

# ENHANCING GEOLOGICAL HERITAGE: THE EXPERIENCE OF THE NATURE PARK OF THE APUAN ALPS (ITALY)

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## **Introduction**

The Apuan Alps correspond to a mountain range at the north-western edge of the Tuscany Region (Northern-Central Italy), where the transition between the Middle European and the Mediterranean biogeographic zones occurs. In this transition area, the Apuan Alps raise up to almost 2000 m of altitude, being stretched from north-west to south-east, as an isolated geographical element from the Northern Apennines main range and separated from the Ligurian Sea for a short distance by the Versilia plain (figure 1).

The overall morphology characterized by steep slopes and deep valleys incised in carbonate rocks has made possible to give the name of “Alps” to the Apuan peaks. Therefore the Apuan Alps represent a fascinating orographic complex, whose worldwide fame is due to the beauty of its marbles (e.g. the Carrara marble) as well as to deep abysses and large caves of the karst underground.

A great part of the Apuan Alps, corresponding to about 500 km<sup>2</sup>, is an area subject to environmental protection under the jurisdiction of the Nature Park of the Apuan Alps (hereinafter Park Authority) which has been established by the Tuscan Regional Law No 65/1997.

From a geological point of view, the Apuan Alps belong to the Northern Apennines, a segment of the Apennine-Maghrebian orogenic system, derived from the collision between Europe and Africa plates after the closure of the Ligurian-Piedmont oceanic basin (Alpine Tethys). The Northern Apennines is a NE-verging thrust and fold belt developed during the Cenozoic by the overthrusting of the ocean-derived Ligurian Units onto the external Tuscan and Umbria-Marche continental margins.

In this context, the Apuan Alps have long been considered a key area for understanding the geological history of the Northern Apennines, as they represent the most important tectonic window of this belt. In the tectonic window the deepest structural level of the Northern Apennines is exposed, being formed by a complex of greenschist metamorphic rocks, the “Tuscan Metamorphic Complex”. This complex is overthrust by allochthonous units formed by unmetamorphic rocks (Tuscan Nappe and Ligurian Units).

The “Metamorphic Complex” is composed by a Paleozoic basement derived from the Hercynian orogeny with an initial age presumably dating back to the Cambrian which is unconformably overlaid by a metasedimentary sequence showing ages from the Late Triassic to the Oligocene. The Meso-Cenozoic cover begins with continental-littoral “Verrucano” deposits (conglomerates, metasandstones) followed by a thick sequence of dolomites, marbles and schists that witness to the development and drowning of two superposed carbonate shelves formed respectively during the Late Triassic and the Early Jurassic. The sequence ends with the Late Oligocene metasandstones documenting foredeep deposits.

Overall, the Apuan Alps display rocks covering a long time span, from the Paleozoic basement to the Cenozoic foredeep sandstones. However, the characteristic rocks of the Apuan Alps are the marbles (e.g. the Carrara marble) occurring at different levels of the

metasedimentary sequence. Marbles have been quarried since Roman times and before and it is impressive the list of different types of marbles extracted that have been grouped in 14 main commercial varieties.

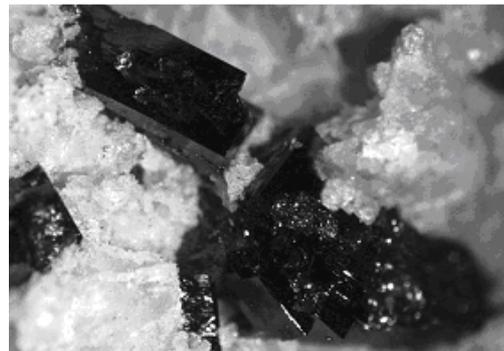


*Figure 1. The mountain range of the Apuan Alps (in the background) from the Ligurian Sea*

### **The geological heritage of the Apuan Alps**

The geological heritage of the Apuan Alps is of particular value as in the same area several examples of significant geological and evolutionary history of the Mediterranean region are preserved. One of the highest expressions of the geological heritage is the above mentioned peculiar tectonic window occurring in the middle of the Apuan Alps where the oldest geological formations of the whole Northern Apennines crop out. In the context of structural geology, we highlight the occurrence of many outcrops that let observe a wide variety of ductile and brittle structures.

The Apuan Alps are also characterized by a unique distribution of minerals; in particular nineteen new mineral species were discovered and described for the first time in the Apuan area, most of which not yet found in other places in the world (figure 2).



*Figure 2. The geodiversity of the Apuan Alps: marble metabreccias (left) and the mineral “apuanite” (right)*

The karst cavities in the Apuan Alps that show significant development of the underground network are more than 1000. Some of these are actually impressive hypogean karst complexes and particularly the Corchia complex is a cave system of global significance. Also epigeal karst landforms (i.e. dolines, doline fields, karren fields) are present.

In addition, several emergencies display valuable geomorphological features connected to dolomitic landscape in carbonate rocks (natural arches, peaks and pinnacles, etc.; figure 3) as well as to glacial erosion and deposits (U-shaped valleys, over-excavated basins, moraines, etc.).

Other remarkable expressions of the geological heritage are the archaeological finds and the historical-cultural emergencies related to quarrying and mining industries.

For the systematic assessment of the value of the geological heritage of the area, the Park Authority started since 1996 the inventory of the geosites of the Apuan Alps. This inventory recorded more than 200 geosites that express all degrees of geological scientific interest, from global to local. As geosite of worldwide scientific interest we must emphasize the Corchia cave complex: it is a geological and climate record preserved in a complex network of tunnels and shafts developed for an estimated length of 53 km and a height difference of 1187 m.

A further geosite of worldwide interest is the "Buca della Vena" Mine where during the last twenty years more than eighteen mineralogical species have been identified.

The Apuan Alps are also significantly present in the first list of geosites compiled by ProGEO (the European Association for the Conservation of the Geological Heritage). This comparative inventory, which expresses the highest values of the European geological heritage indicates the tectonic window of the Apuan Alps, the Mt. Corchia Hercynian discontinuity and the "Cipollino" marble as geosites exclusive of the Apuan area.

The identification of the Apuan geosites took immediately the goal to convert them to intangibles and indispensable elements of landscape and environment. Indeed, the Plan for the Park (the planning tool of the Park Authority) has acknowledged the counted geosites as 'structural invariants' with respect to the anthropogenic changes, i.e. as natural objects that can not be subjected to transformations and uses able to degrade them.

In the Apuan geosites the scientific and educational interests are well matched. The Apuan Alps have always been a fertile field of investigation and a special outdoor laboratory attended by universities, research institutes, schools and environmental associations.

A special educational value of the Apuan Alps is represented by the presence of ancient and modern signs of mining and marble quarrying, which allow considerations on the durable use of not reproducible georesources.

### **Planning the Apuan geopark**

The geosite inventory contributed to state the importance of the Apuan Alps geological heritage. It also encourages the awareness of the geodiversity present in this area inside local communities so that they can share and participate best practices with respect to geoconservation and sustainable development strategies.

In pursuing its institutional goal of enhancing the geological and naturalistic heritage of the Apuan Alps, the Park Authority has therefore undertaken many actions for developing the tourist use of the protected area and the promotion of environmental education as parallel themes within a broad framework of issues that embrace the complex reality of the Apuan territory in all its natural and anthropic components.

The first solid results consist in the achievement of some projects for the creation of facilities that mainly enhance geological and geomorphological topics.

The Park Authority opened to the public museums and guided walking trails in caves, archaeomining areas, disused quarries, archeosites and thermal springs. Several hiking trails in the protected area have been recovered and restored and one of these was equipped with facilities for disabled persons.

However, the most important achievement of the Park Authority for promoting geosites is the Speleological Trail of the Corchia cave complex, the largest Italian karst complex which develops within Mt. Corchia. Completed in 2001, this underground trail made accessible to the general public a stretch of 1024 m of natural galleries, fully equipped with 646 m of stainless steel bridges (figure 4). The karst environment is monitored

continuously by three stations detecting chemical and physical parameters, with particular attention to CO<sub>2</sub> concentration and wind speed, to avoid saturation conditions that might affect the integrity of the calcareous deposits.



Figure 3. The natural arch of Mt. Forato



Figure 4. The Speleological Trail of the Corchia Cave complex

The Speleological Trail is integrated into a network of equipped geosites (quicksilver old mines and marble underground quarries), representing an interesting tourist project called Corchia Underground. The overall cultural task of this project is also supported by the “Pietra Piegata” Museum and the “Working in freedom” local community Museum. The services are carried out by a cooperative expressing the interests of the local community. Therefore the Corchia Underground project is a concrete example of management of geosites and documentation institutions based on the direct involvement of the people living in this territory. The Park Authority has also developed intangible assets that include the printing of naturalistic guides and of “*Acta apuana*”, the scientific journal of the Nature Park of the Apuan Alps, which is published once a year and has always offered priority to geological studies. In 2000, the Park Authority has funded the printing of the Geological Map of the Nature Park of the Apuan Alps (scale 1:50.000).

All the projects that have been taken up for years with the aim of enhancing the knowledge of the geological heritage allowed the Nature Park of the Apuan Alps to aspire to become a member of the European and Global Geoparks Network, under the auspices of UNESCO. The path for this acknowledgement which started in the Marina di Carrara conference (October 2001) where the area’s interest in becoming an internationally recognized Geopark was unanimously ratified by local administration bodies and communities and environmental and cultural associations, came to the stage of submitting the application form to the European and Global Geoparks Network in November 2010.