stages can be traced to the pre-Alpine orogenesis, the long phase of lithospheric extension that created the passive Adriatic margin, and the Alpine orogenesis, started during the Creatico and still underway (neotectonic, seismicity).

The Austroalpine base rising on the North side of Tonale, outside the Park borders, contains a mafic-ultramafic metamorphites complex, which could represent, overall, the remains of an old pre-ercinic ocean (ophiolites) (Neubauer, 1988), subducted and deformed in a mountain chain during the Ordovician.

The collapse of this mountain chain (ercinic), caused by a progressive thinning of the lithosphere, began at the end of Carboniferous and increased during the Permian, (Piaz&Martin, 1998). The lithospheric extension continued until the development of the Noric-Jurassic continental rifting . This crucial phase of the development of the pre-oceanic Tetide is well documented by the Mesozoic coverage of the Brenta Range, located in a transitional area within some sedimentary-successions of habitat with different batimetries. In this area the Mesozoic facies indicate a rapid passage from an structural rise Trento Platform), and a basin area (Lombardy Basin) (Aubuoin, 1963), under the strict control of the sin-sedimentary faults. (Castellarin,1972,1082; Gaetani, 1975).

During the Triassic, but particularly during the extensional evolution of the Noric-Liassic rift, the Giudicarie lines and the Sabion line, could have had an important role. The north oriented continuation of the Ballino Garda tectonic scarp, is clearly recognizable along the west side of the Brenta Range. The line of the Vedretta dei Camosci, during the Lower Jurassic, borders to the east the succession in carbonate platform facies, separating them from the contemporary ones, characterized by a basinal habitat, and appearing on the western side of Val Meledrio. On the eastern side of Monte Spolverino, there are traces of exposures of the Tofin Formation, with its typical associations of limestones flintstones and calcium torbidites and voluminous bodies of mega-breccia (Castellarin and others, 1993). Moreover, the Jurassic rifting controlled the distribution of facies of Grey-limestones.

Between the Batonian and Lower Cretaceous, the events regarding the genesis of the oceanic crust in the Alpine Tetide and its expansion followed the rifting phase, with the consequent drifting of its continental margins that consequentially plunged.(Winter and Bosellini,1981). The stop in production of low-depth sediments in the platform areas and the improvement of batimetries in the basinal areas, are in fact proved by the emergence of bathypelagic facies, like the Ammonitic Red on the platform and the radiolarites on the basinal areas, followed by common successions of Majolica with a remarkable gap in their layers, passing from the zones of old platform to the basinal ones.

In the Upper Cretaceous, the most extreme expression of the sin-sedimentary tectonism is represented by the contraposition of the terrigenous facies with the carbonate facies along the west limits of the Brenta Range

Bacinal Triassic Succession – Photo R. Tomasoni

Outcrop of Megalodon – Photo M. Zeni

Megalodon, Noric Dolomia – Photo E. Guella

(Doss del Sabion area) and, to the north, along the western side of the Giudicarie Line (Val di Sole and Val di Rumo). In order to explain this kind of contraposition, some direct sin-sedimentary faults with a medium angled immersion to the west were identified (Castellarin and others, 1976). These kind of structures have controlled the sedimentary evolution of the area, creating the contrasting stratigraphic situation. Moreover, they had a significant palaeographic role, as they separated the leading trench of the neo-Alpine mountain chain and its accumulation of Insurbic Flysch (Val d'Agola) in the area of Samoclevo – Val di Sole, from the rise of the nearby platform, where the Scaglia Rossa, well recognizable in the area of Cles, was deposited at Tuenno (Castellarin and others, 1993). This kind of extending regime , has to be inserted in the orogenesis context in the face of an advancing chain, so the local direct faults are themselves expression of this kind of structural picture. The developing regime of peripheral bulging, in this area, was preceded in some cases and for a limited period, by a weak basinal inversion along the old Jurassic faults, as high-angle compressive through currents (Sasso Rosso-M Peller-Val d Non (Picotti and others, 1988)).

The alpine orogenesis started during the Cretacious, involving the Austroalpine domination of the Adriatic continental margin. The progressive subduction of the Pennidic ocean (eastern extension of the Ligurian-Piedmont ocean) proceeded into the Eocene, generating acretion of ophiolitic units with eclogitic metamorphism or blue schist facies at the base of the Austroalpine fault prism and, finally, their collision with the European continental margin, represented by the Pennidic base faults and cover exhumed in the Hohe Tauern windowand other more external units. The cold regime led by subduction has changed into normal or warm conditions, due to the continental collision and, maybe to the rising of warm asthenosphere, made easier by a possible detachment of the subducted oceanic lithosphere. These new thermal conditions produced a recrystallization of the collision prism, accompanied by remarkable ductile deformations. The genesis of peri-Adriatic magmatism, that exploded in the Olgocene (around 30-31 Moy) after the Eocenic symptoms, is due to the same tectonic-thermal causes, and is attributed only to southern Adamello and probably linked to favourable local tectonic conditions.

The long tectonic history, along the NNE lines (southern Giudicarie Line) and along the EW oriented transfers (Tonale Line), seems to have been very important as regards the settling of the batholite on Adamello, whose triangular shape could be interpreted as the expression of this origin. The batholite, composite and polygenic, developed between 42 and 29 million years ago (Del Moro and others, 1985; Martin and others, 1996), that is, between the end of middle Eocene and the beginning of Cattian, quite calm period in the orogenesis of the SouthernAlps.

Megalodon (Noric Dolomia) – Photo R. Trevisan

B.2.2.2 GEOLOGY OF THE FUTURE ADAMELLO BRENTA GEOPARK

As mentioned, the territory could be divided into two big sectors:

• The eastern block, with its Mesozoic coverage of the Brenta Dolomites

• The western block with the Adamello Batholite, the metamorphic base, some intrusive Permian bodies and few shards of the original Permo-Triassic coverage.

1) Brenta Area

The oldest units of the eastern area of the future Geopark are volcanic-sedimentary deposits of the Lower Permian; they consist of lava, ignimbrites and pyroclastics, with intercalations of river-lake deposits, that can be explained as refilling products of a big basin near Tione (Cassinis and others, 1982). Usually the percentage of river-lake deposits increases towards the North, achieving its maximum in the area near Massimeno.

Basically, the volcanic succession of the Lower Premian (appearing in Val Rendena), could be divided into a lower unit, consisting of lava and pyroclasts, and a upper unit, where ignimbrites are prevalent (Bargossi and others, 1993; Cortesogno and others, 1998).

Some clastic deposits of the Upper Premian (Verrucano Lombardo and Arenaria di Val Gardena) follow this succession. These deposits are well exposed on the South-East sector of the Brenta Range (Massimeno and Malga Plan, Val d'Algone, between Malga Movlina and Malga Stablei).

The Lower Triassic units are chiefly represented in western (Val Rendena) and in the south-western areas, the closest coverage to the Giudicarie Line. They are typical associations in "facies lombarda", not existing in the eastern sector, or, if existing, characterized by other facies, generally of the "Venetian" or "transitional" type. The Werfen Formation well visible from Ragoli and Val d'Algone (on the south side of Malga Stablei) is a clearly recognizable exception that, despite its smallness, shows some gaps that are similar to the ones of the Dolomites; this exception is valid for the conglomerate of Richthofen in Val Perse.

In the area of the Tione basin units are clearly shown, as the Prezzo Limestone, a formation represented by dark micritic limestones with ammonite moulds (Cima Durmont), and thick insertions of grey-green or yellow marly clay that have a volcanic origin (Buchestein).

The sedimentary successions of the middle sector of the Brenta Range rest on middle Triassic formations, on Contrine limestone and on the Sciliar Formation, a succession of dolostones of the Upper Anisico Age – Ladinico, well exposed on the internal sides of Brenta Range (Val Brenta Alta, Rifugio Casinei, Val Perse). Above them, in the Middle Brenta Range sector (Val Brenta Alta, Rifugio Brentei, Val Perse) a succession of almost one hundred meters of dolostone and dolomitic flinty limestones has been referred to the Breno Formation of Upper Triassico Age.

The Dolomia Principale is a typical formation of platform – dolostones, consiting of a monotonic succession of peritidial cycles (Bosellini &Hardie, 1985). It is placed in paraconcordance on top of the Breno Formation. The Dolomia Principale is the most frequent formation of the Brenta Dolomites, which take their name from the presence of this kind of rock. The most famous peaks of the mountain range are made of dolostones: Cima Brenta, Cima Tosa, the Grostè on whose sides the regular repetition of the strata are well shown; as well as the wide and impressive valleys like Valle di Tovel, Val delle Seghe, and Val Brenta Alta.

Zu Limestone overlies the Dolomia Principale (Valle delle Seghe, Val d'Ambiez, Rifugio Grostè, Turion Basso sides, Perra Grande sides, Croz dell'Altissimo sides, Val d'Ambiez, Val Ceda). Very often, these kind of sediments are rich in bivalve and coral fossils, an example is the "fossil cemetery" north–west of the Rifugio del Cacciatore, located on upper Val d'Ambiez, a layer rich in bivalve Megalodonts, sometimes of remarkable dimensions.

We can also find the Grey–Limestones Range, a sin-tectonic Unit of carbonatic platform, one of the most common during the sub-alpine Lower Jurassic, that developed under the control of the extensional tectonics of the Noric – Liassic rifting.

These typical associations of Bahamian carbonatic platform are bordered on top by Oolites of S. Vigilio. This preceded the definitive sinking of the platform in the deeper areas, largely "aphotic". This process is testified by the overhanging limestones of Rosso Ammonitico Veronese and Rosso Ammonitico della Maiolica. These kind of associations, in facies Veneta, are typical in the eastern sector of Brenta (to the east of the Val d'Ambiez Line); they are missing or incomplete in the western sector.

This chronological gap is characterized in a few sectors of the Brenta Range by the presence of particular units, that testify to the articulate

Scaglia Rossa – Photo R. Tomasoni

Grey Limestone in Pietra Grande – Photo A. Aprili

Jurassic palaeography in this area of the Southern Alps. It is important to mention the Membro di Stenico (in the Formation of Monte Zugna), composed of bioclastic "sponge spicule" limestones, oolites and peloids, that represents the marginal fore-slope deposits.

Another typical sedimentary body in the Brenta Range is the Membro di Tovel of Rotzo Formation, exclusively in the Brenta sector oriented towards Valle di Tovel, from here continuing to the south to the Valle del Sarca.

The Ooloite di S. Vagilio as well, mainly composed of sands of reddish crinoids, shows such peculiar aspects in the north sector of Brenta, that for a long time it was named Encrinite del Peller. It is full of "brachiopodi" fossils; a few of them, like the Rhynchonella Pellerii, are typical of Brenta, and are wrapped in discontinuous lines (Val Formiga) in association with bivalves and ammonites.

The tectonic fickleness of this sector between the Jurassic and Cretacious, is well shown by the impressing submarine slump cubbyholes that are fossilized in the Peller-Sasso Rosso and by the big accumulations of material slumped in the surrounding basin. It is even possible to see bodies of polygenic breccia in big metric blocks, alternated in the Scaglia Rossa, with body thickness from 50m. (Castello di Stenico) to a few m. The gaps have an age included within the Turonian, the Coniacian, and the Upper Santonian. The Megabraccia are an expression of sin-sedimentary tectonism along the Ballino Garda slope, that finds its continuation in this sector, in the N-S oriented high angle fault system of M. Valandro and M. Ghirlo, where the Campanian and Maastrichtian Scaglia Rossa is directly superimposed in unconformity on the denuded substrate, formed by the middle-lower side of the Grey-Limestones. Sedimentary veins with Scaglia Rossa filling of this gap go into this substrate for some dozens of meters. The most remarkable cretaceous Megabreccia body in this zone is the Marugini relief (to the NE of Castello dei Camosci), with a total thickness of about 250 m. These clusters cover with erosional and unconformable contacts the limestones of the Fm. del Tofino (Member D) to the west and the Scaglia Variegata Alpina albiana, the Maiolica and the Rosso Ammonitico Veronese to the east, sealing the sin-sedimentary Jurassic faults of Salti –Vedretta dei Camosci and of Marugini.

Another very important sedimentary cluster testifies the first phases of the lifting of the Alpine chain in this sector. This is the Formation of Val d'Agola, a prevalently terrigenous succession that is directly superimposed a few meters from the Scaglia Cenomanian and maybe Turonian. It represents the north-eastern equivalent of the Flynsch Lombardo, even named Flynsch Insubrico (Castellarin, 1977) that forms the sin-orogenic cluster of undeformed leading-trough of the neo-Alpine pre-Adamello chain.

A discontinuous sediment-succession of the Paleogenic Age on the SE is superimposed on it: here the deep sea conditions were principally inherited from the Mesozoic evolution, above all by rifting (Upper Triassic- Lower Jurassic) and by drifting (Upper Jurassic – Lower Cretaceous). These kind of conditions were subsequently maintained, and intensified, during the neo- and meso- Alpine evolution of the marginal sector to the pre-Adamello chain.

2) Adamello Sector

In the Adamello sector the oldest rocks are represented by the South-Alpine base, that forms the "encasing" rock of the Lower Permian intrusions (Granodioriti on Doss del Sabion) and of the paleogenic batholite of Adamello. In Val Rendena the schists diffusely appear in Val Borzago, in low Val Rendena and with a minor density in Val Siniciaga. They are mica-schists, nodular paragneiss and selicitrico-chloritic phyllites with insertions of acid ortogneiss, whose protolites have furnished the cooling ages of 439-470 million years (Moriani and Giobbi-Origoni, 1982). The Permiano batholite of Doss del Sabion intrudes into them. It consists 2/3 of granodiorites, well visible close to the Doss del Sabion Line. The granodiorites on the orographic rightof Val Rendena also belong to this unit, near the villages of Strembo and Caderzone (Caderzone Granodiorite).

This sector is dominated by the paleogenic batholite of Adamello, the major intrusive body of peri-Adriatic magmatism. It is formed from several plutons of mainly tonalitic composition and by a few basic southern bodies.

The "peri-Adriatic magmatic system" (Salomon, 1897), basically of oliogenic age, is represented by intrusive bodies, volcanic veins and rooms that outcrop along a belt of 700km, extending from Valle d'Aosta to the Austrian-Slovenian border.

The Adamello batholite is divided into several magmatic groups (Bianchi and others, 1970), partially ascribable to independent plutons with reference to the intrusive relations and to the xenoliths. It has been possible to define a sequence of intrusive events, fixed by radiometric dating between 42 (southern Re di Castello) and 30 million years (Val di Genova) (Callegari and dal Piaz gb., 1973; Del moro and others, 1985b.; Martin and others, 1996). The southern basic bodies (Monte Buffione) were fed by mantling sources, previously contaminated by fluids coming from the subduction areas. The "Trondhiemitic-Dioritic" bodies of the middle-eastern sector (Corno Alto) were fed by "melts" contaminated by the lower crust. The northern tonalitic bodies (Adamello Val di Genova) by residual "melts", coming from the subdivision of basic magma in deep rooms and contaminated by materials from the upper crust (Mendum, 1976; Jhan &Blundy, 1993; brack, 1985; Zattin and others, 1995).

B.2.2.3 GEOMORPHOLOGY OF THE FUTURE ADAMELLO BRENTA GEOPARK

The landscape of the future Geopark, shows some clear signs of the glaciation that deeply affected this territory, still active at the highest altitudes. Some erosive and depositional processes connected to water and gravity followed the glacial phase; these processes formed gorges, alluvial plains, fans, landslides, and detrital strata.

Among the morpho-genetic phenomena, karstification is the one that more than any others has determined the clear diversification within the articulated landscapes of the Brenta Dolomites and the austere features of Adamello-Presanella. In the Brenta Range, due to the carbonatic nature of the emerging rocks, the karstic morphology finds its greatest expression; this is a kind of morphology that has partially obliterated or remodelled the glacial signs. It is still possible, however, to recognize the distinctive glacial features.

On Adamello it is not possible to find karstic processes due to the plutonic origin of the rocks.

The mountain massifs inside the Park area were affected by the big Pleistocene glacial expansions, in particular they were affected by the Last Glacial Maximum expansion (LGM) , by the successive Late-Glacial phase, and finally by the so called Little Ice Age (LIG) .

During the LGM on the Adamello massif, the lobes of some of the biggest glaciers of the southern Alps branched out to the South. These were the Chiese Glacier and Oglio Glacier located in the homonymous valleys. A remarkable lobe came down from Val di Sole, and arrived to the Stretta di Mostizzolo where, joining with a ramification of the Atesino Galcier, flowed towards Val di Non trough Passo Palade and the Mendola saddles.

This impressive ice-mass, bordered the east side of Brenta Dolomites, reaching an altitude of 2000 m, continuing to the South trough Val di Andalo, flowing into the Conca del Bleggio, and finally into Valle del Sarca trough Passo Ballino.

The succeeding phases did not reach such extension, and were confined in limited sectors, till the last glacial expansion which occurred between the XVI and the XIX century (Little Ice Age). Impressive evidence of this can be found at the highest altitudes.

The morpho-genetic action of the glaciers created shapes that are basically soft; some spectacular examples are the extended valleys with parabolic-transversal profiles (Val di Fumo), or by the longitudinal profile, recognizable in the extended basins or plains, alternated by steep rocky thresholds, that can reach

Moraine of Little Ice Age in Adamello Massif – Photo R. Tomasoni

an altitude of some hundreds of meters (Val di Genova).
The mountainsides are marked by extended glacial sides; the large cirques of the highest sectors are surrounded by jagged tops and sharp peaks; examples are Upper Val d'Amola and the area of Laghi di Cornisello.
In several valleys the *trimlines* are perfectly preserved from the LGM and to the LIA (Little Ice Age). Examples include Val di Genova and Val d'Amola.
There are several lakes on the glacial over-deepening basins; some of them have formed in recent periods, due to the remarkable retreat of the glaciers in the last fifty years (Lago Nuovo del Mandrone and Lago Nuovo di Lares, on Adamello).
Fields of roche moutonnèe and striations are especially widespread on the Adamello –Presanella Range, due to the crystalline nature of the rocks and to the recent de-glaciation of this sector. Often, the shapes of the glacial modelling process, follow and remark the structural motives that characterize these ranges.
Depositional shapes that concern the main phases of the Late Glacial Period and the LIA, are present in many Park valleys. The glacial deposits of the LIA arevisible as lateral moraines with a ridged profile, located near the current glaciers, or near the ones that have recently become extinct. Remarkable examples of this kind of feature are visible in Val d'Amola and in Valagola.
With reference to the peri-glacial sphere, in Adamello and Brenta *rock-glaciers* are very common. These landforms have been deeply studied for a long time, and studies are in progress thanks to the Park in collaboration with some major research institutes.
In the Brenta Dolomites, as mentioned above, glacio-karstic morphologies prevail; wide karstic basins and extended gently leaning surfaces, characterized by karstic clefts, sinkholes and dolinas, often aligned along tectonic structures (faults and fractures), dominate the middle-northern sector of the Brenta massif. Impressive examples are the Pian della Nana, Pozza Tramontana, and the Conca dei XII Apostoli, where the glacial signs surround an extremely suggestive karstic landscape.

Aladino Cave – Photo Museo Tridentino Scienze Naturali

Even hypogean karstification is well developed and, several of the water courses on the Dolomite massif are fed by karstic sources. Examples are the sources of Rio Bianco, near Stenico and the celebrated Vallesinella Waterfalls, which are the source of a branch of the Sarca River, that gush out of some fracture systems and interbed leaks.
Numerous caves, cavities, and karstic wells strongly influence the water, making the Brenta Dolomites a very important karstic acquifer. This is why the massif has been studied and monitored for many years (Borsato and others, 2000).
Among the caves, studied since the Middle Ages, worthy of mention is the Bus de la Spia, near Sporminore. It floods at regular intervals, due to the rising of watersfrom a siphon located some hundreds of meters away from the entrance.
Besides karstification, there are numerous morpho-genetic processes that, not being linked to glacial action, are still active. Gravity leads to the genesis of strata and debris cones, located on the floor of almost all the canyons and the rocky areas. Alluvial fans are located on the floor of the main valleys, and torrential deposits, active fans and *debris-flow* are located at the higher elevations.

Nardis Waterfalls – Photo Faganello

B.3 List and description of the geological sites existing on the Geopark territory and details of their importance (scientific, educational, historical, cultural, popular)

The previous section described the uniqueness and at the same time great geological diversity of the Adamello Brenta Geopark, with several geological expressions of a certain relevance.
In order to focus and characterize the geological and geo-morphological peculiarities of the future Geopark, four relevant categories representing the main processes that are responsible for the genesis and the evolution of the territory have been identified: glacial and peri-glacial morphologies, karstic morphologies, geological sites, and demo-ethno-anthropological sites.
For each category the sites of high geological value are identified, representing one or more process. The evaluation of each sitemade according to the criteria of the census and cataloguing processes of the geo-morpho-sites of Trentino. This operation was coordinated by the University of Pavia in cooperation with the Museo Tridentino Scienze Naturali and was inserted in the research process COFIN–2001 "Geo-sites in the Italian landscape: research, evaluation, assessment".
Attention was given to those elements that support in a clear and exemplar way a past core event, or a past event of the climate history, helping understand the territorial evolution of each territory involved.
On this basis, a list was created ofall the elements that, together with their uniqueness, could significantly contribute to the understanding of the geological history of the territory proposed as European and Global UNESCO Geopark.
The principal criteria applied in order to choose these elements, were integrity, uniqueness within the regional area, representative for a specific process, didactic importance, naturalness and conservation status, value (intended as evidence of the geologic history), scientific relevance, and their landscaping, historical, cultural, and ecological values. Moreover, the eventual geo-tourist exploitation of these sites was also considered, favouring the sites that, of equal value, are located in accessible areas and that would not suffer any obvious environmental damage.
The location and the concise description of the 60 sites that are deeply linked to the glacial processes, are represented in the cartographic attachment. The next paragraphs represent a brief analysis of the 4 categories mentioned above; for each category some sites that represent a whole geological category are described.

Agola Glacier – Photo V. Masè

B.3.1 GLACIAL AND PERI-GLACIAL MORPHOLOGIES

All the sites that are inextricably linked to the glacial and peri-glacial processes belong to this category.
Most of them are located in the Adamello-Presanella Range, because this Range is the centre of the main glacial areas of the whole territory proposed as Geopark; some of the main glaciers of the Alpine Arc are located here. The geological peculiarities of this sector have permitted a complete preservation both of the glacial morphologies referred to the Pleistocene LGM and to the subsequent "late glacial" and LIA expansions.
Some very representative sites, evaluated according to the above mentioned criteria, are described in the following paragraphs.

Agola Glacier
The Agola is a small cirque glacier, with a surface of almost 220 ha; it is oriented towards the North-West. It has a sub-triangular shape, its front is located at an altitude of more than 2850 m. Dolomitic rocky sides surround the glacier on the north side, for more than three quarters of its perimeter; to the south it is exposed and arrives on a detrital side that is almost flat. This glacier is fed by avalanches that fall from the surrounding rocky sides; avalanches that are basically settled on the central zone of the glacier, by a slope alteration. The result is an anomalous (irregular) distribution of the accumulation, referred to the central area of the glacier, but not to the top of it. This kind of accumulation is typical of many Brenta Dolomites Glaciers, and is one of the most peculiar characteristic of them. Particularly impressive and significant are the erosion and accumulation glacial morphologies, that characterize the glacier's surroundings. The lateral moraines of the LIA completely border the shape achieved by the glacier during the last expansive phase; a phase that finished around 1850. They are two sharp bars, located on the borders of the glacier, whose crest is located about 40 m above the exisitng surface of the glacier. The Agola Glacier, at maximum LIA expansion, had an extension of about 55 ha; from that period it has suffered a frontal retreat of about 800 m. Roche moutonnèe characterize the rocky sides on the borders of the glacier and the whole floor-area. Noteworthy, apart from during the intensive summer melting process, is the absence of a pro-glacial stream, is the meltwater being immediately captured by the karstic water- circulation system, that characterizes the whole Brenta Range.

Lobbia Glacier
The Lobbia Glacier is located in a wide valley groove, oriented North-South; it is bordered to East and West by two rocky ridges, with crests that sometimes surpass 3400 m in altitude.
It is a complex glacier, characterized by several lateral glaciers flowing into a central upland. The upland creates two valley-tongues. The World Glacier Inventory classifies this glacier as "valley glacier with simple field"; by other classifications it is defined as "upland glacier with radial lobes". The central flat area divides the impressive north lobe (descending to Val Genova), from the smaller lobe that goes to the South (to Val di Fumo). This glacier is basically characterized by immediate feeding, and by several crevassed zones, located in particular near the lateral feeding fields and near the slope alterations of the valley lobes.
Around 1820, as described by Julius Payer, the glacier's surface was about 1200 ha; in 1925 it was about 930 ha. During the 60's, the Italian Glacier Inventory calculated a surface of 760 ha. Today the area has a total surface of 666 ha (2003). This is the second glacier of the Adamello Range (for extension). The front, today oriented to Val Genova has retreated by more than 2 km between 1850 and 1985-90. During the greatest action of LIA (around 1850), the glacier was extended as far as Malga Matarot, and nearly linked to the big glacial flow of the Adamello/Mandrone Glacier. In recent years the northern front has suffered a retreat of about 220 m. (between 1996 and 2005) and, due to its small thickness, it will soon to disintegrate.

Adamello/Mandrone Glacier
The Adamello Galcier has been classified as an unitary glacier only in the last years. Recent research permitted verification of the thickness and the most important glacial flow directions in the Passo Adamè area, and on the Pian di Neve. It has been deduced that this area is basically a

Lobbia and Mandrone Glaciers – Photo G. Alberti

large accumulation area; from this area several lobes are formed. The greatest of them flows to Val Genova (Mandrone Lobe) and is included in the area that is proposed as Geopark. The Adamello/Mandrone is the most extensive glacier of the Italian Alps, and represents the main element of the glacial system of the central area of the Adamello Range.
The WGI defines this glacier as "a valley-apparatus with a composed field", but it is possible to classify it as "an upland glacier with radial lobes". Generally, the starting point of the glacial flow, that runs towards Val Genova (Mandrone Lobe), is located by Passo Adamè. The Adamello Galcier is directly fed by snowfall. Several glacier zones are deeply crevassed, particularly near the slope alterations and on the most steep lateral sectors. As described by Julius Payer, at the end of the 1800s the glacier extended for 3000 ha; during the 1920s it had an extension of less than 2500 ha. The last survey on the glacier's area was in 1997 and calculated a total extension of 1763 ha.
The lobe located on the head of Val Genova has suffered a retreat of about 2 km from 1820 when it arrived above Rifugio Bedole (about 1650 m.) and the LIA was at its greatest. The glacier front, of very small thickness, suffered a retreat of more than 130 m from 1989 to 2005.

Val d'Amola Rock Glacier

This is a medium sized rock glacier, oriented to the north and located at an altitude between 2290 and 2490 m a.s.l..It consists of the tonolites and granodiorites of the tertiary Batholite of Adamello. This rock glacier is constituted by an unitary inflated detrital body ("mono-morphic" rock glacier), that lacks a proper structure and/or undulations. The glacier is 530 m long and about 250 m wide, with a surface of about 9.8 ha. On its sides the detrital body shows two longitudinal lengthened crests, while the central area is depressed. The frontal area is roughly divided in two lobes. The deposit is superficially constituted of enormous rocks; while the deeper levels are characterized by thin material. The bigger and well oriented boulders are affected by a wide coverage of lichens, while the superior/upper vegetation is totally missing.
In accordance with several morphologic indications, this rock glacier is considered active and moving. Near the Val d'Amola Glacier there are two others rock glaciers: the first one is located on the right side of the main apparatus, the second one is located on a semi-cirque of the main rock glacier. The presence of active rock glaciers confirms the theory that the right side of Val d'Amola, as other zones characterized by the same conditions, is affected by inconstant permafrost that, in the well exposed areas achieves, towards the floor, an elevation of about 2300 m.

Val d'Amola Rock Glacier – Photo R. Seppi

Head of Val Genova

The Val Genova enters for about 20 km inside the heart of the Adamello massif, dividing the Presanella and the Adamello Range. The wild look of its natural landscapes, basically linked to the impressive glacial and peri-glacial morphologies and the numerous waterfalls, makes the Val Genova one of the most interesting tourist attractions of the whole area.
Its head in particular, maintains some

In 1865, from a picture of J. Payer

In 2006 – Photo A. Carton

Lobbia and Mandrone Glaciers

Mandrone Glacier

In 1890 - Photo G.B. Unterveger

In 2006 – Photo R. Tomasoni

of the clearest morphological signs connected with the evolution of the Lobbia and Mandrone glaciers, the two main ice masses of the future Geopark. The analysis of these enable a detailed reconstructionof the recent geological history of this habitat. Wide depressions of glacial overdeepening (Piana di Bedole, Pian Venezia, and Conca del Matarot), are divided by steep rocky terraces. From these terraces, a long time ago, descended the impressive ice-falls of the two glaciers. The Piana di Bedole (1580 m) is traversed by the Sarca River, that rises from Pian di Venezia. (1650 m). The river has its source in the union of the Mandrone Glacial streams, descending from the rocky ramparts of Acquapendente, and the Lobbia streams, coming from the Conca del Matarot (1720 m). The Conca del Matarot, a marvellous amphitheatre that overlooks the right side of the main valley, was filled, till the end of IX century, by the Lobbia Glacier's tongue, whose front, now retreated by more than 2 km, is today at an altitude of about 2700 m. Inside this trough, the glacial lobe has left several well preserved signs of its passage. There are some lateral and frontal morainic levees that testify the glacier's position during some phases of its retreat. These conditions make the site particularly interesting for scientific research. The relatively easy access to the area, and the excellent preservation of the glacial morphologies, have permitted a detailed reconstruction with precise temporal references, of the frontal variations of the hanging glacier during the LIA process.

The gorge formed by the Sarca River is of special interest, produced by the morphological gap between the Pain di Venezia and the Piana di Bedole; it represents one of the most beautiful expression of fluvial erosion of the whole area. Several hanging valleys are modelled on the sides of Val Genova; their floors are located on higher elevations in comparison with the main floor; the water courses running trough these areas form spectacular waterfalls. These include the famous Cascate di Nardis and Cascate di Lares.

A characteristic morphology of the right side of the upper Val Genova is the so called "Menecigolo Belt", a sub-horizontal glacial cliff, interpreted as a glacial side. The "Mencigolo Belt" borders on the top a clear trough, formed by a very thick ice lobe, originating from the confluence between the Lobbia and Mandrone glaciers during their greatest expansion.

Monte Peller

A site located on the north-east side of the Monte Peller (2300 m a.s.l.), it represents the extreme limit of the future Geopark. It is a beautiful example of a relict cirque glacier; it is characterized by a circular shaped depression, surrounded by steep rocky sides and partially barred downhill by an unprominent threshold, that is bordered by morainic curved bars. It develops from an altitude of 1900 m to the top of Monte Peller, about 2300 m, with a diameter of 600 m. The rocky sides that surround it are formed by terrigenous Limestones that are closely stratified; their tonality goes from Grey to Dark Red.

Mount Peller – Photo R. Tomasoni

Val di Fumo – Photo V. Masè

They belong to the Scaglia Rossa Formation (Cretaceous). In some zones the regular sub-horizontal attitude of the strata appear interrupted by chaotic intervals characterized by sin-sedimentery micro-folds that are the proof of old slumps. The sub-vertical sides reach an altitude of about 200 m, and are connected to the cirque-floor by colluvium faults; they have several debris flow channels. The two sides of the cirque form a semicircle oriented NE-SW: the southern side is connected to a morainic levee; a small niche is formed near this zone. The northern side, at whose top is the Rifugio Peller, is completely rocky.
The rocky floor shows the features of an over-excavation depression that is now filled by detritus. Two small lakes are located on the most depressed zones and small sinkholes characterize the rocky sub-stratus.

Val di Fumo

Val di Fumo represents one of the most evident examples of a glacial erosion valley; it is North-South oriented with a total extension of about 11 km in the southern sector of the Adamello Massif. The valley-floor, almost flat and uniform, goes from an altitude of 1800 m (Malga Bissina Lake) to an altitude of 2300 m (Conca delle Levade).The valley is formed by the igneous rocks of Adamello Batholite. The lithological monotony of the area, permitted the glacial erosion to create impressive perfect shapes.
From the Rifugio Val di Fumo to the head area, it is possible to see a perfectly defined transversal "U" shape profile. It is locally covered by colluvia or other deposits. On the sides, particularly steep, and on the valley-floor, there are wide surfaces of Roche moutonnèe, smoothed and striated, that follow the flow of the glacier. The two sides of the glacier,right- and left-hydrographic, are well shown, interrupting the side-continuity. The eastern ridge has Cima Carè Alto on top, characterized by several cirques with small glaciers. In some cases they are characterized by impressing lateral-frontal moraines attributed to the LIA. A few glacial cirques are present up the main valley-side and they exist even on the west ridge of the valley where, however the, glaciers are now absent. In the valley-floor, the over-deepening depressions have created peaty and moist soil. From this area the Chiese Stream, fed by the melting waters of the Lobbia Glacier, winds its course.

Val di Fumo – Photo V. Masè

B.3.2 KARSTIC MORPHOLOGIES

The geological prominences that are representative of the karstic processes and features are representative of this category.
Due to the geological and stratigraphic structure of the area proposed as Geopark, these kind of sites are located exclusively in the carbonatic Massif of the Brenta Dolomites and its ramifications.
Very significant are the phenomena linked to the superficial karstifications that have covered the previous glacial morphologies. Less diffused, but extremely significant, are the examples of hypogeal cavities and karstic sources.
The following paragraphs describe some particularly significant sites, evaluated in accordance with the above mentioned criteria.

Vallesinella Sources and Waterfalls
Vallesinella is one of the most suggestive valleys of the Brenta Dolomite Range; among the most beautiful elements are the many waterfalls in this area. The carbonatic nature of the outcropping rocks of the area, and in general of the whole Brenta territory, has favoured the development of remarkable karstic phenomena. This process permits the water to flow on the surface for a while, then disappearing under the soil, re-emerging far down from an openingin the rock, generating a spectacular water show. The Vallesinella Waterfalls are the expression of an articulated and complicated karstic system, representative for the carbonatic massif. In some cases the water comes out directly from the rocky inter-strata, more or less stratified, of the Principal Dolomia. This is the case of the Cascate Alte waterfalls; located between 1550 and 1610 m, which can be considered as the Source of the Sarca di Vallesinella river. A little far down the Sarca River flows into a restricted gorge, forming the Cascate di Mezzo waterfalls.

Vallesinella Waterfalls – Photo Archive Pnab

Bus de la Spia
Located above the village of Sporminore, near Castel Sporo-Rovina, not far from Val Goslada, the Bus de la Spia is one of the most famous and oldest natural caves in Trentino. At the beginning of the 1600s Marx Sittich von Volkenstein mentions it in his "Landebeschreibung von Sueditrol": "…a big hole that seems to sink deeply in the Earth, but where no-one has ever had the courage to enter…".
The large entrance was used as a store by the Castellans; later the lower tunnel was built in order to prevent the cave from flooding caused by internal floods. The first exploration and the first detailed description was given by Cesare Battisti (a noted regional Geographer at the beginning of '900).
The cave is formed along a fault plane, oriented towards the internal zone of the side; it perpendicularly cuts the strataof the Grey Limestones (Borsato, 1995). The Bus de la Spia has a single gallery about 300 m long with a diameter of about 3 m. It descends steeply to a terminal lake-siphon, whose minimal winter level is

Bus de la Spia – Photo Mattei, 1993, Gruppo Grotte Rovereto

located at about minus 59 m from the entrance. It is possible to further proceed only by immersion. The gallery proceeds, descending for more than 200 m (maximal difference of level minus 38 m) to the south.
The Bus de la Spia is famous for a peculiar and unique phenomenon of rhythmic oscillation of the level of the terminal siphon (Battisti, 1905). Every 6-7 hours the water level starts to slowly rise, rumbling for the expulsion of the air bubbles that are trapped in the rock cracks. After about 45 minutes the water level starts to lower to the initial point. The cave flooding usually affects the long final slide down to the lake-siphon; the more external area is reached by the water only during particularly intense rainfalls when some small basins are filled, forming typical small lakes. The water rarely comes out the cave.

Collalto Cave
Located at an altitude of about 100 m, on the Principal Dolomia Formation (Noric), at the beginning of Val d'Ambiez, near S. Lorenzo in Banale. A brief conduit links several shafts of different wideness, that proceed one after another achieving a depth of 120 m. From this point on, the cave branches out in several sub-horizontal galleries that have an average dimension of 3x3 m. These galleries, in the deeper area, cross some wide halls, more than 100 m long and 40 m high. On their floor it is possible to see accumulations of sand and clay, and a stream, fed by springs located on different levels, flows at intervals. The whole length of the cave is about 5km; this peculiarity makes the Collalto Cave the most extended karstic cavity of the Brenta Dolomites, with the widest range of hypogeal habitats in Trentino.

Arca di Fraporte
Natural Bridge on the Grey Limestone Formation (Lower Jurassic), located at an altitude of 1436 m a.s.l. on the right side of the head of Val di Laone, above the village of Stenico in Val Giudicarie. Its dimensions are so remarkable that it is almost impossible to note the arched shape from a close distance. It appears as a wide cave 66 m long, 49 m high and 42 m wide, tapering at its end. Only entering the cave it is possible to observe the enormous rocky bridge, about 40 m long and 31 m wide, at a height of 50 m. The arch is divided from the rear rocky wall by a wide crescent-shaped window of .
The genesis of the Arca di Fraporte is traced in two evolutional phases: first a wide underground cavity formed under the rocky spring where the bridge is formed; next, the most external zone of the vault divided fromthe rest of the side; this happened due to the formation and enlargement of the crescent-shaped window. These processes are due to water action that entered the most fractured and permeable sectors of the rocky structure. On the vault's opposite side it is possible to see a big circular hole, about 10 m wide, whose genesis is connected to the complex hydro-geologic evolution of this small valley.

Collalto Cave – Miorandi – Photo Gruppo Grotte Rovereto

Arca di Fraporte – Photo A. Ghezzo

Conca dei XII Apostoli

The Conca dei XII Apostoli is located in the mide-southern area of Brenta Dolomites; it is a wide area in upper Val Nardis, and is bordered on the upper side by Cima d'Ambiez (3096mt.), Cima Val d'Agola (2966 m), and Cima Pratofiorito (2909 m). The profile of the valley is characterized by a terrace morphologiy on a monoclinal structure, crossed by several wide faults. Of note is the Linea della Vedretta dei Camosci, where a spring at 1500 m, connects the Grey Limestones (on the west side), with the Principal Dolomia (on the east side). The structural asset, with the collaboration of the carbonatic nature of the appearing lythologies, has favoured the development of remarkable glacial-karstic morphologies, dominated by wide depressions that can reach dimensions of 150-700 m and depths of about 20 m. At high altitudes, on the sidewalls, it is possible to see small cirque-glaciers of the Vedretta dei XII Apostoli, Agola, and Pratofiorito. On the floor fronts there are the de-glacialized areas, with roche moutonnèe, and the lateral-frontal morains of the LIA are obvious.

The karstification find its maximum expression in the numerous wide glacio-karstic depressions, and it is identifiable even in restricted karstic gorges or in superficial micro-formations as "spray grooves", "channelling", "interlayer cavities", "corrosion baths", and karstic holes and clefts.

XII Apostoli Basin – Photo V. Masè

B.3.3 GEOLOGICAL SITES

All the sites that have geological-stratigraphic, sedimentary, palaeo-graphic, paleontological and geo-morphological characteristics can be put in this category (referring to those not put into the two previous categories).
These phenomena are distributed in a more homogeneous way on the future Geopark territory, because they are representative for a wider number of geologic processes.
The following paragraphs describe some particularly significant sites, evaluated with the above mentioned criteria.

Fossil Mine in Val Formiga – Photo R. Tomasoni

Fossil Mine of Val Formiga
This is a rich fossil mine located on an altitude of 1900 m, at the head of Val Formiga, a small valley that from the glacio-karstic depression of Pian della Nana descends to Val di Tovel.
The Mine was known from the early 1900s, and has been deeply studied by several scholars, especially in the first half of the previous century (Vialli, 1937). It is a small lens, created by the stratigraphic enclosure of the of "Encrinite del Peller" formation (Lower Toarcinano-Bajociano Age).
The studiess have noted a remarkable fauna of brachiopods and cephalopods that can be traced in the Lower Toarcian and Aalenian; some of them are typical to the Brenta Massif, like the Rhynchonella Pellerii.
The fossil concentration is due to the fact that they have filled a karstic depression that originated during the Upper Pliensbachian, in the lower Massone Formation.

Paleo-landslide of Sasso Rosso
The detachment niches and part of the accumulation of big paleo-landslide of the Upper Cretaceous are exposed on the southern side of Sasso Rosso, a peak 2600 m high belonging to the northern ramifications of the Brenta Range. They are "fossilized" in the karstic-silicoclastic sedimentary-succession (Castellarin,1972).
These are marvellous erosion and deposit formations, that involved the submarine slopes during the Middle-Upper Cretaceous, when the sea floors were passing a phase of general instability. This site is representative of the palaeographic cretaceous evolution of the Brenta Dolomites.
Not far from the "paleo-landslide", on the jutting northern side of the Sasso Rosso-Cima Uomo ridge, it is possible to see another spectacular geological structure: the Moud Madris, perfectly preserved in the structure of Lago di Tovel in the Grey Limestone. This is a dome structure, about 50 m wide, with a maximum thickness of 35 m. It represents a rare example of a mud mound, visible in the carbonate successions of the area.

Sasso Rosso paleo-landslide – Photo R. Tomasoni

Limarò Gorge

The Sarca River covers the distance between Ponte Pià Lake and Sarche, flowing on the floor of spectacular canyons. Due to the different lythologies and the articulated tectonic structures that are covered, the river has formed restricted and winding gorges that are dozens of meters deep; moreover it has formed ravines that are bordered by spaced jutting walls of hundreds of metres.
The first typology of gorge characterizing the Sarca River is in the lower area of Diga di Ponte Pià and Ponte dei Servi, near Val di Comano Terme. In these zones it is possible to see the basinal Jurassic Formations of Val d'Oro and Tofino, the pelagic Limestones of Rosso Ammonitico (Middle Jurassic) and the cretaceous-tertiary units of Scaglia Rossa and Fm. of Ponte Pià, created by the succession of thick karstic and marly strata.
The erosion has modelled these rocks, excavating winding canals that are characterized by smoothed and sinuous shapes, where dressed surfaces and small potholes predominate.
This kind of morphology is typical of the Ponte Pià and Ponte Balandino gorges.
The second typology of gorge is completely different from the first one: in this case enormous dimensions prevail with a variety of the rocks. These are ravines with depths of hundreds of meters, and a prevailing rectilinear course; the ravines are excavated in the Grey Limestone Formation (Lower Jurassic), a carbonatic unit that tends to create vertical and jutting walls. The river's bed is not particularly wide (10-15 m) and with a slight slope. In some zones it is covered by live rock and in other zones by pebbles and cobbles that have been carried by the river-stream. The Limarò gorge, to the NW of Sarche, is the most representative and spectacular example of this canyon typology.

Limarò Gorge – Photo R. Tomasoni

Passo del Frate – Photo R. Tomasoni

Passo del Frate

The Passo del Frate, 2246 m a.s.l., is named for the unusual shape of the high karstic pinnacle that is visible in the centre of the pass. Seen from a long way off, the pinnacle looks like a praying friar. The pass connects the Head of Val d'Arnò, the right side of Val di Breguzzo, with Val Daone. In this area there is a wide band of saccharoidal marbles, located by the contact metamorphic aureole located on the edges of the Tertiary batholite of Adamello, involving the Triassic sedimentary succession for about 1-2-km. This is formed by basinal formations (Prezzo Limestone; Livinallongo, La Valle) and platform formations (Fm. of Esino, Fm. of San Giovanni Bianco, Fm. of Breno,

and Principal Dolomia).
The marbles are crossed by some levee intrusions of diorites and gabbrodiorites, oriented more or less NE-SW; the greater alterability of this kind of intrusive rock (in comparison to the marbles), has favoured the creation of deep incisions by the levees, making the karstic crests appear. This erosive process, over the years, isolated the friar-shaped pinnacle (about 20 mt high).
The Passo del Frate and the Alpe di Maggiasone basin (on the pass floor, to the east), represent a preferential site for observing the effects of the contact metamorphism on the rocks that surround the Adamello Batholite. Moreover it is possible to note beautiful examples of glacial relict and selective erosion morphologies that affects the different visible lithotypes. The white marbles (metamorphised Esimo limestone) of this area were, within certain limits, extracted from 1400 onwards, in order to provide stone material for facings and sculptures.

Turrion Basso
This is an isolated pinnacle with the shape of a spindle, it is N-S oriented, rises for 200 m from the Campo della Flavona (a wide depression at an altitude of 2100 m), located in the mid-eastern sector of the future Geopark. Two remarkable "transpressive" N-S oriented faults, divide the depression from the Grosté upland to the west and from the Campa peaks to the east. The Turrion is litologically formed from a karstic-marly unit of Zu Limestone (Retic). In a structural view it represents a klippen, that doubles the outcropping Retic succession of the area; the sub-horizontal dècollement flat is located on the floor of the pinnacle. The original morphology of the Turrion Basso can be connected to the particular structural asset of the area, where the glacial processes acted. The nearer sectors to the two "transpressive" faults have suffered a more intensive erosion process than the thrusted Turrion group ; this is due to the more intense fracturing process of the rocky substratus. The Turrion Basso represents a multidisciplinary site, where it is possible to note the effects of more than one morpho-selective process (litology, structural asset, glaciation, karstification).

Campanil Basso
The Brenta Dolomite Range is world famous for the steepness and austerity of its imposing rock walls, culminating in peaks and ridges of different and varied shape and size. The Campanil Basso (2883 m a.s.l.) is the most attractive pinnacle for thousands of alpinists and mountain addicts. The massive banks of Principal Dolomia (Noric) have been modelled by erosion, shaping this tall pinnacle, that is inserted directly in the heart of the Brenta Range, close to Cima Tosa and Campanil Alto, at the head of Val Brenta. The continuity of its high tapering walls, the absence of significant fissures and its isolated location, makes it a model of selective erosion.
The Campanil Basso is also important because of the enormous historical and romantic value that it enjoys worldwide among mountaineers.

Turrion Basso – Photo Archive Pnab

Campanil Basso – Photo H. Lorenzoni

Lake Tovel and its Underwater Forest

Lake Tovel is an enchanting lake, located on the floor of Val di Tovel. This area re-entersthe north-eastern ramification of the Brenta Dolomites for about 17 km. The existing lake basin, well known for a rare natural phenomenon that in the past dyed its water red, and for the amenity of the surrounding landscape, represents an important site for interpreting the recent geomorphologic evolution of this area of the Geopark. Many scholars have studied this area, pointing out the complicated and extremely interesting genesis of the lake.

The depression where the lake is located, originated after the retreat of the glacial lobe that, at the end of the Wurmian Ice-Age, affected Val di Tovel. About 15,000 years ago, the head of the valley was occupied by a wide mass of relic ice, whose melting process was slowed by the detrital coverage that had fallen from the surrounding rocky walls. It created a particular morphology of ridges and depressions; in the largest sector of these basins is the present Tovel Lake; during that period the depression was about 20 m below the present level.

The incontestable evidence that the lake was on the lower sector of the basin is provided by several underwater tree trunks, still planted at a depth of about 18 m. The dendro-chronological analysis has determined the trees' death as 1597 A.D. The regularity of the annual rings of the last years of their lives indicates sudden death, due to the abrupt rising of the lake level. This rising was probably due to the obstruction of the emissary by some landslide accumulations that had fallen from the eastern walls. The water, that has risen more that 3 m (from that period on), has successively formed an opening to the south, originating the present existing emissary and lowering the water level to the current one.

Tovel Lake and submerged forest – Photo G. Volcan

B.4 Existing or potential pressure on the territory and on these sites

The territory proposed as Geopark is an area with a strong tourist appeal; it is under pressure, above all during the summer and winter seasons. Excluding the winter tourism, that doesn't damage the geo-sites, the summer tourism is basically naturalistic, and is strongly connected with environmental improvement and the use of the numerous paths that help to channel and control the tourist flows; these are the motivations that orient the Park towards social usage of the environmental, that has to be appropriate and sustainable.

The significant geological, geo-morphological, archaeological and naturalistic sites located in the area of the future Adamello Brenta Geopark are not subject to damage or destruction. With reference to the most fragile sites, the fossiliferous and mineralogical areas, the recognition of the area as a Geopark, would be an interesting and significant occasion in order to preserve them, thanks to the increased value of the area. The value would increase thanks to two basic elements: the first is the effort to create preventive measures based on information, and the second is the effort to make visitors and locals (refuge-keepers, guards, etc.) responsible. At the same time it would be necessary to start an educational and sensitisation program to make people awre of the geological heritage and its value.

One of the 12 Park rangers at work – Photo M. Zeni

B.5 Existing measures for the preservation of these sites

With reference to the sites with a significant geologic relevance existing in the protected area of the Adamello Brenta Natural Park, they are subjected to the preservation laws indicated in the Park Programme approved by the Provincial Council after the decision no. 6266 of 23.07.99; in particular in art. 22, par. 4: *" It is not permitted in these areas (geotopos and sites of relevant geo-morphologic relevance) to realize any transformation on the soi profile, or to insertmanmade structures of any nature, that will alter the existing appearance"*. Moreover, according to the above mentioned law, the activity of mining and removing of minerals and fossils is forbidden in the whole Park Territory.

With reference to the sites of geologic relevance that are not located in the protected area, but that will belong to the territory proposed as Adamello Brenta Geopark, they are protected by several measures:

- National Law no.1497 of 29/07/1939, that protects the geological rarities;
- P.L. no. 37 of 31/10/1983, modified by the P.L. no. 1 of 04/01/1988, whose aim is: *"The preservation of the mineralogical, palaeontological, paletnological, spelaeological and karstic heritage existing in the territory of the Provincia Autonoma of Trento". Art.2 follows: " It being understood the existing laws refer to mines, quarries and peateries, and the mining, quarrying, and collection of minerals and fossils, even presenting themselves as loose superficial fragments, is allowed only-with proper authorisation;exceptions as otherwise provided for in the following Art. 10". Art.3: "The minerals and fossils mined or collected on the provincial territory can not be sold, except with specific authorisation to public Authorities or Associations that have didactical, scientific, or cultural*

purposes, granted by the Provincial Council for the acquisition of a single item or entire collections".

• Provincial Planning Legislation, adopted with decision no. 2402 of 27/11/2006, identifies the so named "invariants", that are *the territorial elements that represent the distinctive environmental characteristics and the ones of the territorial unit, as of stable configuration or of slow modification; in particular the elements that deserve preservation and improvement in order to guarantee a balanced and sustainable development with reference to the evolution processes provided and promoted by the territorial planning measures* (Art. 8). The "invariants" include the main geological and geo-morphological sites (geo-sites) like *peaks, gorges, waterfalls, morpho-sculptures, moraines, karstic areas, caves, glacial and peri-glacial morphologies, areas of palaeontological, mineralogical and stratigraphic relevance.* The Municipalities are allowed to update and increase the list of the "invariants". The candidature and the eventual entrance of the Area in the European and Global UNESCO Network of Geoparks represents an opportunity in order to preserve and develop the geological-environmental heritage; it is proposed by the Municipalities through the attached list of Geo-sites.

• General Plan of Usage of Public Water, adopted with D.P.R. of 15/02/2006, that regulates the integral management of water in accordance with a quantitative and territorial security profile and according to a qualitative profile.

It is believed that the System of Laws and Regulations adopted in the Provincia Autonoma di Trento, referring to the preservation of the heritage of geological, geo-morphological, hydro-geological, palaeontological and mineralogical relevance, could guarantee the adequate and satisfying conservation of these sites.

Therefore, in terms of preservation, the geo-sites identified inside the territory proposed as Geopark can be considered exhaustively and effectively preserved and protected.

B.6 Data on the management of these sites

The Authority responsible for the administration and the management of the Geo-sites is the Adamello Brenta Park. It will act in agreement and in cooperation with the local Authorities involved (municipalities, sites properties, tourist offices, etc).With reference to the Geo-sites located in the protected area, they are objects of development, preservation and promotion in accordance with the indications included in the Rules of Institution of the Park Planning (art. 22): *the Park promotes the census of the geotopos of the sites of geo-morphological relevance, in particular with reference to kastic phenomena, dolinas, precipices, potholes, erratic boulders, moraines, erosion pyramids, springs, waterfalls, mineral layers, characteristic or rare deposits (...) it takes care of the distribution and the updating of the geo-morphologic research, in order to identify and classify as "natural monuments", the sites that represent a remarkable environmental diversity, and that are relevant in scientific terms (...) It identifies the sites that are involved in the main geotopos with a geo-morphological relevance; these will be appropriately signalled to visitors, pointing out the appropriate behavioural rules for respecting the environment.*

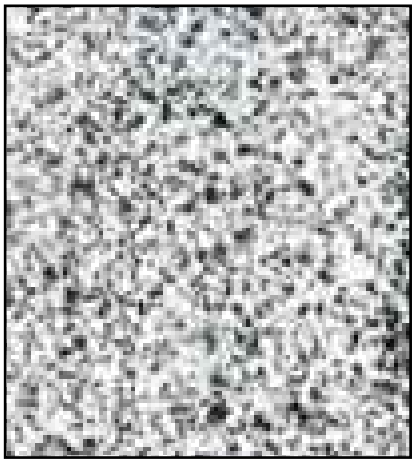
With reference to the geo-sites that are located outside the protected area, today there are isolated management actions intended to improve the territory where the geo-site is located, promoted by local authorities: Municipalities, Turist Offices, etc. Because these actions are isolated, it is believed that entrance into the European and Global UNESCO Network of Geoparks could represent a valid opportunity in order to plan a management strategy shared with the local Authorities, permitting the improvement of the existing inestimable geological heritage, and favouring an increase in the local economy of the area involved. The Adamello Brenta Geopark is offered as a leader as regards the proposals for improvement and for the coordination of the actions that need to be ideated and shared with the local Authorities. The conservation of the sites external to the Park, remains under the authority of the municipalities that have guaranteed it, after formal entrance into the Geopark Network.

Fascination on Brenta Dolomites – Photo F. Zibordi

B.7 List and description of the non-geological sites in the territory, that can be connected to the sites of geological importance

B.7.1 SITES OF DEMO-ETHNO-ANTHROPOLOGICAL IMPORTANCE

This category includes sites whose geological-environmental peculiarities have played a key-role in the socio-cultural and economic development of the area proposed as Geopark.
Particular attention was given to sites where the "geological asset" has represented in the past, an important resource for the territory. These include old quarries, old mines and the handicrafts that are associated with these activities. Also included are sites that in the past were favourable for the creation of human structures or activities, thanks to their unique territorial conformation.



Tonalite through microscope – Photo Serv. Geol.

Old stone-quarries
Inside the area of the future Geopark, there are several stone-quarries that have a remarkable historic importance; from these quarries some of the most important stone in Trentino was extracted. These stone varieties were widelyused to build and decorate palaces, churches, and monuments all over Italy. The traditional buildings of Val Rendena are commonly built with the local stone, making Tonalite a common element of the local architecture.
The principal historic stone varieties are the marble from Breguzzo, tonalite from Adamello, and "nero" from Ragoli.
Some of the historic quarries are still obvious and are of geo-mineral importance since the old quarry fronts show some litologic sections that can easily be used for the observation of the petrographic characteristics of the exploited layers.
The most significant historic excavation sites are located in Malga Trivena (Breguzzo marble), in Scariche (Nero di ragoli), and Pimont (Adamello Tonalite).

Old stone quarries of tonalite near Pimont - Photo Archive Servizio Geologico PAT

Old Pyrite quarries in Val San Valentino
Inside the territory of the future Geopark, as in the rest of Trentino, the indelible remains of antique mining activity that affected these valleys in the past is still visible. This activity is documented, besides the real mines, above all in the associated legends and tales. From the late Middle Ages to the present time, they evoke an imaginary world of the most private aspect of the territory: the underground realm and its "treasures".
The San Valentino Quarries are located on the left side of the San Valentino Valley; they are set in the small valley of Malga Coel of Vigo. The quarry was already known in past centuries, and its activity ended during the 1960s. The mining activity was for the mixed

Old glassworks in Carisolo – Photo R. Tomasoni

Old glassworks in Val Algone – Photo Bosetti

sulphides andthe existing galleries are evidence of a good mining activity, of ancient origins, that involved the right orographic side of Val Rendena (from Mortaso to the further areas near the Village of Verdesina).
Inside the territory of the future Geopark there is other evidence of mining activity in Val di Breguzzo, Val Daone, and on the right orographic side of Val Rendena between Bocenago and Mortaso.

Old Glassworks in Carisolo

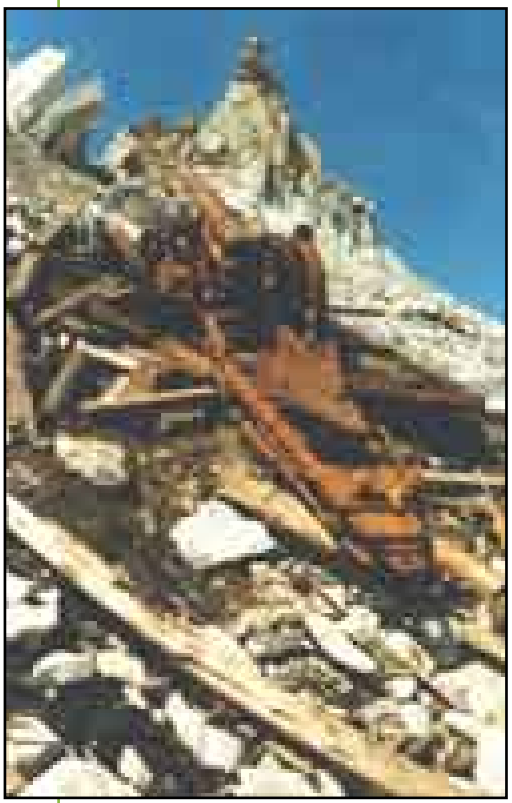
During the 1800s there were three Glassworks in the Giudicarie: the Bormioli and Garuti Glassworks in Val d' Algone, the Pernici and Bolognini "Glass Industry " in Carisolo and the Venini glassworks in Tione. It was a flourishing and renowned industry that produced sheets of glass for windows, bottles and, in the Glassworks of Carisolo, precious Boehmian Glasse, exporting their products to northern Italy and northern Europe. The Valli Giudicarie had all the requirements for glass production: a subsurface rich in precious quartz, an essential element for the production of the glass pulp; woods for supplying of the fuel; abundant flowing water used to drive the big hydraulic wheels of the quartz mills and sawmills.
The Pernici e Bolognini (1805-1888) Glass Industry, located in Carisolo, employed about 70 people: quartz crushers, woodcutters, and master glassmakers from Bohemia and Alsatia, apprentices and maintenance. The production plant was like a small village, with the big "Halle" where the furnace was located with its impressive smokestack; the worker's lodging; the "colombera", were the offices were located; the country house; sheds and stables; the "venetian" sawmill, and the quartz mill.
The minerals came from the mines of Borzago and Giustino, and were carried on mules or sledges. They were crushed in the impressive granite mill to produce the raw material for the production of the glass pulp. The Glasswork's activity lasted about one century, representing an illuminating entrepreneurial example that transformed an isolated community into an open minded multicultural world. Testimony that particular period includes: the ruined smokestack of the Val d'Algone Glassworks and the "Fabrica Cristallorum" structure near Carisolo.

War cemetery at 2445 m of altitude – Photo M. Magnai

Corno di Cavento

The Corno di Cavento, climbed for the first time in 1868 by J. Payer, the first climber of Adamello, is a peak of 3402 m in height. It is on the N-S ridge, whose highest peak is the 3462 m high Cima Carè Alto, located in the Adamello Range.
The great importance of Corno di Cavento is its historic role. During the First World War (1915-1918), it was the battlefield, as was most of the Adamello-Presanella Range, of hard combat between the Alpini and the Kaiserjaeger (the Italian and Austro-Hungarian mountain troops). This war is referred to as the "White War".

The Corno di Cavento was an important advanced austro-hungaric stronghold that was connected to the rear lines thanks to fortifications and a tunnel system that had been dug in the ice. The traces of the old military posts on the Corno are still visible.
The Corno di Cavento was conquered by the Alpini in 1917 after an attack by the Italian troops, anticipated by the shells of the "149" cannon , called the" hippopotamus", which had been positioned by the Alpini at a height of 3200 m on top of Cresta Croce, up the Lobbia Pass. The cannon is still on the Cresta, and the Cavento posts are some of the many war remains, that after about 100 years since the tragedy, are still emerging from the ice. They are still common on the peaks. Sometimes the ice reveals the mortal remains of the fallen, that for so many years have been frozen inside the glacier.
These indelible traces mark the suffering, courage, strenght, and sacrifice of thousands of men who were forced to fight for the absurdity of the war. Today, these places evoke a feeling of fraternity and friendship within the people.



Cannon in Presanella Massif – Photo L. Pini

Adamello Peak seen from a trench – Photo P. Carestia

Castel Corona
This is a Medieval fortification, built in a wide natural cave (in the local dialect named "corona"), located on rocky ledge on the Zu Formation (Upper Triassic). Today it is possible to see only the ruins of the ancient defensive structure. It was probably built during the XII century. The cave, that hosts the fortification, was formed as a result of a more erodible rocky level on the Dosso Corna wall.

Archaeological Site of Campo Carlo Magno
In 1979, near the Campo Carlo Magno col (a pass that divides Val Rendena from Val Meledrio), traces were found of stone working. At the site, located at an altitude of 1660 m between Malga Campo Carlo Magno and Malga Mondifrà, about 20 finds were discovered. These include a blade made from direct marginal working, a toothed blade, a hollowed out item, and a fragment of nucleus .The finds, conserved to the Museo Tridentino Scienze Naturali, were hidden just under the grass; and are attributed, with some doubt, to the facies field of the recent Mesolithic.

Lookout post at Cavento Pass, 3191 m - Photo Centro Studi Judicaria

B.7.2 NON GEOLOGICAL SITES OF FLORISTIC AND FAUNISTIC RELEVANCE

Flora and vegetation

From a floristic point of view, the area proposed as Geopark, can be divided into two big sectors: the Adamello-Presanella Range and the Brenta Dolomites Range. They are characterized by a geo-diversity that has favoured the development of endemisms and of typical vegetal associations, that are particularly evident in the vegetation bands up to the tree line.

BRENTA GROUP: the extraordinary floristic richness that is recognizable in the Brenta Range is due to the karstic-dolomitic rocks that are characteristic of this area. They determine the presence of typical floristic band, with exclusive species of the karstic sector *(Androsace Helvetica, Daphne striata, Gentiana lutea, Papaver rhaeticum, Paederota bonarota, Physoplexis comosa, Thlaspi rotundifolium)*.

Interesting species exist in the surroundings of Valagola Lake, like the *Scutellaria alpina*, unique in Trentino; inside its waters lives the rare *Potamogeton graminifolius*.

The endemism include:

Nigritella buschmanniae Teppner & Ster, 1996: an extraordinary botanic rarity, and a strict endemism of the Brenta Range. Its presence has been verified, to date, only on the upper pastures located on the Grostè area. This species is classed as "threatened" in the Red List of Trentino Flora (Prosser, 2001).

Physoplexis comosa - Photo V. Masè

Erysimum auranttiacum Leybold: it is a gillyflower with orange-coloured flowers that is endemic of Southern Brenta and of the Gazza-Paganella Range.

Moreover, other floristic species that have been indicated in the community projects, are indicated in the Red List of the Trentino flora. (Prosser, 2001). Two examples are the *Cypripedium calceolus* and the *Primula spectabilis*.

ADAMELLO: within the floristic peculiarities, remarkable in Val Siniciaga (secondary valley of Val Genova) the *Linnea borealis* L. It is an arctic plant that has installed itself after the ice ages; this represents its southern extensional limit in Europe. An endemic species of the Adamello and Ortles Ranges is the *Primula daonensis*, peculiar of the siliceous soils. Another remarkable species is the *Trientalis europea*, existing in Val S. Valentino, one of the two certain locations in Trento Province.

Humid areas are abundant in the Adamello-Presanella Range, due to the nature of the rock that causes water-stagnation and the consequent maintenance of some peaty areas (the following are indicated as provincial biotopes: Pian degli Uccelli, Palù di Darè and di Bocenago, Val Meledrio).

Cypripedium calceolus - Photo G. Pincelli

Erysimum aurantiacum – Photo G. Volcan

Nigritella buschmannie – Photo G. Pincelli

Stambecchi – Photo Corradini

Ermellino – Photo L. Del Terra

Fauna

The fauna of the protected area is, like the flora, positively affected by the distinct and original geo-diversity, that determines the great environmental variety. The fauna of the area is in fact one of the richest of the Alpine Arc. It includes many alpine species like the steinbock (Capra ibex) and the brown bear (Ursus arctos). The brown bear is an animal of great geological relevance and the Park symbol. It was reintroduced at the end of the last century, thanks to the important project Life "Ursus"- that aimed to protect and preserve the bear population inside the Brenta Range. It is co-financed by the European Union, and is implemented in cooperation with the Provincia Autonoma di Trento and the National Institute for Wild Fauna. Nowadays there are 18-20 specimens living in the Range.

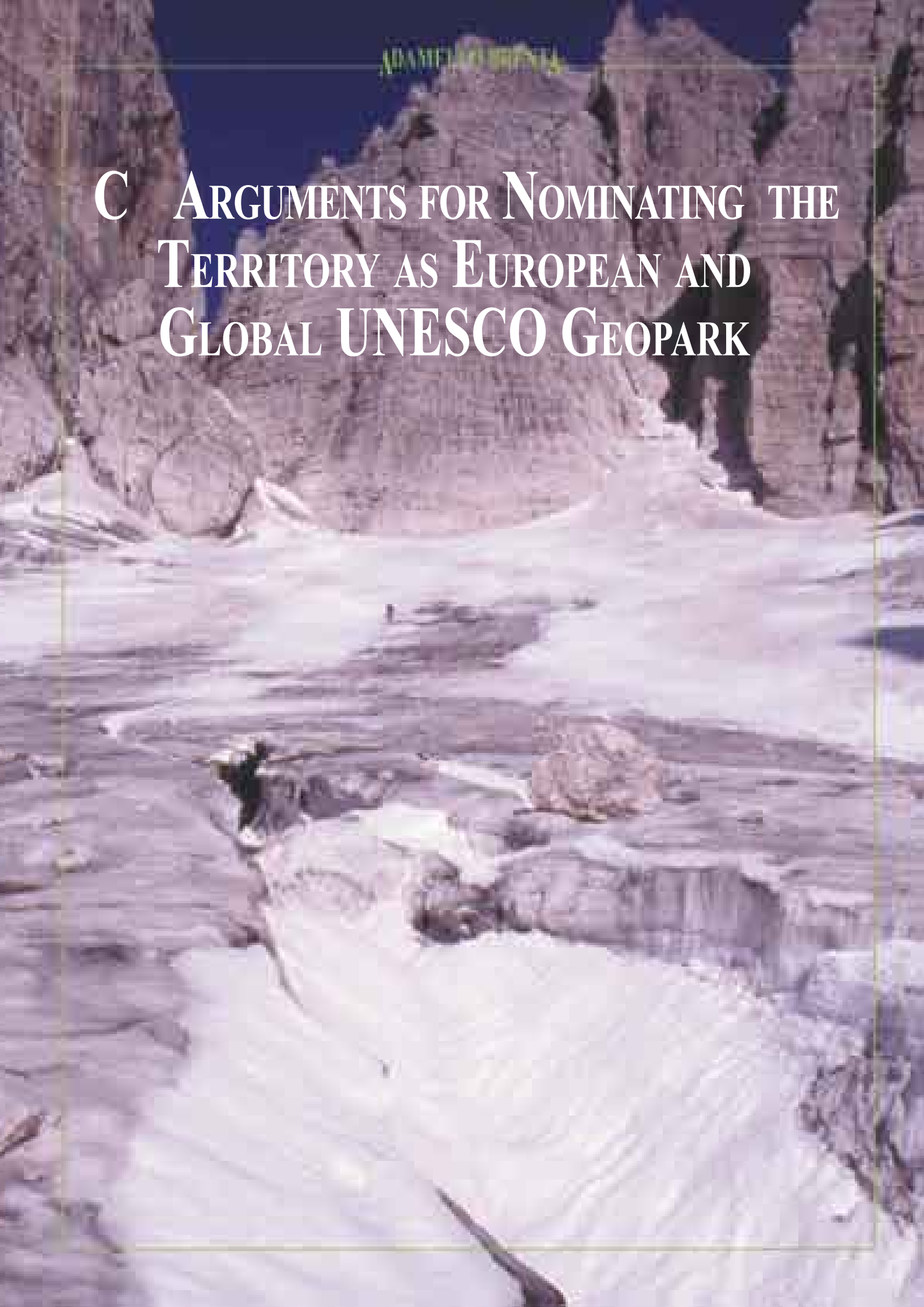
The presence of Ungulates is very marked in the area: beside the deer, the roe, and chamois, there is also a steinbock colony, existing thanks to a reintroduction project, that started during the 1990s. The Mustedils include weasels, stoats, badgers, and beech-martens. There are 18 species of Chiropteran in the protected area; their presence is of zoological importance.

From a naturalistic point of view there is a significant presence of Galliforms (ptarmigans, Greek partridges, capercaillie, grouse, and mountain francolin), and of nesting predators (buzzards, goshawks, sparrow-hawks, perns, kestrels, and 14 pairs of golden eagles, with a total of 96 species of nesting birds). The erpetorfauna is represented by 11 species of reptile and 5 species of amphibian. With reference to the ichthyic fauna the char is or interest, as a glacial relict.

There are also several vertebrate and invertebrate species, that even if less visible, are considered as important elements. These occur in the whole area of the future Geopark, and contribute to the biological diversity, reinforcing the food chain, and permitting the preservation of the faunistic heritage.

Orso – Photo G. Volcan

Capercaillie – Photo N. Angeli



C Arguments for Nominating the Territory as European and Global UNESCO Geopark

C.1 Comprehensive analysis of the territory for the development of geo-tourism

As remarked in the previous chapter, the area of the future "Adamello Brenta Geopark", represents a territory of extraordinary geologic-environmental importance and value: in this area, many geological features are represented.
The various sites of high geological value, under a scientific, educational, historical, and cultural point of view, represent the most significant elements of a precious heritage that the Geopark wants to improve and preserve through suitable and sustainable forms of Geo-tourism.
The area of the future Geopark includes different zones that have different economic functions, and in which tourism, even if basically diffused, is not homogeneously developed (Paragraph D.1).
The tourism, both during winter and summer, is greatly developed in Upper Val Rendena, with its leading resort Madonna di Campiglio, and in the Andalo and Molveno area. The south-eastern sector is developed mainly thanks to the famous Comano Thermal Baths, that are known for their curative and therapeutic effects. This is an area dedicated to health and to psychophysical wellness. The above mentioned zones, where 2/3 of the municipalities included in the Geopark are located, are areas with a clear tourist appeal. In recent years, the trend has been to diversify the tourist offer, in order to guarantee high quality standards. With reference to the municipalities located in Val di Non, the main economic activity is agriculture, but in recent years a rural/farm tourism activity is developing.
The present situation is that the well known tourist resorts are trying to diversify their offer towards sustainable tourism, giving clear importance to the environmental element; on the other hand the areas whose tourism is not yet developed, are trying to improve the tourist sector, thanks to the rediscovery of their territories and to the improvement of their original characteristics; this trend represents an extraordinary opportunity for economic, cultural, and social development.
The Adamello Brenta Natural Park represents, in this sense, a sort of guarantee; in fact for several years the Park policy has been oriented towards the development of sustainable tourism, intended in its wider meaning, where the attention given to the territory and its preservation are the driving elements for an economic and social improvement of these communities.
Evidence of this is the Park's adoption, in 2001, of the Environmental Certification System ISO 14001, that is oriented towards quality and sustainability.
There are other initiatives that should be mentioned, like the *Life Tovel Project* (a territorial plan created in order to develop the tourism of Tuenno, an area of high naturalistic and landscape value); the projects for *sustainable mobility* that aim to optimise the mobility in Val Genova, Val di Tovel, and Vallesinella; the *"Park Quality" Project*, a quality brand given to private companies that meet the requirements of environmental preservation and that have a direct connection with the territory, supporting in this way the Park policy; the *European Chart for Sustainable Tourism* and the *EMAS* registration, both obtained in 2006 (see paragraph D.1).
Also worthy of mention is the candidature, dated 23th of September 2005, of the Brenta Dolomites as a World Human Heritage of UNESCO, promoted by the Provincia Autonoma di Trento together with the Provincia Autonoma di Bolzano and the Provinces of Belluno, Pordenone, and Udine. This candidature represents firstly the recognition of the universal value of this heritage and, secondly, it imposes a sense of responsibility with reference to its preservation. If the Park is acknowl-

Geotourists in the future Geopark – Photo B. Tassoni

Geotouristic excursions – Photo Archive Pnab

Mountain refuge in Brenta Massif – Photo Dalpez

edged as a World Human Heritage of UNESCO, this will mean worldwide recognition and visibility, and will represent great added value for the territory.

On these assumptions, it can be foreseen that geo-tourism will probably have success within a short time; this aim will be achieved also thanks to a dense net of paths, that covers the whole area proposed as Geopark: more that 900 km of paths, constantly maintained by SAT (Trento Alpinistic Society) workers and by the Park itself, making it possible to enter the Geopark area and to reach the geological sites in safety. Several mountain refuges and high altitude camps represent an extraordinary means for the transmission of the geological culture and for appreciation of the landscape features, through the distribution of informative material, the organisation of events, or through excursion, tours, and so on.

Moreover, the path network may also ease the congestion of the most famous zones, permitting the discovery and revaluation of the less known zones and of their interesting and significant geological sites, developing them under a tourist point of view.

Geo-tourism can thus become an interesting opportunity for the tourists that are interested in environmental matters and earth sciences, but aims to be, above all, an occasion to diversify the concept of "mountain holiday", offering to the "ordinary" tourist a new interpretation of the territory, in order to give them the possibility to fully understanding and appreciating it.

Several well known scholars came in these zones in the IX century; this is an interesting evidence of the interest and of the geologicalal importance of these areas, from a geological and geo-morphological point of view. Nowadays many Italian and foreign Universities and Research- Institutes are working on the Geopark area. The presence, covering the whole territory, of logistical infrastructures, that are able to host the "Research Teams" and/or scholastic or university groups, would permit orientation of the "Scholastic geo-tourism" towards different directions, permitting a constant enrichment and updating of the geological knowledge, guaranteeing an immediate and adequate popularisation.

At the same time, the geo-tourist policy has to give its attention to the preservation of the environment, minimizing its impoverishment and, above all, increasing its value. It is therefore necessary, to identify the most vulnerable sites, in order to define some "risky" areas that have to be preserved and less affected by the masses.

School activities in Park guest quarter of Valagola (1592 m) – Photo Archive Pnab

C.2 Overview of the geo-instututions and of the geo-activities existing in the Geopark area

The Park Planning, in its essential principles, expresses a modern idea of preservation: beside the preservation of the beauties of nature, it wants to promote the social utilisation of the environmental heritage and scientific research. The territorial and town planning regulation, as the improvement of the Park peculiarities (both the naturalistic and the environmental ones), are matters of the Park Planning, adopted in 1999. The Plan, articulating the park area in integral, guided, and controlled reserves, contains the prohibitions, the limitations, and the instructions regarding territorial usage. In order to pursue the law's aim, the Park intervenes preserving the territory and its infrastructures, even controlling and orienting the flow of visitors. During the summer period, the Natural Park promotes several initiatives in this sense. Attention is given to environmental education, thanks to several Info Points, at the visitors centres and the guesthouses, receiving long-stay scholastic groups. Several didactical projects are available for the school-projects, oriented to environmental education with the aim to introduce the protected area to pupils and students and to let them understand the importance of its preservation.

With reference to Nature preservation and, more precisely, to Geo-preservation, it this kind of didactical projects are very important, oriented, above all, towards the younger generations; they must, in fact, be considered as the future users of the environmental heritage. This sensitising operation is possible through the realisation, every summer, of excursions, led by nature-experts and alpine guides, through meetings followed by slide shows, and through the realisation of educational paths, that can be easily run, where some stops are located in correspondence with the most interesting sites (for each path a brochure is available).

The Park Area is perfect for addressing the geo-preservation theme; in fact in this area it is possible to find two sites that are risking extinction: the Glaciers and the Peri-glacial world. With reference to the Peri-glacial, the Park has financed a research-project that has the aim of identifying the Rock-glaciers, that in several cases are no longer viable with the existing morpho-climatic habitat (Seppi and others, 2002). The project is co-financed by MIUR and started at the end of 2004 under the title "The geologic heritage as a resource for sustainable tourism", the Natural park entered this project as a co-sponsor together with the Research Unity of Pavia. Within the project's aim, there is, with reference to the Park area, the evaluation, inside the whole district, of the rock glaciers and the realisation of a glaciological path. Thanks to this project, a recently developed itinerary will be scientifically commented, covering the most spectacular glaciers of Adamello and dedicated to Vigilio Marchetti, an alpine guide from Trentino, who dead in 1993. Inside the area of the Natural Park several structures have been created, whose aim is to permit the spreading of knowledge about the mountain habitat. Significant in this sense is the "Julius Payer Study Centre Adamello ". This is the name of the structure realized by SAT in 1994 in cooperation with Museo Tridentino Scienze Naturali, dedicated in memory of the Bohemian Austrian Official and the first Alpinist that climbed Adamello (15th of September 1864). The Centre is located in the heart of the Natural Park, inside the old "Rifugio Mandrone", been built by the Leipzig section of D.O. and A.V. in 1878. It was one of the first alpine refuges in Trentino.

The principal aim of the Centre is to introduce glaciers and high moun-

Study Center Adamello-Julius Payer – Photo R. Tomasoni

tains habitats, and to promote studies and research on different matters, in order to spread the results. In the Centre a logistics point is also available that promotes courses and didactical meetings. Near the Study Centre the alpine refuge "Città di Trento" is available, an important logistical base for permanent courses.
The limnological Centre of Museo Tridentino Scienze Naturali, instituted not long ago, has a more specific geological and biological aim, and is located at Tovel Lake. The two-floor building is composed of a central hall for the microscopy, a chemical laboratory, and a small kitchen; this permits researchers and scholars to organize summer courses autonomously or in cooperation with the Museum's researchers.

C.3 Policy for preservation, enhancement, and economic development of the existing geologic heritage

The preservation and protection projects promoted by the Adamello Brenta Natural Park, can be inserted in a wider and more articulated strategy for the preservation of the natural and historical-cultural heritage of the territory. Planning measures were adopted, in order to actively preserve the environment. The active preservation is pursued together with a socio-economic development that aims to be adequate and consistent.
The strategic aims of the Park, as already said in paragraph A.4, are oriented towards environmental preservation and biodiversity, towards scientific research, environmental education, territorial enhancement and sustainable development. They are strongly connected with the three main values that lead park activities: participation, communication, and quality.
The geological heritage preservation and socio-economic development policy are strongly linked to these principles, and are oriented towards the following issues:

- The preservation of the geological heritage and the promotion of its scientific study.
- Educational activities oriented to natural science
- Geo-tourism promotion, intended as a new tourist model, giving attention to the preservation of geological heritage
- Increasing employment in the eco-tourism field
- The participations of the local communities and increasing knowledge and consciousness of geological and geo-morphological territorial value
- The promotion of a socio-economic increase in cooperation with the local administrative bodies, the tourist operators, and other public bodies
- The popularising and the communication of the Park's work

In this sense the Natural Park aims to play a leading role, for the improvement of the geological and geo-morphological, and historical and cultural patrimonies. These elements have to be adequate and coherent with the active preservation principles and with the general administration, both institutional and not-institutional, that act on the territory and that are already used to cooperate with the Natural Park, thanks to the recent path followed after adoption of the European Chart for Sustainable Tourism. With reference to sustainable tourism, the Natural Park has promoted several ideas, underlining the geological and geo-morphological aspects (paragraph C.2 and D.4).
The Natural Park is aware of the need to work together with the other administrative bodies, and the necessity of "forming a network", in order to compare and elaborate new working strategies.
Therefore, in order to plan and enact these strategies, the Natural Park is going to permanently collaborate with the Museo Tridentino Scienze Naturali and with the Geologic Service of the Provincia Autonoma of Trento, in order to interrelate with the different local structures that are involved.

Informative board in Val Genova – Photo I. Giuliani

C.4 Interest of the territory to become part of the European and Global UNESCO Network of Geoparks

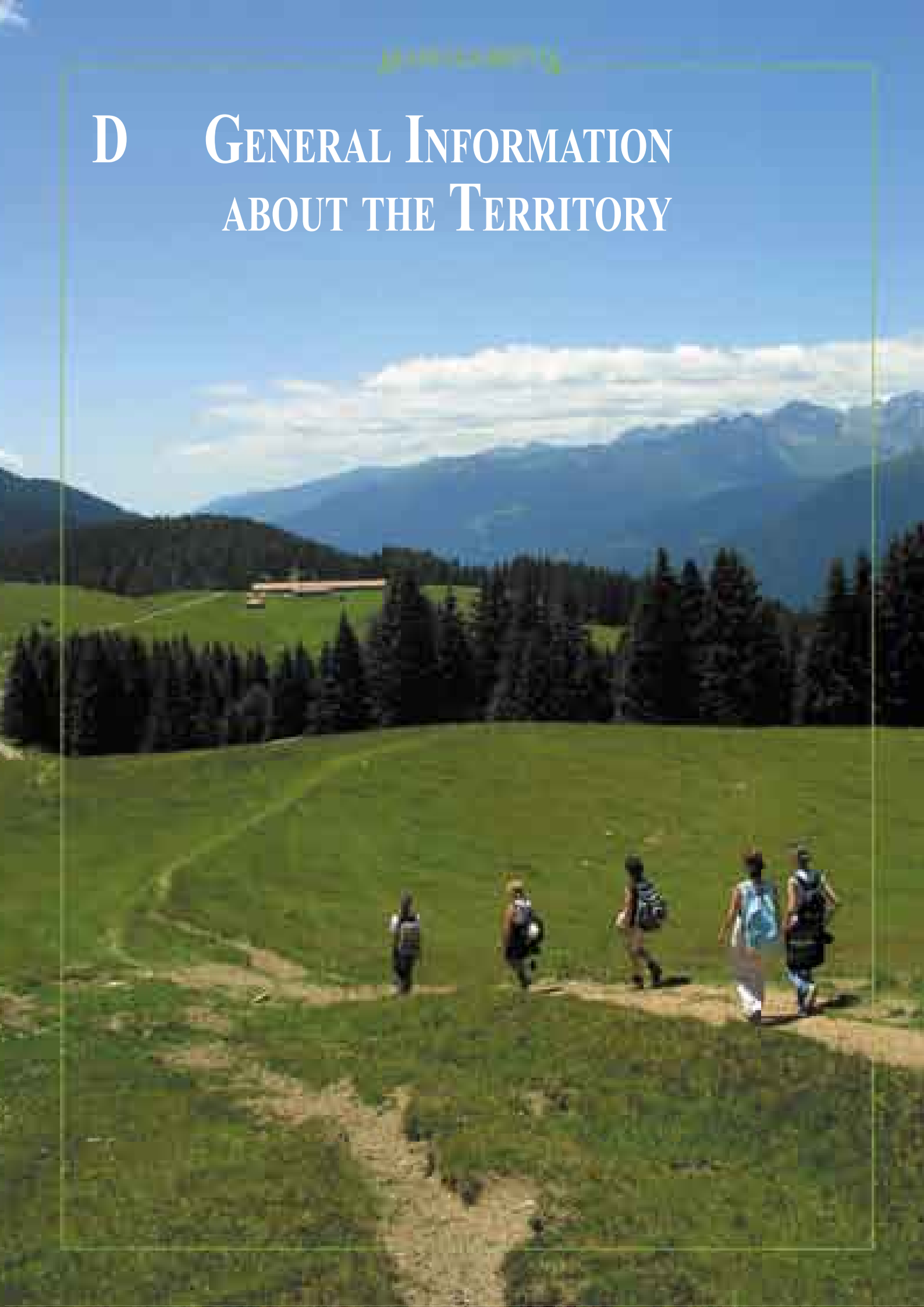
As mentioned above, in paragraph B.2, after the approval of the Park Planning, in 1999 the Natural Park has promoted scientific research in a geological and geo-morphological field, giving great importance to the census of geo-sites and geomorpho-sites that have been indicated as "natural monuments". The Park has even promoted the popularisation of these kind of studies. In 2005, thanks to this aim, the Natural Park started the process for its candidature as European and Global UNESCO Geopark, firstly through candidature in the variation of the Management Annual Programme of 2006, approved by the Provincial Council resolution no. 1720 of 18th August 2006. It is important to underline that the Park wants to share the following Network aims:

- Cooperation for the preservation of the geological heritage
- Improvement of local sustainable development, through increasing the image of geological heritage
- The promotion of Geo-tourism, in order to improve environmental education, development and popularisation of scientific research.

The local bodies are in favour of the candidature of the Natural Park for the European and UNESCO World Network of Geoparks; it is possible to verify this with the supporting letters (attachment 2), signed by the municipal administrations and by other public and private bodies, acting within the scientific or tourist field.
The Adamello Brenta Natural Park has already started its action towards increasing the natural heritage (Par. D.4), often dealing with geological and geo-morphological themes. If the Park was acknowledged as a European and Global UNESCO Geopark, it would be a great opportunity to popularise and increase geological knowledge, educating and stimulating the younger generations towards geology, a highly articulated and fascinating subject.
Within the area proposed as Geopark, rare and isolated projects for the preservation and enhancement of the geological heritage have already been promoted: the admittance in the European Network of the Geoparks would represent a great opportunity in order to unite these actions, making them common and shared.
The mentioned area is characterized by a rich geo-diversity: it would represent an ideal setting for an open air laboratory and for environmental education with the aim to teach the value of the geological heritage, making people more conscious of it. This purpose would be very useful for the understanding and the preservation of this heritage, so that also future generations have the possibility of enjoying it. The admittance in the European Network, would also represent an important possibility in order to develop a new typology of tourism: Geo-tourism, representing one of the most important elements for the sustainable development of the local economy. It would offer the possibility of close cooperation with the local bodies, that thanks to the admittance to the European and global UNESCO Network would have a real occasion to get fully in touch with their territory and its geology, matters that have always influenced the lives of the resident populations.
There would be the possibility of important cooperation with the Museo Tridentino Scienze Naturali, and with other bodies, like the Universities, with the aim of improving and extending research on geological and geo-morphological sites.
The admittance to the European Network would give the Park an important brand, increasing the territorial value, and thanks to the participation of UNESCO, would be acknowledged worldwide.
The admittance to the Network would enable the Park to keep touch with others Geoparks. Conversely, the Park could contribute to the overall Network, also thanks to the help that the Natural Park can offer, thanks to our operating experience. Furthermore, the Park would have the possibility to cooperate with projects promoted by the European and global UNESCO Network of the Geoparks, together with other Geoparks supported by European funds.

Geotouristic activities – Photo Archivio Pnab

D General Information about the Territory

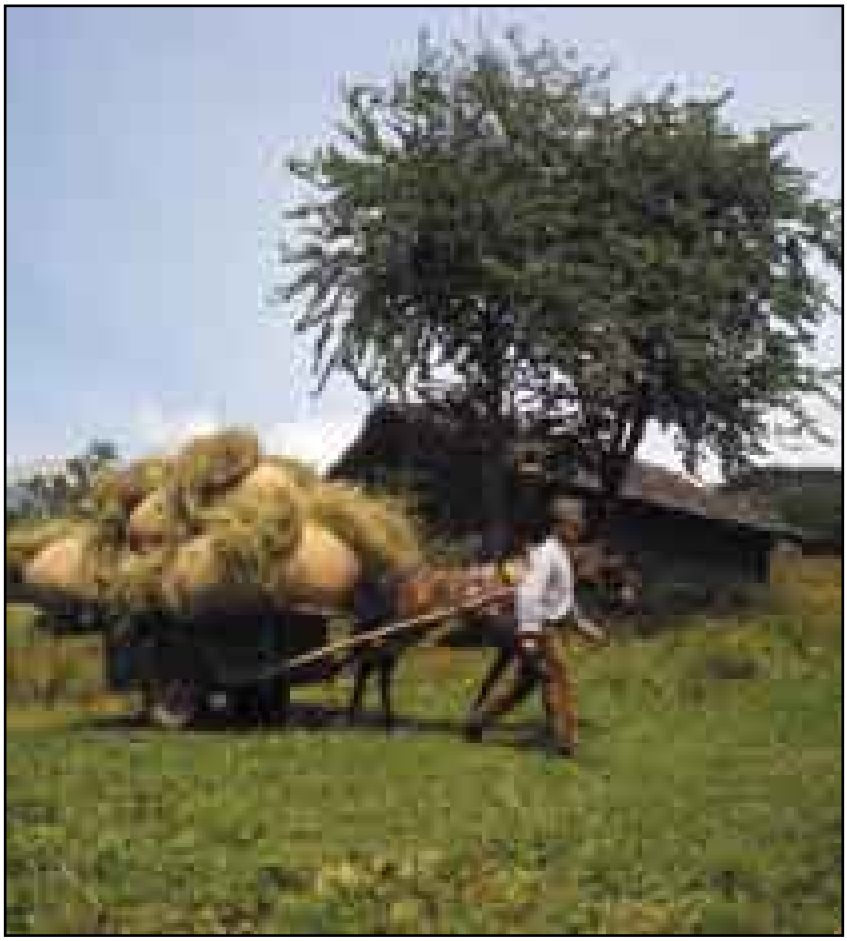


D.1 Economic field. Description of the principal structures responsible for the policy of sustainable development and for the main economic sectors within the territory

The Territory of the future Geopark includes 38 administrative municipalities, involving different realities and diversified economic fields.
The predominating economic form is Tourism, in particular in Val Rendena, on the Paganella Upland, in Val di Sole, and in Comano (Thermal Baths). The winter tourism is striving, in recent years, to diversify its services and to orient itself toward a qualitative service. In this sense, the eco-tourist offer of the Natural Park, represent an important occasion in order to attract new clients. The summer tourism is basically oriented towards a nature based form of tourism.
The Giudicarie Area, with Tione as its principal centre, is principally characterized by the Tertiary; this territory is trying to increase its economy through the rediscovery of handicrafts and of the ancient local traditions.

The agricultural economy, based on apple monoculture, is typical of the 12 municipalities in Val di Non. In recent years, due to the national and international technical and productive competitiveness and to the field being abandoned by the young generations, the apple economy is destined to decrease, even if it still maintains a determining role within the economic and social development both of the territory and of the whole provincial territory. These economic changes, have oriented agriculture towards diversification, supporting apple cultivation with complementary activities, like Agritourism.
The Provincia Autonoma di Trento has based its territorial policy on five strategic aims (the most important being sustainability), firstly thanks to the P.L. no. 2 of 1988, that disciplines tourist development in Trentino, then with the Provincial Resolution no. 1485 of 2005, that leads the territorial development. A sustainable development strategy requires a long-term vision, that involves increasing three determining elements - the environment, the socio-cultural area, and the

EMAS Certificate of registration



Certificate of the European Chart for Sustainable Tourism

Rendena cows – Photo F. Polla

economic element – the cooperation and the coordination within the local bodies, in order to switch from a individualistic to a systemic model. This kind of strategy, that is founded on the principles of sustainable tourism, has oriented all the provincial bodies.

The Natural Park, with the adoption of the Environmental Certification System ISO 14001 in 2001, started a course of sustainability and quality. The project *"Life Tovel"*, co-sponsored by the European Union through the LIFE Environment initiative, has experimented a model of territorial planning that is dedicated to the tourist development of Val di Tovel, an interesting area from a naturalistic and landscape point of view.

The same direction was given to the projects *"Sustainable Mobility"* in Val Genova, Val Tovel and, from the summer 2006, in Vallesinella; these projects aim to reduce car traffic in the summertime; the project *"Park Quality"*: a quality brand given to the companies that have the requisites for environmental preservation and that are linked to the territory; in this way they agree with the culture of the Park. It represents an important occasion to increase the local economy and to stimulate the spreading of a new environmental sensitivity.

After the adoption, in September 2006, of the *European Chart for the Sustainable Tourism of the protected areas*, issued by Europarc (European Parks Federation), the Natural Park confirmed its super-partes position; it has obtained a relevant role both for the territorial management and for the promotion of new modalities of tourist development.

Another important target that the Natural Park has achieved is *EMAS registration* in December 2006, a means used by the European Community to promote new environmental models of sustainable development. Its peculiarities are a constant and progressive obligation and the involvement of the interested structures, being oriented towards a sustainable strategy. All these have been strategic projects in order to constructively agree with the socio-economic elements existing on the territory, that are very important means of knowledge and acceptance. Moreover, the private and public bodies operating on the Park area, have adopted a sustainable development strategy; several municipalities are undergoing the ISO 14001 Certification, others are being registered EMAS. The "Società Funivie" of Pinzolo ("Cable-lift Company") , like the Park, obtained ISO 14001 Certification during the Winter Season 2004/2005. During the year 2006, Caderzone and Molveno (two municipalities included in the Natural Park) achieved the "Orange Flag", that is an important tourist-environmental brand given by TCI (Italian Touring Club) to those resorts that implement a sustainable and qualitative environmental strategy.

Sustainable mobility in Val Genova – Photo L. Nave

D.2 Future prospective for territorial protection

From the point of view of protection, the Natural Park is already subject to important preservation measures thanks to provincial and national laws and thanks to European directives.
Nevertheless, the Park, in agreement with the Municipalities, in the case of acknowledgment as a European and Global UNESCO Geopark, will increase the measures of active preservation that are already operating. These actions would be basically oriented to the geological and geo-morphological aspects, increasing the enhancement actions. It is believed that, in order to preserve a geo-site and a territory in general, it is necessary to let it and its value be known; these aims could be achieved through enhancement, environmental education, and popularisation. After an eventual acknowledgment as European and global UNESCO Geopark, the Municipalities involved will undertake to indicate as "invariable" in the New Provincial Town Planning, all the geological and geo-morphological sites mentioned above and the ones identified within the external portion of the protected area, as mentioned in the supporting letter, signed by the Natural Park Authority. In this way the municipalities have the possibility of ensuring better preservation of the sites, using the protection criteria indicated by the Province and by the PUP, in order to enhance the geo-sites.

D.3 Degree of protection of the territory

The whole area candidate as "Adamello Brenta Geopark" is subjected to the preservation laws that are indicated in the new Provincial Town Planning, adopted with the Provincial Resolution no. 2402 of 27/11/2006. It represents the principal means for territorial and management planning of the Province with the aim to preserve environmental resources and to give value to the landscape, as an important element of the territorial identity and quality; its first principle is sustainability, intended as a rational usage of the soil and its resources.
With reference to the territory included in the Natural Park area, the preservation laws are indicated in the Implementation Rules of the Park Planning; it indicates the targets and the means of town and territorial discipline of the environmental, natural historical, cultural, and economic resources available. It also indicates the forecasts and necessary innovations in order to preserve the territory in its social and tourist usage.
A vast portion of the area is subjected to preservation laws promoted by the European Community; in fact inside the area proposed as Geopark there are 25 sites that have a Community relevance (SIC), in accordance with the "Directive 99/43/CEE regarding habitat preservation" and 4 special protected zones (ZPS), in accordance with the "Directive 79/409/CEE regarding the preservation of wild birds". These zones involve 81% of the total surface proposed as Geopark.

D.4 Existing services

As above mentioned one of the main aims of the Park is the preservation and the active conservation of territory and environment; this aim is inserted in a wider strategy that has the aim to give value and to use the environmental heritage and to give an adequate environmental education. From this point of view the Park is operating in order to give value and to popularise the geological and geo-morphological heritage and, in general, the natural and historical-cultural habitats, in terms of tourist and didactical improvement. These include:

•3 Nature-Courses provided with information panels that illustrate and easily explain the surrounding landscape, with its natural, historical and cultural peculiarities, giving attention to the geological and geo-morphological aspects.

• 5 Self-guided Courses, organized in stops; each observation post deals with a specific theme, that can be geological, geo-morphological, botanical, or faunistic. In particular the Self-Guide Course located in Val d'Ambiez "Men and Rocks" is completely dedicated to the geology and the geo-morphology of the area together with human traditions.

All the illustrative material available, contains descriptions and general indications about the geology and the geo-morphology of the area, giving indications about the existing paths.

• Info Point and Guestroom at S. Antonio di Mavignola where panels are available that offer some indications about the geological elements of the Park. The Guestroom, together with another located in a "malga" (1600 m a.s.l.) is able to host 24 people, in particular school pupils that have the possibility to experience direct contact with nature, thanks to an emotional and sensorial approach. The aim is to stimulate their desire for knowledge, and to make them respect and preserve the environment.

• 4 Visitor's Centres, dedicated to specific themes, like the Brown Bear, Tovel Lake, Fauna, Vegetation; the centres are used for didactical and popularising activities.

• Study Centre "Adamello –Julius Payer"

• 17 projects for environmental education. These are offered to schools and have the aim of introducing the natural environment, its understanding and preservation

• Popularising and didactical activities for an adult public, dedicated to naturalistic faunistic, botanical, historical and cultural themes; it is possible to learn and understand the landscape from a geological and geo-morphological point of view.

• A network of paths of more than 900 km and cycle-tracks, that cover the whole area of the Park; it is possible to appreciate, thanks to them, the naturalistic elements, and in particular the geological and geo-morphological features.

• Cooperation with the Trentino Glaciologic Committee of SAT, with reference to the didactical, popularising, and research areas; the collaboration has the aim to increase knowledge, preservation, and improvement of the glacial resource.

• Cooperation with the Museo Tridentino Scienze Naturali, for scientific research.

Several services are also available that deal with the history, culture, and traditions of the territory. The main services include: Museum of the Malga (Caderzone), Museum of the Val di Sole Community (Malè), Eco-museum of Judicaria "From Dolomites to Garda" (Bleggio Inferiore), Eco-museum of Valle del Chiese "The door of Trentino" (Condino), Museum of the Alpine War in Adamello (Spiazzo), Museum of Glass (Carisolo), and Historical Bourg of the 7 Villas (S. Lorenzo in Banale).

Park guest quarter in S. Antonio di Mavignola

Visitors Center "Area Natura Rio Bianco" in Stenico

D.5 Future services

If the territory is accepted as a European and Global UNESCO Geopark, a specific strategy will be elaborated, whose aim is to create and plan actions to conserve the rich geological and geo-morphological heritage. This target would be achieved in cooperation with the municipal administrations, the tourist offices, and public and private local bodies. The Park has already planned some projects that aim to increase the value of the geological and geomorphological heritage, also from a didactic and popularising point of view. Some of these projects are already in phase of realisation:

• Realisation of a path in Vallesinella, in accordance with the CRENODAT project. The path
is dedicated to the theme of springs, with interesting geo-morphological didactical and educational characteristics of karstism.

• Realisation of the glaciological path Vigilio Marchetti (see par. C.2)

• Realisation of a geo-tourist path, in accordance to the Research Project supervised by the Earth Science Department of the University of Pavia named "The geological heritage as a resource for sustainable tourism". The path shows geo-morphological peculiarities from past glaciation and offers great aesthetic and didactic impact. It helps pupils and visitors to interpret and understand the landscape.

• Ideation, realisation, and publication of two geo-tourist guides. It is desirable that these guides will be inserted in the collection of geo-tourist guides of the future Geopark.

• Realisation and publication of a naturalistic guide for the "Val Algone Path", a route already equipped with panels, that explain, beside other matters, the geological features of the extraordinary valley and the anthropic formations linked to geology (quartz quarries).

• Ideation and creation of a project for environmental education, basically dedicated to the geological theme: "Geology within the Park".

• Design and construction of a Visitor Centre in Carisolo, basically dedicate to the water theme. It will be an interactive and multimedia centre, that will indicatively explain the following themes: springs, streams, and waterfalls in relation to energy production, and glaciers, lakes and peateries, Val Genova and its geo-sites, karstification, and geology.

Geotourists in the future Geopark – Photo F. Polla

• Didactical practical activities for university students

• Creation of a specific section in the web site, dealing with the future Geopark and with the connected activities. More in general it will deal with the education-information about the geological heritage of the area

• Creation and ideation of a mascot for the future Geopark

• Creation and publication of explanatory material with the aim of promoting the conservation and knowledge of the geological and geo-morphological heritage of the future "Adamello Brenta Geopark"; it will be distributed by the Visitors Centres, by the Info-Points, and by the local tourist offices

• Publication of this dossier, as a special number of the Park Magazine. About 20,000 copies of this magazine are distributed to the resident population.

Vallesinella Waterfalls – Photo Archive Pnab

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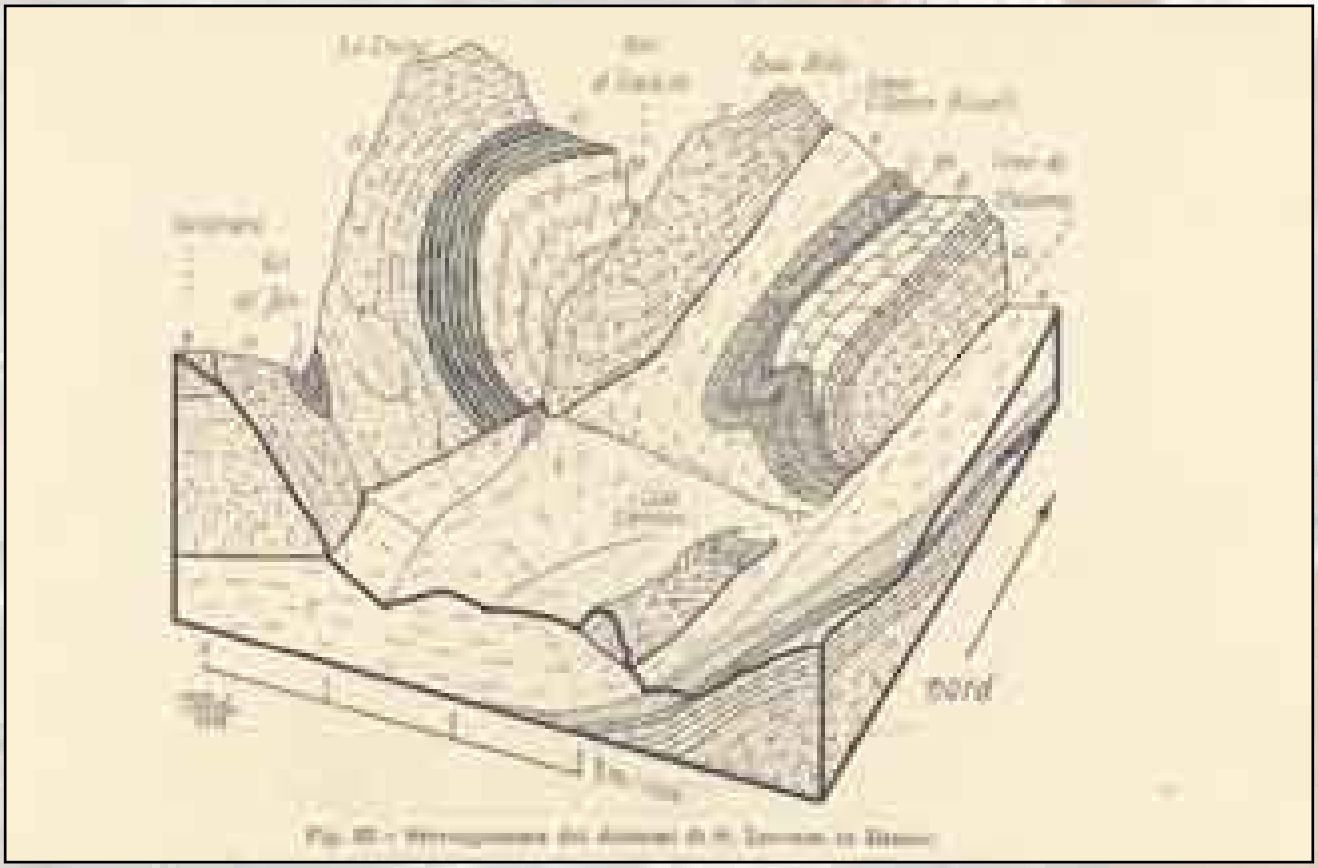

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