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Following the Tracks of Charlemagne in the Cottian Alps. The Cultural and Geological Heritage of the Franks Trail (Susa Valley, Piemonte, NW Italy)

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Abstract

This paper presents an attempt at the evaluation of the Alpine geoheritage of the Susa Valley (Piemonte region, NW Italy). The area is included in the project for the creation of the 'Cottian Alps Geopark', whose application to the European Geoparks Network is in progress. The Susa valley is a unique and great geological section showing all the structures and rocks involved in Alpine orogenesis. Moreover, it shows outstanding examples of interactions between human activities and processes of the physical environment. We considered these cultural landscapes as a heritage worthy to be known by people and to be exploited by geotourism activities. Therefore, we investigated the local geodiversity, assessed the geoheritage and identified the geosites characterised by a high potential for the enhancement of public understanding of geoscience and for recreational activities. In this paper, we describe the actions and methodologies carried on for creating geo-itineraries and for improving tourism activities and scientific knowledge. In particular, we focus attention on the Franks trail, a 60-km-long route crossing the Geopark territory, which follows the path blazed by Charlemagne in 773 AD as he attempted to avoid the Longobard army. The trail runs through many sites which tell about natural and cultural heritage. Our evaluation project makes the trail suitable as a 'cultural extension' of the 'Via GeoAlpina', an international project that aims to show the wonders of alpine geology and geomorphology.

Keywords

Franks trail
Cottian Alps
Geoheritage
Cultural geology
Geoparks

Introduction

Humans have populated the Alps for at least 15,000 years. During this time, wild animals have been hunted, herds and flocks farmed, forests cut and fields cultivated, water resources used, quarries opened and mines excavated, villages have been built as well as related infrastructures. We have changed the natural landscapes, but at the same time, we have also experienced climatic changes, avalanches, floods, landslides and earthquakes.

The interaction between human actions and components of the physical environment has been defined by the

UNESCO during the Convention on the Protection of the World Cultural and Natural Heritage held in 1972, as 'Cultural landscapes'. In this framework, landscapes should be considered as a heritage to be known and enjoyed by people. Fortunately, during the last decade, there has been a growing interest by citizens and public administrations towards the protection and preservation of the landscape and its components. This has contributed to changes in the tourist offers, including within classic historical, cultural and eno-gastronomic itineraries as well as with those with a naturalistic and environmental focus (Ghiraldi et al. 2014a, b). Among the latter, a distinct sub-sector is so-called 'geotourism'. Following the definition provided by Newsome and Dowling (2010), geotourism can be defined as a form of natural area tourism that specifically focuses on geology and landscape. It promotes tourism to geosites and the conservation of geodiversity, contributing to increasing the awareness of the importance of the Earth Sciences through appreciation and learning. The Piemonte region (NW Italy) offers an extraordinary wealth of history, culture, art, legend and traditions that combined with the great heterogeneity of the landscapes, making it an ideal laboratory for testing alternative tourist offers. Here, the added value is the provision of interpretive and service facilities enabling tourists to acquire knowledge and understanding of the geological and geomorphological evolution of an area beyond the level of mere aesthetic appreciation (Ghiraldi et al. 2014a, b). The growth of the Geopark network is the best evidence that broadcasting both the geological and cultural aspects is one of the best ways for promoting sustainable development through geotourism (Gordon 2011). In addition, disseminating geodiversity concepts is a key factor for the sustainable management, both for tourism activities and for risk assessment related to different geomorphological processes (Bertacchini et al. 2003; Brandolini et al. 2006, 2012; Hose 2008; Prosser et al. 2010).

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Aims and Methodology

This work aims to produce a further contribution in the evaluation of Alpine cultural and geological heritage by means of an integrated approach combining the geology and geomorphology with cultural, historical and artistic aspects of a territory. According to the sixth article of the Arouca Declaration (2011), many geopark evaluation projects propose the creation of geo-itineraries in order to improve tourism and scientific knowledge (Coratza et al. 2004; Barbieri et al. 2005; Bissig 2008; Magagna et al. 2013; Pica et al. 2013), for at least three reasons:

1. From the scientific point of view, geo-itineraries allow us to tell a geological story: combining multiple pieces (geosites) of a single mosaic (geoheritage of the area), illustrating its content (geodiversity) and spreading geological and geomorphological awareness.

2. Geo-itineraries are means for combining geological topics with cultural and environmental aspects: meeting both the definitions of geotourism provided by Hose (2012) and by the National Geographic Society (2005).

3. Geo-itineraries usually encourage visitors to spend a longer time in the Geopark, allowing the use of accommodation and facilities, bringing economic benefits to the local communities.

On the basis of the considerations stated above, a well-established methodology (Giardino et al. 2011; Ferrero et al. 2012; Ghiraldi et al. 2012) for the geoheritage promotion of a territory has been applied, including geosites identification, assessment, selection and dissemination of information. The methodology proposed can be summarised in the following steps:

1. Definition of the state of the art concerning geodiversity and geoheritage, by means of scientific literature, remote sensing analysis and field surveys

2. Inventory of geosites carried out by combining data collected from field survey with different sources of information from territorial analysis and thematic maps production at different scales using a geographic information system (GIS) software

3. Comparative evaluation of geosites in order to facilitate exploitation strategies of different geo-thematic tours, both classical and virtual, by means of web mapping application, in order to provide easy to access and suitable tools for people interested in the geological heritage (Ghiraldi et al. 2010)

4. Production of descriptive cards for each stop of the trails, in order to facilitate general public understanding of the processes forming the present-day landscape (Giardino et al. 2004; Lozar et al. 2014)

The results obtained so far are the following:

(a) Allow the selection of several sites that best represent the interaction between cultural and geological heritage

(b) Highlighting how geodiversity has conditioned the life and the habits of local populations

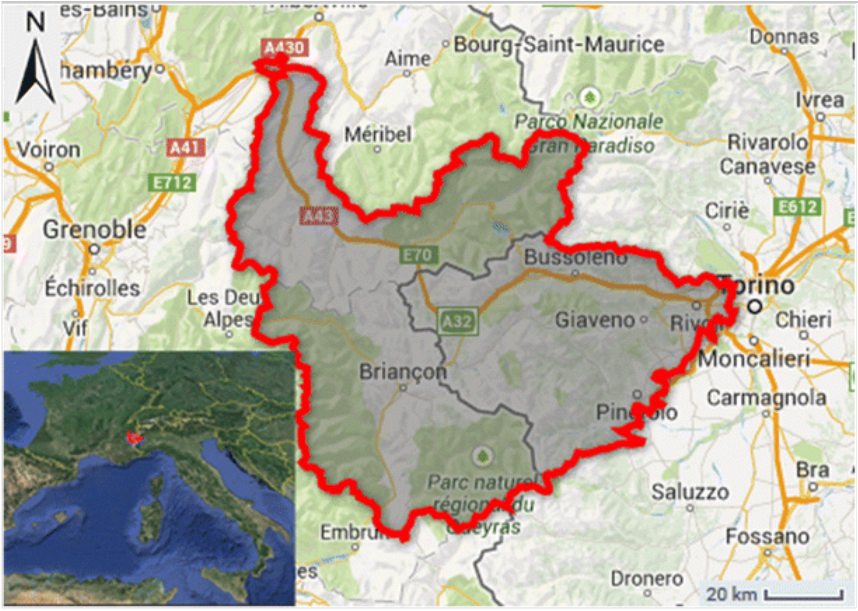
(c) Make the geology and geomorphology of the Susa Valley approachable by peoples of different age and culture (Panizza and Piacente 2003; Hoblèa et al. 2011; Brandolini et al. 2011)

The Study Area

The Susa Valley (Piemonte, NW Italy) is included in the territory of the cross-border 'Cottian Alps Geopark project' (Geoparco delle Alpi Cozie–Gèoparc des Alpes Cottienes–Interreg Alcotra 2007–2013, Project 2.), whose application to the European Geoparks Network is in progress (Fig. 1).

Fig. 1

The Geopark range (in *red*) and its location in Europe (*box*)



The Susa Valley is one of the main valleys of the Western Alps. It extends over 50 km in an east-west direction from 300 m a.s.l. of the Rivoli-Avigliana moraine amphitheatre to 3500 m a.s.l. of the head of the valley near the French border and constitutes a complex water-drainage valley system. The valley bottom hosts the Dora Riparia River, which has two main tributaries, the Dora of Bardonecchia and the Cenischia torrents.

The valley can be subdivided into three segments:

– A higher part, formed by the highest zones from the alpine watershed to the Oulx-Salbertrand Plain (1.000 m a.s.l.)

– A middle part, between Oulx-Salbertrand Plain and the Dora Riparia-Cenischia confluence

– A lower part from the Dora Riparia-Cenischia confluence to the mouth of the valley on the Torino plain

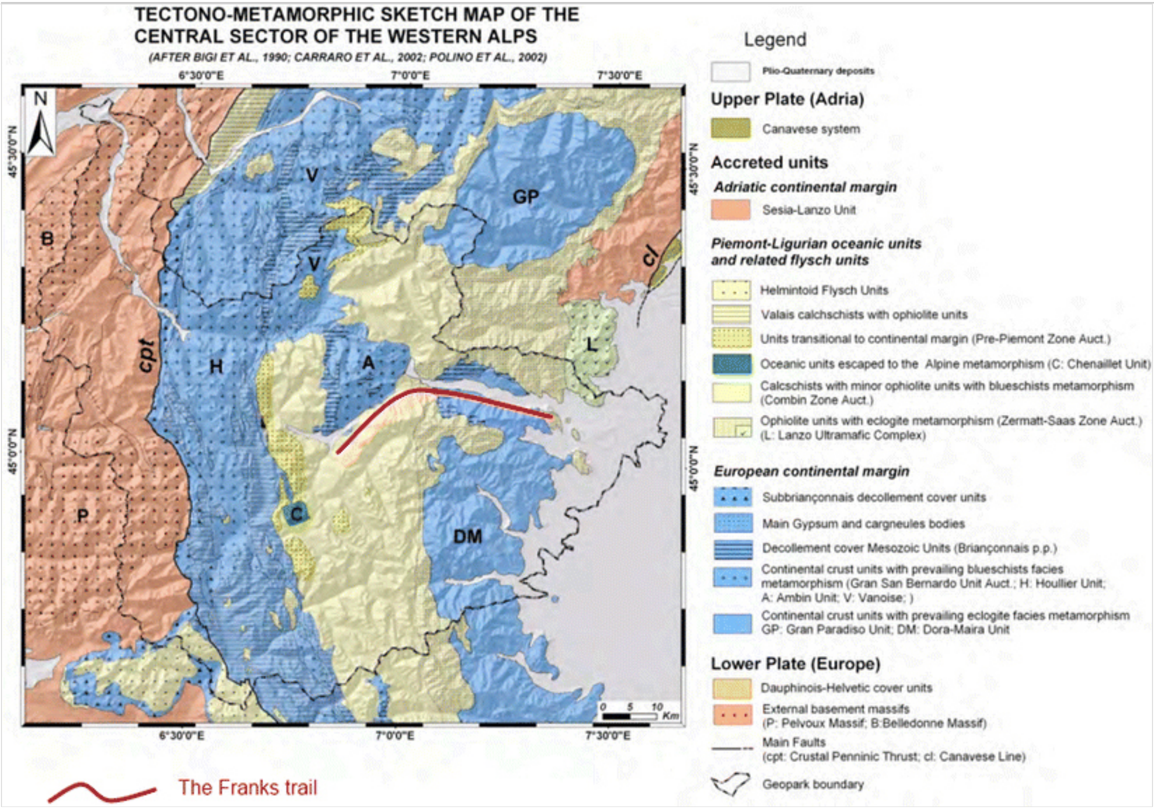
The general aspect of the valley clearly shows the heterogeneity of the landforms due to the interaction of different processes and phenomena during recent geological time. The long-term geomorphological evolution indicates that the head of the Susa Valley originally belonged to the western side of the Alpine chain and now forms part of the eastern side, after the continuous systematic migration of the main watershed from the inside towards outside (Staub 1934). Such processes would have happened, according to Staub, mainly during the Miocene. In the Lower Pliocene, similarly to the other main western Alpine valleys, the lower part of the valley was invaded by the sea. The retreat of the latter was followed, in the Middle Pliocene and the Lower Pleistocene, by the deposition of a swamp-coastal-fluvial succession ('villafranchian' facies).

The quaternary glaciers have already started to form and their existence and evolution in the Alpine relief and from the accumulation surface of the ‘villafranchian’ succession, their progressive erosional deepening has brought about the re-excavation of a valley parallel to the previous one. Traces of the glaciers are very recognizable as erosional landforms and in the well-preserved deposits on both sides of the valley. The post-glacial evolution of the Susa Valley is strongly characterised by various gravity instability processes: large landslides, rock fall and deep-seated gravitational deformations related to the surface releasing tensional processes due to deglaciation and by the structural settings of the relief. At present, higher altitude zones are characterised by cryogenic and nival phenomena while in the lower elevation zones and in the valley bottoms, the erosional and depositional processes of fluvial environments become most importance.

From a geological perspective, the Susa Valley represents a natural cross-section through the axial section of the Alpine chain, where from east to west, it is possible to observe the geological features associated with the continental margin, which is made by crystalline rocks (Ambin Unit and Dora Maira Unit) and the Ligure-Piemontese Oceanic units (Calchschists and Ophiolitic rocks) (Fig. 2). The most common lithofacies are gneiss of different types, ophiolites (serpentinites, prasinites, eclogites, peridotites), calchschists, micaschists and other metamorphic rocks. Sectors of Mesozoic sedimentary rocks such as carbonates, with little or no metamorphic deformation, are also preserved locally.

Fig. 2

A tectono-metamorphic sketch map of the central sector of the Western Alps (modified from Baral et al. 2013)

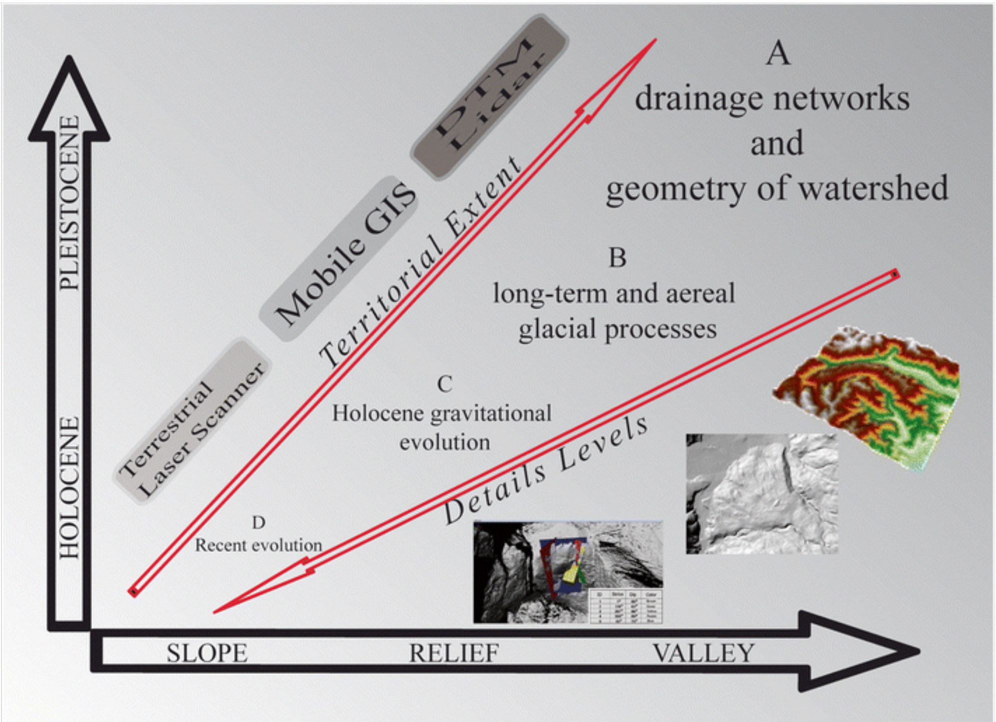


The Franks Trail

The Franks trail is a route crossing for 60 km the Susa Valley territory. It follows the path blazed by Charlemagne in 773 AD as he attempted to avoid the Longobardian army encamped at the bottom of the valley. The path starts from Oulx village and finishes at the San Michele Abbey, and in past centuries was travelled by numerous pilgrims on their route towards Rome (Fig. 3).

Fig. 3

Major events that have contributed to change the landscape: *black arrows* represent the spatial extension (*horizontal*) and the time evolution (*vertical*), while the *red arrows* represent the tools used (see text for further explanation)



The idea to reconsider the Franks trail as a geo-itinerary is due to the presence along the path of many interesting sites both from the geological and the cultural point of view. It takes about 3 or 4 days to hike along the trail, during which tourists can enjoy abbeys, moraines, quarries, mines, museums and natural protected areas. A further advantage is the connection with the 'Via GeoAlpina', an international project that aims to create geo-itineraries across the Alpine chain, showing the wonders of alpine geology and geomorphology. Upstream, beside the Franks trail near the Montgenevre area, there is a segment of the 'Via GeoAlpina' named the Colletto Verde trail that leads hikers to an ancient ocean floor showing spectacular outcrops of pillow lava (Boschis and Giardino 2004). Downstream, there is the segment that crosses the Rivoli-Avigliana morainic amphitheatre (Giardino et al. 2010a).
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The geosites along the Franks trail are very different both for their time of evolution and the spatial extension of the landforms (Fig. 4). For these reasons, different tools have been used for studying and the analysing the sites:

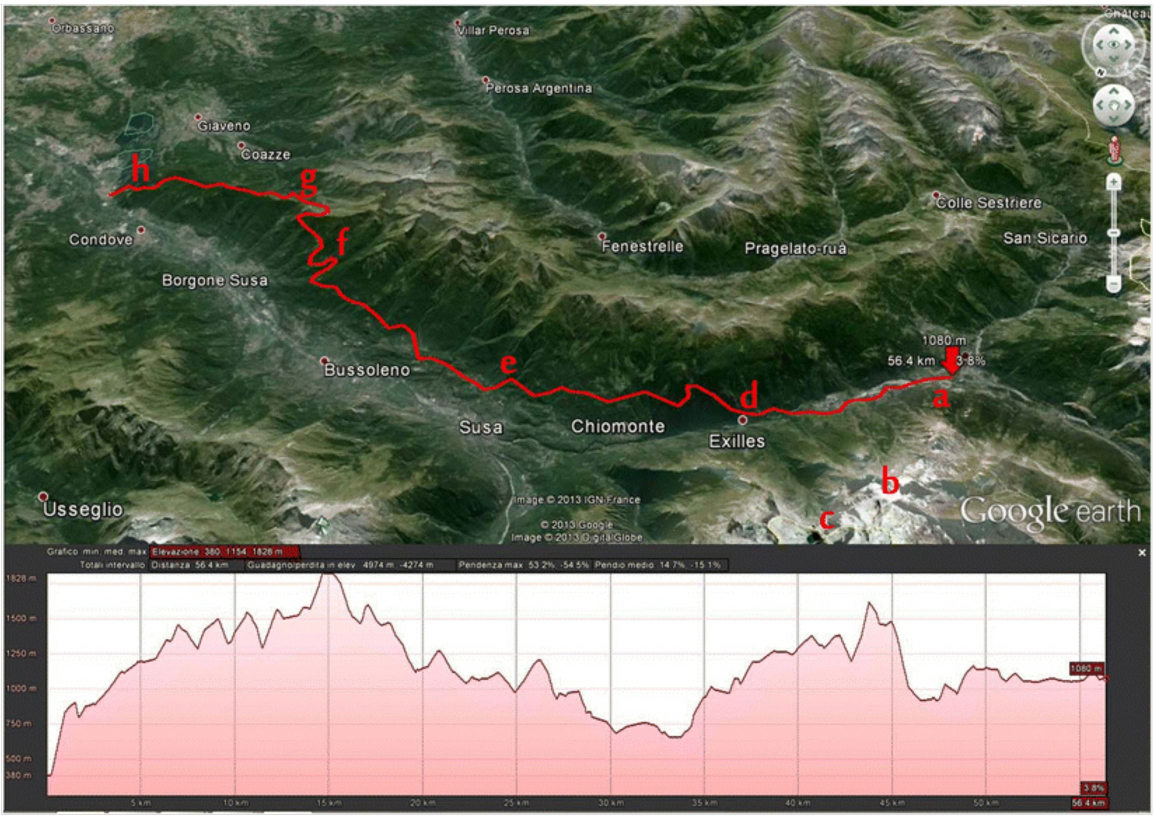
1. For macro-landforms, aerial photography combined with digital terrain model (DTM) has been used.

2. For more detailed activities such as terrain survey on medium-size landforms, pocket PC and tablet equipped with mobile GIS and specific application for data collection have been a practical solution.

3. For detailed survey activities performed on micro-landforms, laser scanner and close range photogrammetry obtained the best results.

Fig. 4

The tracks and the profile, from *right* (Oulx) to *left* (San Michele's Abbey)



In order to present multidisciplinary information, the trail comprises several spots, selected for their holistic properties, which integrate both scientific and humanistic aspects (Reynard et al. 2007). In addition, for a best dissemination of the project, a web-based platform has been developed following previous experiences (Martin and Ghiraldi 2011; Martin et al. 2014).

The Geosites

The geosites selected offer a system of relationships between environmental and human history and can be understood easily by a general public. Because of their high value, some of the locations have been selected even if they are not located along the Franks trail; some are just a heartbeat away from the main path, others are located on the opposite side of the valley.

The proposed geosites are the following:

(a) The Oulx intermountain plain. The geomorphological framework of the area is characterised by several mass movement features, differing in age, size and genesis. Among these are as follows:

1. The large Sauze d'Oulx paleolandslide: a post glacial gravitational phenomena activated by the retreat of the Susa Valley's glacial mass (Carraro et al. 1979).
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2. The Cassas landslide occurred in 1957, during a heavy meteorological event and involved nearly 10 million m^3 of rock

3. The Testa del Mottas landslide occurred in prehistoric times but reactivated in 1728

4. The Serre La Voute post glacial paleolandslide, occurred around 9500 to 8300 years BP and that created a natural barrier (dam) and the consequent formation of a lake basin, as now evidenced by the Oulx plain

(b) Seguret's gorge. This incision on the southern side of Mount Seguret developed along a fault crossing the northern side of the Susa Valley. The gorge is carved within quartzite rocks and is characterised by steep slopes which make it almost inaccessible. The only access point is located in the apical portion where a tourist could appreciate many subglacial and torrent erosion features, such as wells, potholes and waterfalls (Ghiraldi et al. 2014a, b).

(c) Saraceni Caves. These represent a beautiful example of sub-aerial exposure of karst conduits. Besides their karstic and geomorphologic aspects, this geosite also shows the tectonic feature of the area and many contextual aspects, such as cultural and historical, linked to legends about the caves and to the military roads that makes the area accessible (Ghiraldi et al. 2014a, b).

(d) The Fort of Exilles. Between Susa and Oulx, the valley is overlooked by the unmistakable shape of the fort of Exilles, situated on a glacial *verrou* whose western part was smoothed for military reasons. The top of the *verrou* links with the *roches moutonées* of Cels, on the left bank, testifying to their common origin.

(e) View from the Church of Madonna della Losa. This wonderful panoramic view allows the observation of many important features of the low and medium Susa Valley system, starting with the unique shape of the Rocciamelone mount (3538 m). On the left side of the view, it is possible to observe the confluence of the Cenischia valley with the main valley and appreciate the different erosional rates that have affected the two valleys. On the southern flank of the main valley, some glacial *verrou* and spillway channels testify to the south to north migration of the ancient glacier. On the northern flank, the Foresto and Chianocco gorges represent a post-glacial phase, characterised by erosional deepening of waterways as a result of changes in the level of the bottom valley.

(f) The Montebenedetto Abbey. The abbey is on the right lateral moraine of the Gravio glacier, which provides evidence of the last phases of Pleistocene glaciations. The abbey was built in the twelfth century by Carthusian monks from the Chartreuse of Grenoble and used until the fifteenth century, when a flood of the river Fontane partly destroyed the buildings. Since then, it was has been on rarely used for agricultural activities.

(g) The Val Sangonetto geo-itinerary: In the Susa-Sangone divide, the trail meets the Val Sangonetto geo-itinerary. The divide represents a great viewpoint for the Palè morainic amphitheatre, a beautiful landform created by the Pleistocene glacier of the Sangonetto Valley, now totally disappeared. Here, we can observe three moraine ridges, formed during different glacial pulses.

(h) The San Michele Abbey. The trail ends with the symbol of the Piemonte Region, the San Michele Abbey, built at the end of the tenth century on the Pirchiriano Mount. The abbey represented one of the most important Benedectine abbeys of the NW Italy during the Middle Ages and a necessary stage for the pilgrims travelling to Rome along the Via Francigena. This stop was also selected because of the strong connection between historical and geological heritage, i.e. the ridge of Mount Pirchiriano is part of the so-called 'Chiusa di San Michele', a type of choke point placed at the mouth of the Susa Valley where the Longobardian army in the eighth century erected some defensive structures in order to face Charlemagne's army. The king of the Franks, however, avoided the Longobardian army and passed got around the blockade by abandoning the valley floor and climbing the Pirchiriano Mount, following the glacial saddle formed by an ancient spillway channel and surprising the Longobardians on the opposite side (Fig. 5).

Fig. 5

Some of the selected geosites: **a** the Sauze d'Oulx paleolandslide (*hillshade image*), b the Saracen's Caves; **c** the Seguret Gorge; **d** the Palè Morainic Amphitheatre; and **e** the San Michele's Abbey. (photographs **b** and **c** from Ghiraldi 2010, **d** from Giardino and Mortara 2004, **e** from Giardino et al. 2010a)

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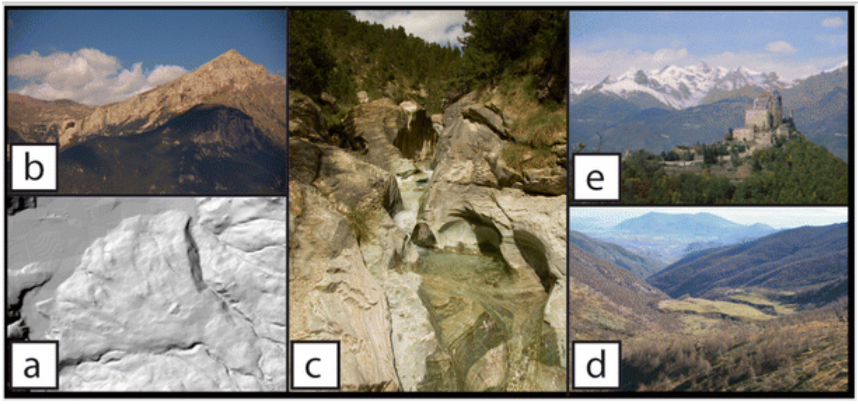

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Conclusions

The loss of geological heritage is an irretrievably lost, it is usually a result of natural events and/or anthropogenic factors; either way, such processes can present a direct risk for people and a sure loss for scientific knowledge. Both unexpected natural events and anthropogenic factors are symptomatic of a lack of knowledge and environmental awareness, probably due to the following:

1. The difficulty of understanding geological temporal and spatial scales

2. The idea that geoheritage is static and therefore indestructible

3. Wrong decisions by public administrators

It is, therefore, necessary to educate the public as to the fragility of the landscape, emphasising its evolution and its dynamics. Geoparks are good tools for this purpose, thanks to the involvement of the population in the birth of a geopark itself and the possible economic benefits they can gain related to geotourism.

Analysis of the existing relationship between geological, cultural and historical heritage in the Susa Valley has been carried out following a well-known methodology developed by the Department of Earth Sciences of Torino University. In order to plan geotouristic activities combining different topics, it was necessary to create a multidisciplinary working group and inform the local administrators about the potential impact of the project. An aspect of fundamental importance for the success of the initiative was the methodology for preparing the itinerary. Including geosites with a holistic value could satisfy the different needs of the public, provided that the language used is simple and intuitive. Furthermore, the technological advances that have characterised recent years and the increasing accessibility to the Web and mobile devices, allowing the establishment of solutions capable of reaching a large number of potential users, could be useful not only for advertising the area but also for informing and sharing the knowledge of a territory in an integrated manner, taking into account cultural, historical and artistic aspects related with the Earth Sciences.

The Franks trail is located in one of the most populated Alpine valleys and meets all the requirements stated above. It could, therefore, be a great opportunity for creating a field laboratory to enhance the understanding of the interaction between geological and human sciences, as well as to assist the dissemination of Earth sciences to the general public and improve the economic benefit to the local communities. In the near future, the trail will be also promoted in schools by producing educational materials in order to increase awareness about landscape dynamics (including risks) and opportunities for positive developments.

Acknowledgments

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