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From Geotourism and Geoeducation, to Geoheritage: the Value of Tangible and Intangible Heritage

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Abstract

This research aimed to explore the emerging challenges and the rapid evolution of awareness of the value of the geo-heritage of one's territory; particularly how this can evolve both in a value for geotourism and in effective educational paths. An attempt has been made to demonstrate, through a few examples, that the construction of a sensitivity towards a tourism attentive to geological and geomorphological values, important because it leads to greater attention to the sites, their conservation and protection and ultimately to respect for the environment, requires, for their effective valorization, scientific knowledge, albeit at different levels of depth, of what is observed, of what is protected, and above all of what natural phenomena are the result.

It is easy to appreciate, observe, photograph, and keep the memory of a beautiful mountain, a landscape, or a particularly original geological or geomorphological aspect, often identifiable with a geosite. It is less easy to recognize that the same value for the purposes of geoconservation, and therefore of valorization, can be attributed to phenomena, perhaps less beautiful from an aesthetic and environmental point of view, with a lower visual impact, significant both from a geological point of view, but even more historical, cultural, anthropic, revealing unexpected connections and transversal cultural and intangible values between different cultural areas.

These sites, places, contexts can have a profound impact on human sensitivity and perception, transforming a geological place into a place of cultures, a geo-site into a geoheritage-site. This research has tried to deepen this aspect, proposing some cases, situated in an author's known context, and particularly appreciated by the author, precisely because of the wealth of stimuli they can provide to the interested tourist, but also to the student to whom we wish to convey the perception of richness and depth of an environmental context, rich in scientific contents but also in cultural values.

Keywords: Heritage, Cultural Tangible and Intangible Values.

Introduction

The terms geosite and geopark represent, by now, quite widespread concepts: their knowledge and their use are expanding, both in the scientific community and in the world of education and of tourism, increasingly aimed at the discovery and use of natural environment, in their complexity. The direct consequence is the need to conserve and enhance these places, introducing the concept of geoconservation, the set of practical geosite management strategies, which is based on the idea that geological resources have a high scientific and touristic value, often threatened by human activities.

Even in natural parks, initially born more than a century ago to protect flora and fauna, in the United States bison or sequoias, in Italy ibex and chamois for Savoia Royals' hunts, the "non-living" components of the territory, the shapes of the landscape, the rocky outcrops, the waters and their action on the environment, waterfalls, lakes, are acquiring an increasing value. Yellowstone, the first natural park in the world, established to preserve the few herds of bison that survived the massacres of settlers, is now perhaps best known for its exceptional geological values, as the Old Faithfull and the Grand Prismatic.

The set of geosites represents the geodiversity of a territory, understood as a range of geological, geomorphological, hydrological and pedological characteristics of an area, all essential elements for the species living in that territory. The conservation of geodiversity and the protection of geological heritage are crucial to maintain the integrity of ecosystems. In Gray, (2004), the concept of geodiversity is defined as "the natural range of geological features, therefore rocks, minerals and fossils, geomorphological and soil". It is therefore a category of heritage comparable to other forms of natural heritage, such as biodiversity. Gray also identifies over 30 aspects of terrestrial geodiversity that can be recognized and classified into intrinsic, cultural, aesthetic, economic, functional, and scientific values and that justify the establishment of a given geosite. The geodiversity of the Earth will be sustained if the heritage of geological sites is preserved. If a geological resource is protected and valued, it will increase its attractiveness for tourists but also its value for geoscientists.

In previous research works, I tried to demonstrate, presenting simple cases in a known context, that not only the scientific value, but also cultural, historical values, rich in expected and unexpected connections made the geosite an exceptional educational tool as well as a tourist resource.

Based on this experience, perhaps it would be appropriate to distinguish the concept of *geosite,* with the different elements of geodiversity that can distinguish it, with that of *geoheritage.* Already in 1996 Dixon believed that only the components of geodiversity that have a relevant value for man, with scientific, educational, aesthetic, touristic, economical, intrinsic, and inspiring significance can be considered as geo-heritage.

From Geo-site to Geo-Heritage, an Evolutionary Process

I tried to analyze the word geo-heritage, its meaning, and its application to natural contexts, highlighting the subtle differences that, according to my perception, distinguish it from the geosite, attributing it a more complex function, in an evolutionary process aimed at protecting the territory. Above all, I needed to understand its precise meaning: if this "new" word identifies peculiar characteristics of geoconservation or geodiversity or is just a different way to indicate the same concepts. A large literature is existing, but not always convergences.

It is natural to imagine a geosite a place where the geological, geomorphological, petrographic characteristics highlight exceptional, peculiar aspects, not only for the specialist but also for the interested tourist and perhaps for the student. The wonder, amazement or simple curiosity that arouse environments, landscapes, peculiar geological formations, as a geyser, a series of columnar basalts, make sense of the attribution of geosite and require its protection, conservation, and enhancement. In literature, but also in practice, the concept of geosite is often assimilated to that of geoheritage. And distinction, if there is, is subtle. Also, despite in Italy, a country rich in natural beauty, landscape variety, many of which are at high risk for an intrinsic fragility but also for a land use often not very careful and invasive, over 3000 geosites have been analyzed, classified, it is still difficult to recognize, both locally and internationally, how a geological value, a geological object, can have a significant cultural value, can represent a heritage, even of humanity. We can take as example the Mont Blanc Massif, or the Matterhorn.

Figure.1,2,3 Mono Lake Tufa Reserve- Old Faithfull Park, USA, Columnar basalts (Iceland) s. occhipinti

Even UNESCO finds difficult to recognize those values: when, for example, in Italy among the 58 sites recognized as World Heritage only a couple of them have a significant geological value, despite criteria 1 and 3 of the Convention on the Protection of the World Cultural and Natural Heritage, adopted by UNESCO in 1972 recognize as a material heritage of humanity *natural monuments consisting of physical and biological formations or groups of such formations of outstanding universal value from aesthetic or scientific appearance, and narrowly defined natural sites or natural areas of outstanding universal value with a scientific, conservative or natural aesthetic appearance.*

The evolution of the concept of geosite, a site where we find scientific values certainly recognizable by the geoscientist, the expert, or the enthusiast, towards the perception of geoheritage can perhaps be useful to accompany the profane, the student, or

the tourist, towards a greater awareness of values a tangible but also intangible heritage. The site to which we want to attribute the value of geoheritage must, however, have specific characteristics that identify it. These characteristics, in addition to those that already normally identify a geosite, must give meaning to the word heritage, so they must contain *human history, past or recent, culture or emotion.* Visiting, exploring, knowing a place that constitutes a geoheritage must therefore represent not only an opportunity to acquire scientific, cultural, environmental information but also represent a sort of pilgrimage to sites, home to events that in remote or recent times represent significant or symbolic moments in the history of the Earth, of the humanity, of the lived of the local population.

Attributing to a place, as well as scientific and cultural, a symbolic value, which urges to remember an event, to relive a story, a legend, to represent a phenomenon, to share and express a feeling, constitutes an added value for the place itself.

It does not matter if the site of the geoheritage is represented by a dramatic event such as a landslide, such as a glacial deposit, or a particular environment, perhaps not so different from countless others, but still characterized by specific values. Just as we study the historical events of the past so that their memory is not lost and so that what happened in the past is not repeated in the future, we must be aware that for the same reason the geological heritage also represents a precious memory.

Geoconservation, a Priority Need for Geoheritage

The peculiarities that characterize the geopatrimonial places require not only a careful and punctual enhancement of the different aspects that characterize the site, but also an even more careful and punctual protection, and, where necessary, a dynamic maintenance of the site, precisely because of the characteristics of "diversity", not necessarily of "exceptionality" that can characterize it. It is useful to remember that geoconservation, or conservation of geodiversity, is meant to mean a strategy for managing geoheritage sites based on the idea that geological resources have a high value for both science and tourism and are often subject to great threats from human activities. Geoconservation must not only prevent damage or loss of geoheritage but must also improve and promote its geological and geomorphological characteristics, processes, sites, and specimens.

Therefore, even for those characteristics that usually do not involve any change: a landslide body, a rocky outcrop, a fault mirror, simple conservation is not enough, but an active management mode must be provided with the aim of ensuring the preservation of quality. Geoconservation could be defined therefore as the offort to try not only to preserve the geoheritage, but also to point out and to enhance the characteritics, the processes, the sites, geological and geomorfological specificities and even historical and cultural events linked to them. Of course, as with any method of storage, it is necessary to establish the purpose of storage, then the values and determine from which threats it should be protected, with the precise purpose of preserving well-developed and significant representative examples of those elements that are particularly valuable and rich in meaning in a region. To achieve geoconservation it is necessary to increase public awareness of the value of geoheritage, both for scientific or aesthetic reasons through educational and cultural fruition and promotion and interpretation through geotourism and a careful and well-oriented educational fruition.

It is necessary to guarantee the existing condition, but also to enhance those aspects, or points of view otherwise not recognizable, it is necessary to guarantee the dissemination of scientific, historical, peculiar information, but also their accessibility.

An important aspect of geoheritage is the principle of proximity. It is not easy, in fact, to arouse emotions in front of a rocky outcrop, a fold, a fault, fascinating for a geologist but not for an inexperienced public, object of analysis for an enthusiast, but certainly not for a demotivated student: we are not facing artistic monuments, works of art, places that have characterized history. Therefore, the place we want to arouse impressions, emotions, involvement, can do it more easily if it will be close, physically, or virtually, close to the visitor and to his experience.

Geoheritage for Geotourism and Geoeducation

For an adequate enhancement of the geoheritage, the site must therefore have adequate requirements: accessibility, scientific interest, wealth of suggestions, but it is necessary to know how to transform a place, even if unattractive, into an exciting, immersive path using effective and intriguing communications. Often geosites are presented and described, as in the case of bibliographies that will be indicated as illustrative of the cases presented below, of high scientific and qualitative level; geological, geomorphological, petrographic, and evolutionary detail in the case of phenomena in progress or instability. These are scientifically indispensable tools, but certainly difficult to interpret for the non-expert, the teacher who intends to motivate and interest the student, the tourist who wants to document on the site. A key issue is in fact the need to involve local communities that geological heritage could have a role in local development plans, and this can encourage local awareness of the wise management of sites. A key role is played by local authorities, who must include geological heritage in their local planning and economic development policy.

Natural, cultural, and then, geological sites could be integrated and used as a basis for a tourism more and more interested in human roots, in reviving traditional activities in environment and sustainable development.

The geological phenomena to be proposed can in fact be relatively interesting from a pure scientific point of view, but they don't necessarily have to have exceptional characteristics, but, as for more complex phenomena, some information is, of course, necessary to understand the phenomenon: a brief geological framing of the context, with particular attention to the perception of deep time, so

far from our natural idea of historical or everyday time, an analysis of the dynamics, history, and evolution, and of characteristics of the phenomenon, without forgetting a Geoeducation for nature conservation as part of education for sustainable development.

Moreover, they must be easily accessible and free of dangers, even by students and tourists, or clearly visible, from far and effective from an emotional point of view and be rich of connections with other scientific aspects or other subjects, Finally, to make the activity more effective, less banal and engaging it will be useful to research and to propose all the elements than can solicit in-depth curiosity, wish to analyze, to research and to find connections. Unlike geosites, rather than a thorough knowledge of the phenomenon, they must solicit an emotional involvement. So if any expected or unexpected connections are discovered, maybe they will be more of a narrative style, educational, a storytelling that can engage and excite.

Analysis of Some Cases

To explain and demonstrate the effectiveness of these ideas, three sites were chosen that are considered rich in geoheritage, all located in Italy, Aosta Valley but many others could have been presented and could effectively represent useful examples.
They were chosen because they were less "showy", apparently more common, for example compared to geological monuments such as the Mount Blanc, or the Grand Paradiso National Park, or even some mining sites. These three were chosen because the author studied and analyzed them, with their different geological and historical aspects and tested them consistently with the suggestions proposed for the management and promotion of a site rich in geoheritage. Although many others may possess similar characteristics, we have tried to combine personal knowledge, in some cases the rich scientific documentation already existing, the personal emotion experienced in walking through the sites, and even more the pleasure of presenting proximity sites.

THE BECCA FRANCE LANDSLIDE

Location and Motivation of the Choice

The landslide of Becca France, occurred in a transversal valley of the Valle d'Aosta, left orographic side, above the village of Sarre, between the 2312 m.of Becca France and 1500 m valley floor concerned, burying the valley floor of the Clusellaz stream, left tributary of the Dora Baltea.

It was the largest known natural disaster that hit the Aosta Valley, although the region has been affected over the centuries by numerous catastrophic events, with serious damage and deaths. A lot of high-level scientific research have described this event, formulating different hypotheses about its cause. For this, please refer to the bibliography. For a knowledge of the place and the event for the purposes of its role as a geoheritage site, this "narrative" is proposed.

The detachment of the landslide occurred on July 6, 1564, at 6 am, causing the destruction of the ancient village of Thora that stood in the incision of the Clusellaz stream on a plateau on the left orographic slope opposite to that of origin of the landslide. The shelf on which stands the current village of Thouraz (Sarre), is a morphological terrace open to the panorama of the Aosta valley floor, in sharp contrast with the huge gash of the mountain located to the west: the Becca France (2,312 m).

The toponym "Becca France" implies a double interpretation: according to some authors the name of this mountain derives from the fact that from its top it is possible to see the French mountains, unlikely given its modest altitude; more likely, the term "France" would be a translation from patois of the word "Frantze" (frank, sincere, solid).

The event, due to its catastrophic nature, the extent of damage and deaths, the complexity of the probable causes, and above all for the historical-social analysis of a period characterized by well-being, but also by extreme climatic events, on the limit between a period of climatic optimum and the beginning of an era characterized by decidedly colder climates, can legitimately be considered a geoheritage site.

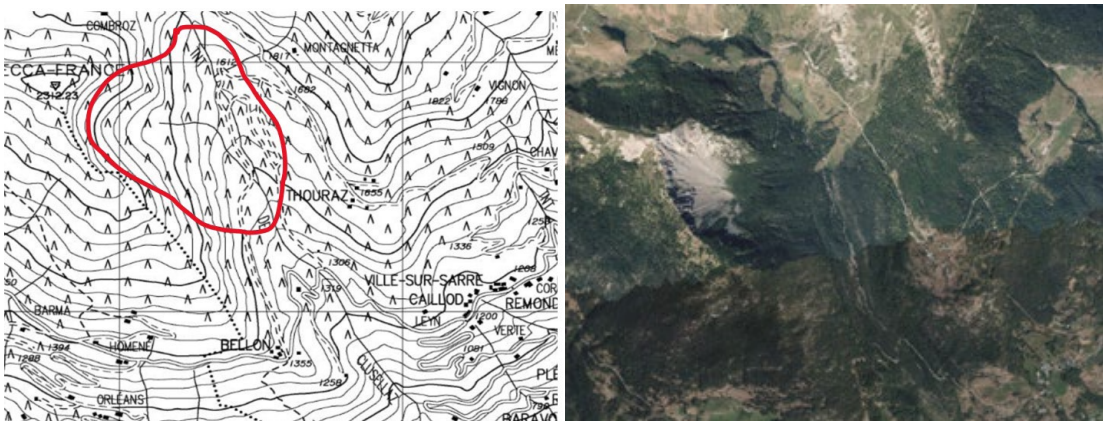


Figure 4-5 topographic map, aerial photograph - https://geoportale.regione.vda.it

Geology and Geomorphology

The area examined is at the tectonic contact between materials of the Middle Pennidic Domain and the Piedmontese Zone. The rich geological documentation recognizes, above the tectonically deeper continental unit, the Great St. Bernard aquifer, the Calcschists and Green Stones Complex, the ophiolites, consisting respectively of lime shale and marble, and of calcschists and prasinites, separated by a tectonic contact consisting of gypsum and carniole.

The Quaternary cover consisted mainly of glacial deposits from Pleistocene glaciers and a DGPV, a large deep gravitational deformation of the slope. The Becca France landslide is a complex landslide in which, however, the elements that characterize its morphology are clearly distinguishable. The detachment niche, from vertical to subvertical, extends on the right side of the Clusellaz Valley on the E side of the Becca France ridge. It has considerable dimensions, a cavity in the slope surrounded by an escarpment where we can recognize cracks that tend to widen; a maximum width of 950 meters and an average difference in height of about 400/450 meters, the niche is still evident today for the lack of vegetation cover.

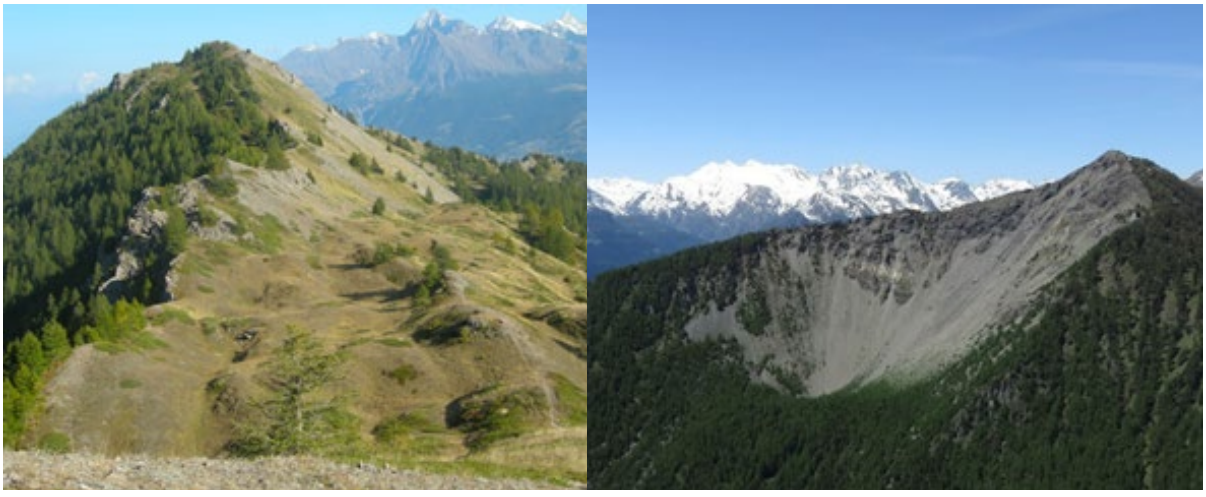
The strip at the foot of the wall, the accumulation of the landslide, a few tens of meters thick, extends for about 3 km in the Clusellaz valley floor and consists of extremely heterogeneous material: next to shredded fragments, we can also find large blocks stacked one above the other, showing different longitudinal ridges, up to ten meters high and a few hundred meters long, at an altitude between 1700 and 1900 m. Larches begin to colonize areas less prone to collapse and flows.

The Event

The detachment of the landslide, in a context of general geological instability, was triggered by the concomitance of various predisposing causes: the strong energy of relief, with a difference in height of 700 m between the mountain ridge and the valley floor, the fractured and melted rocky substrate and the poor geomechanical properties of the calcschists, and finally the chemical dissolution of the gypsum along the tectonic contact between the two units. But heavy rains were probably the main culprits, a credible hypothesis given that the event dates back to the second mid-sixteenth century, a period notoriously characterized by frequent floods and landslides throughout Europe, in the vicinity of the Little Ice Age.

In addition, recent studies have identified, on the southern summit of Becca France, the phenomenon of duplication of the ridges, direct evidence of the presence of a Deep Gravitative Deformation of the Slope. Before the historic event, DGPV contributed to undermining the stability of the slope by determining strong conditions of disarticulation and fracturing of the rock. A few days earlier, finally, an earthquake with a hypocenter in the Ligurian Sea would have affected the entire area of the Maritime Alps and could have been counted among the preparatory causes of the event: the earthquake could have further compromised the stability of the rock mass.

Following the collapse, the accumulation of material from the material landslide body formed a dam and a dam lake that lasted about 300 years. On June 10, 1851, at 11 am there was a sudden flood of the Clusellaz stream, swept Sarre, devastating fields, mills, and houses. The causes of this phenomenon, in addition to the rapid melting of snow caused by the unusual high temperatures of the previous days, have been attributed to the emptying of this lake. The resulting damage was considerable because the water dragged downstream a large amount of material that constituted the accumulation of the landslide that fell about 300 years earlier.



Figures 6-7 Becca France, crest duplication – the detachment niche - s. occhipinti

Why Geoheritage

News of the village of Thora were already present at the end of the twelfth century, but it is certain that it was already populated in the early Middle Ages. Thora was a flourishing village of two hamlets, Bubloz and Chabloz, which based its economy on trade, also thanks to its strategic position at the intersection of the road

that led from Aosta to the Great St. Bernard Pass and Valdigne, and which had allowed Thora to become a place of communication and flourishing exchange of goods with Switzerland and France. The beauty and healthiness of the place also made Thora an important place of vacation and rest. In fact, the village was the summer residence of many nobles from Valle d'Aosta and Valais who owned villas and land, which therefore in that historical period, indicated conditions of well-being and good quality of life.

The name of the village was due to the name of the de Thora family, who owned most of the assets in the area, including their manor house and had established important commercial ties and obtained prestigious assignments in the nearby city of Sion, in present-day in Switzerland, so much so that two important annual fairs were held there in which the inhabitants of the valleys and neighboring countries participated: the cattle fair and the fair of products of the earth. Chronicles of the 15th century report the existence of a hospice for wayfarers and a chapel dedicated to St. Theodulo probably built in the thirteenth century.

A place of opulence and prosperity, the village is told to have dozen mills, at least fourteen looms, millstones and presses to produce nut oil. There were about 500 dead, a whole village destroyed. Later, the village was rebuilt further east, on the opposite side of the mountain at an altitude of about 1600 meters, in a place considered safer. Geology, natural hazards, landslides and earthquakes, complex phenomena and dynamics, history and climate change, economy, and well-being: numerous elements are intertwined to provide a historical, economic, and social framework strongly marked by a geological event. A geoheritage site where once again geology is a founding node for history and society.

THE BIG MORAINE OF THE VERRA GLACIER

Location and Motivation of the Choice

The Great Verra Glacier is one of the largest glacial environments in Valle d'Aosta with an area of 728 hectares. It is located on the southern slope of the Monte Rosa massif, a large circular amphitheater, bordered to the west by the hump of Rollin, to the east by Monte Castore, with approximately in the center, the unmistakable rocky conformation of the Becco dell'Aquila. The glacier is divided into two separate entities (Large and Small) by the rocky pyramid of Lambronecca. They are both glaciers of the "valley" type that close the upper Val d'Ayas to the north, passing through the Verra basin; from here originates the Evançon stream. The large amphitheater rises about 3000-3100 m., but further down the glacial tongue is forced to form a large icefall. The glacial tongue, currently in regression, like many similar environments in the Alps, is bordered laterally by powerful moraines. This glacier was studied, over time, by great glaciologists such as Federico Sacco, Umberto Monterin and Manfredo Vanni who wrote the Charter of the Sardinian States of 1856.

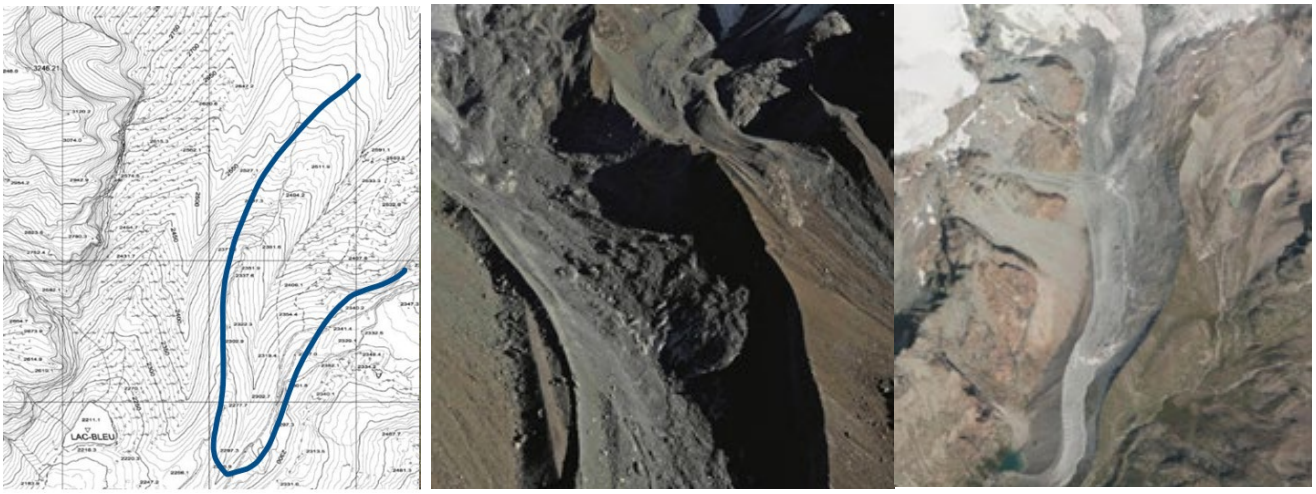


Figure 8-9-10 Verra glacier moraine- topographic map, aerial photograph - https://geoportale.regione.vda.it, – Google Earth referring to the investigations of 1821, that the Great Verra Glacier reached the Pian di Verra.

The left lateral moraine, on whose ridge, partly in decay, runs the path to the Mezzalama refuge, highlights the enormous difference in height between the current altitude of the glacier, represented by a few glacier plates and widespread rivulets of water and the crest of the moraine. A lot of high-level scientific research has described this site. For this, please refer to the bibliography. For a knowledge of the place and the event for the purposes of its role as a geoheritage site, this "narrative" is proposed. The choice of this glacier, and its left lateral moraine as a geoheritage site, among the many existing in the Aosta Valley is due to its accessibility, according to the rule of proximity, to the imposing and exceptional structure of the moraine cord, which highlights the important glacial retreat initially due to the physiological retreat in the post-glacial phase, but as can be seen from recent surveys on melting, due to global warming. Years of regressive trend have affected the breadth of this glacial basin, with a particularly negative peak found at the end of July 2017 and again in June 2022.

The Event

Since 1923 the regression of glacial extent has reduced the length of the lower tongue of the Great Verra by about 500 meters. In 1923, in fact, Federico Sacco reported in his notes, made between 1913 and 1923 that the Verra glacier in the period of 1820 must have been entirely contained among its high lateral moraines, and when it returned to advance in the period 1850-60, the share of the ice was such as to exceed the crest of the moraines.

After the continuous retreat, only in the seventies, a combination of environmental factors led to the advance of the Glacier that had reached a length of 5.10 km. The decrease today is very visible by anyone, going up the left moraine of the glacier and observing the glacial front below: in recent years, in the Mount Rosa group, the limit of perennial snows has risen by 100 meters of altitude, loss of ice due to the warm months. The summers of 2003, 2015 and 2017 severely affected the glacial surface, like that of many other ice basins. The vegetation cover, where the altitude allows it, is progressively colonizing the sides of the moraine with young larches

Figure 11-12 The Verra glacier moraine - s. occhipinti

Why Geoheritage

In September 1935 U. Monterin discovered a fir trunk on the front of the glacier then at an altitude of 2250 meters, well above the normal altitude where this species of plants grows in 1950 m. He argued that it had not been moved by man, as a silt rich in serpentine testified to a long stay of the trunk under the ice, and therefore hypothesized that the tree had been uprooted by glacial expansion, perhaps in 1550, at the beginning of the Little Ice Age after growing upstream of the point of discovery. It is therefore assumed that the current moraine was once covered by a real forest, then overwhelmed by the advance of the glacier. Sedimentology, analysis of radioactive isotopes and dendrochronology have confirmed that from 750 to 1550 the Alps experienced a period of climatic optimum, characterized by a much drier climate, with average temperatures about three degrees higher than the current ones. This explains the existence of stable settlements at Piani di Verra and a limit of eternal snow at 3600 meters.

This allowed communications between Ayas and the Teodulo hill, through a mule track to the Cime Bianche Col. In 1600 the glacial expansion of the Big Verra glacier closed this centuries-old communication route, cutting off Ayas from trade beyond the Alps and causing the decline of the power of the lords of Challant, as well as perhaps originating the ancient and fascinating myth of the lost city of Felik, whose legend attributes the destruction of the town to the advance of the glacier, as a punishment for the inhabitants, too attentive to material goods. Once again, a geoheritage site where geology is a founding node for history and society.

THE CIME BIANCHE VALLEY

Location and Motivation of the Choice

The Cime Bianche Valley is located in the upper in the Aosta Valley in Valle d'Aosta, on the right side of the head of the valley; it develops from Saint Jacques, 1300 m, up to the three hills, the Upper Col, to the north which represents the crossing point between Val d'Ayas and Valtournenche, the Lower Col, to the south and the Roisettaz Col. The route is characterized by a succession of grassy plateaus, which develop between the nearby Gobba of Rollin to the east and the Dolomite ramparts of the eastern slope of the Roisettaz to the west. The summit of the Cime Bianche Col, just under 3,000 meters high, allows a close-up view of the Matterhorn and the Grandes Murailles. The upper part of the valley is dotted with numerous lakes, including the Cime Bianche Big Lake, Ventina Lake and Pers lake. On the western side we also find the Tzère Great Lake. A lot of high-level scientific research have described this event, formulating different hypotheses about its cause. For this, please refer to the bibliography. For a knowledge of the place and the event for the purposes of its role as a geoheritage site,

this "narrative" is proposed. The Vallone is a place of great value for its rare and fragile ecosystem, characterized by geological peculiarities: among the three White Peaks (Gran Sometta, Bec Carré and Pointe Sud) a bright band is what remains of the coral islands of a tropical sea upset by the collision of the European plate with the African one. It is characterized by a unique biodiversity that has earned it the applause of the Italian Botanical Society, thanks to the myriad of springs, wetlands and rubble, streams, and high-altitude lakes. *For these characteristics, for the presence of archaeological values, witnesses of past climates and phases of anthropization, it can legitimately be considered a geoheritage site.*

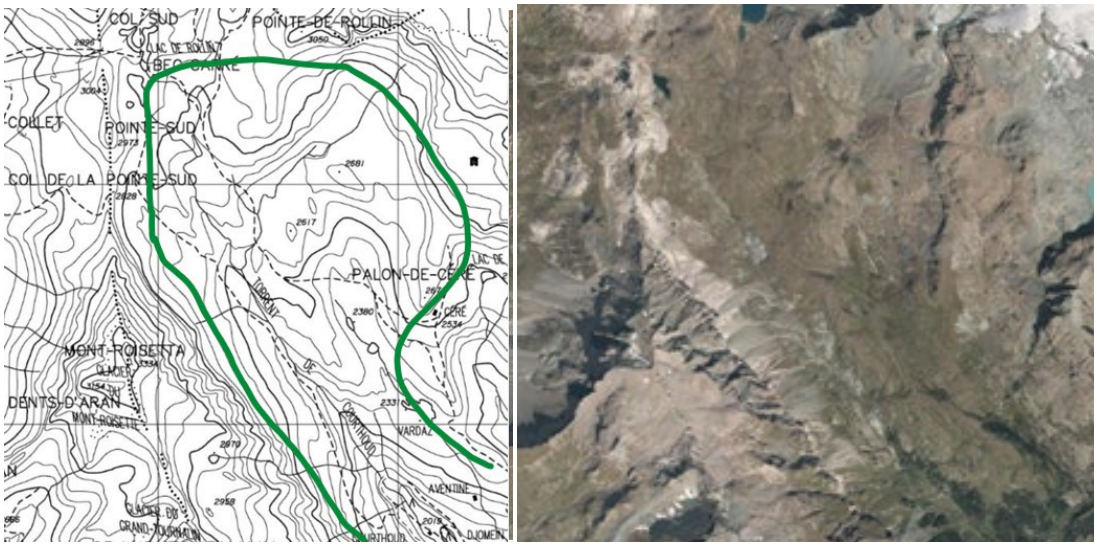


Figure 13-14 Vallone Cime Bianche - Topographic map, aerial photograph - https://geoportale.regione.vda.it, –

Geology and Geomorphology

This area has an exceptional geological nature. The Val d'Ayas is in fact approximately at the contact between the rocks called Sesia-Lanzo, which during the first phase of the Alpine orogeny were torn from the edge of the African plate and quickly dragged into the terrestrial lithosphere at a depth of 50-60 km, which constitute the left side of the Valley and the Complex of the Calcschist with green stones, the ophiolites, which mainly make up the right side. More in detail, along the valley of the Cime Bianche there are several rocky bodies, with mining associations of great interest for the understanding of the landscape and alpine dynamics. The valley is set on a series of materials of oceanic origin, with a prevalence of serpentinites that already emerge on a part of Monte Rosa and that represent the lower level of the ancient bottom of the Alpine Ocean, rised by the orogeny at over 3000 meters. Interspersed with serpentinites at higher altitudes can be recognized basaltic magmas that have intruded into the oceanic crust or have been erupted by the numerous underwater volcanoes; during their passage, they locally shredded and altered serpentinite.

Further upstream, a whitish horizon represents the lagoons that had opened before the formation of Tetide, and the Piedmontese Ligurian Basin that occupied this sector, in which coral reefs and materials deriving from the evaporation of lagoon waters were formed, now transformed into dolomitic limestone and evaporitic rocks. This horizon of white rocks that runs along the right orographic side of the valley, to form the three white teeth of the Cime Bianche and which represents the margin of the ancient continent towards the ocean that was forming and is therefore much older than the oceanic rocks that lie below. Above this horizon, appear the calcschist, rocks deriving from calcareous marine sediments, with some inclusion of metabasite and serpentinites, which constitute the Tournalin and the Roisetta Mounts.

The Event

Already in 1990 G.V. Dal Piaz, urged the establishment of a "Lost Oceanic Park" in the valley of the Cime Bianche for its geological riches as evidence of the ancient Ligurian Piedmontese Ocean, and which currently occupies the entire intermediate sector of the Valle d'Aosta, with a South-West North-East trend, bordered to the South East by the Sesia Lanzo Complex and to the North West by the Pennidic Units, Great St. Bernard Fold and locally covered by the edges of the Dent Blanche Fold. In the area numerous faults that as consequences on the orogenic contact, affect its morphology and are easily recognizable. Glacial forms, gravitational deposits , and peat bogs are present.

There are also numerous traces of ancient anthropization, dating back to the Middle Ages in the phase of climatic optimum and subsequently interrupted by the advent of the Little Ice Age at the end of the 16th century.

Figure 15-16 Cime Bianche Valley - s. occhipinti

Why Geoheritage

Traces of passage and human presence are visible in many signs, from prehistory to the Walser era. It is in fact a significant archaeological area for the presence of sites for the extraction and processing of soapstone, as well as for the firing of lime. Only the climatic variations of the Little Ice Age and the recent changes due to an economy based on tourism have changed the original destination.

The richness of geological, petrographic, morphological peculiarities, but also biological and floristic make this valley unique in the local context.

This is the last large area of the entire Val d'Ayas without ski slopes or ski lifts, roads, private hydroelectric power plants and invasive structures for the ecosystem; the Vallone is protected by the ZPS "Glacial environments of the Monte Rosa Group" and risks being distorted by the construction of some ski lifts to allow the connection between the Valle di Ayas and Valtournenche. In this case, unlike the cases previously illustrated, recognizing the value of geoheritage, where geology is a fundamental node for history and society also means guaranteeing adequate protection.

Conclusions

Every time the discovery of how naturalistic aspects and in particular geological ones can condition, limit, or promote historical events, economy, society, constituting tangible and intangible cultural values is a charming surprise. Constantly looking in this direction can, on the one hand, promote protection, enhancement, of precious areas, but on the other hand increase attention to a sector, geo-heritage, still not present in the common sensibility, both local populations and administrations, tourists, even when attentive and interested in naturalistic aspects.

References

1. DIXON G. – (1996) Geoconservation: An International Review and Strategy for Tasmania A report to the Parks and Wildlife Service, Tasmania and the Australian Heritage Commission.
2. GRAY M. – (2004). Geodiversity: Valuing and Conserving Abiotic Nature. John Wiley, Chichester, 434p.
3. OCCHIPINTI S. –(2019) Geoparks and geo-sites: geological "learning objects – in Geoheritage, Geoparks and Geotourism Geoconservation and Development (as per Springer Guidelines): January 15, 2019 https://link.springer.com/chapter/10.1007/978-981-15-4956-4_12
4. OCCHIPINTI S. –(2019) A problem-based learning Approach enhancing students' awareness towards natural risks and hazards in Italian schools – Geosciences https://www.mdpi.com/2076-3263/9/7/283/htm https://www.researchgate.net/publication/334056690_A_Problem Based_Learning_Approach_Enhancing_Students'_Awareness_of_Natural_Risks_and_Hazards_in_Italian_Schools

Becca France Landslide

5. GIANOTTI F. (2012) Geological context of the Becca France historical landslide (Aosta Valley, NW Italy)
6. IFFI -Inventario dei fenomeni franosi in Italia-Italiano–Ispra http://www.isprambiente.gov.it/it/progetti/suolo-e-territorio-1/iffi-inventario-dei-fenomeni-franosi-in-italia
7. http://www.isprambiente.gov.it/files/pubblicazioni/rapporti/rapporto-frane-2007/Capitolo_6_Valle_Aosta.pdf
8. REGIONE VALLE D'AOSTA, SERVIZIO GEOLOGICO -2012 http://www.risknet-alcotra.org/rna/allegati/risknat-b2-c2-schede-frane-vda_1023.pdf
9. https://www.regione.vda.it/territorio/territorio/geositi/beccafrance/frana_i.asp

Verra Glacier moraine

10. SERVIZIO GEOLOGICO D'ITALIA – (2017) Memorie descrittive della carta geologica d'Italia vol.101 Note illustrative del F. 070 Monte Cervino della carta geologica d'Italia alla scala 1:50.000 http://www.isprambiente.gov.it/files2017/pubblicazioni/periodici-tecnici/memorie-descrittive-della-carta-geologica-ditalia/volume101/memdes_101_caratteri_geografici_e_geomorfologici.pdf
11. CATASTO GHIACCIAI https://sites.unimi.it/glaciol/index.php/it/catasto-dei-ghiacciai-italiani/

12. CATASTO GHIACCIAI VDA http://catastoghiacciai.partout.it
13. CAMANNI E. https://www.enricocamanni.it/pubblicazioni/storia-di-ghiacci-storia-di-uomini/

Vallone delle Cime Bianche

14. DAL PIAZ G. V., Ernst G. W. (1978) – Areal geology and petrology of eclogites and associated metabasites in the Piemonte ophiolite nappe, Breuil -St.Jacques area, Italian Western Alps. Tectonophysics 51, 99-126
15. DAL PIAZ G. V. (a cura di) (1990) – Le Alpi dal M. Bianco al Lago Maggiore. 2 vol, © S.G.I., BeMa Editrice. vol. II itinerario L 13 pag. 139.
16. PRINETTI F. "Andar per Sassi" (Musumeci ed.) https://andarpersassi.it/il-vallone-delloceano-perduto/