Ente di gestione delle aree protette della Valle Sesia

Parco naturale
Alta Valsesia e dell'Alta Val Strona

Parco naturale
Monte Fenera

Organizzazione delle Nazioni Unite per l'Educazione, la Scienza e la Cultura · Geoparchi Mondiali UNESCO

SESIA VAL GRANDE GEOPARK

Story of a supervolcano

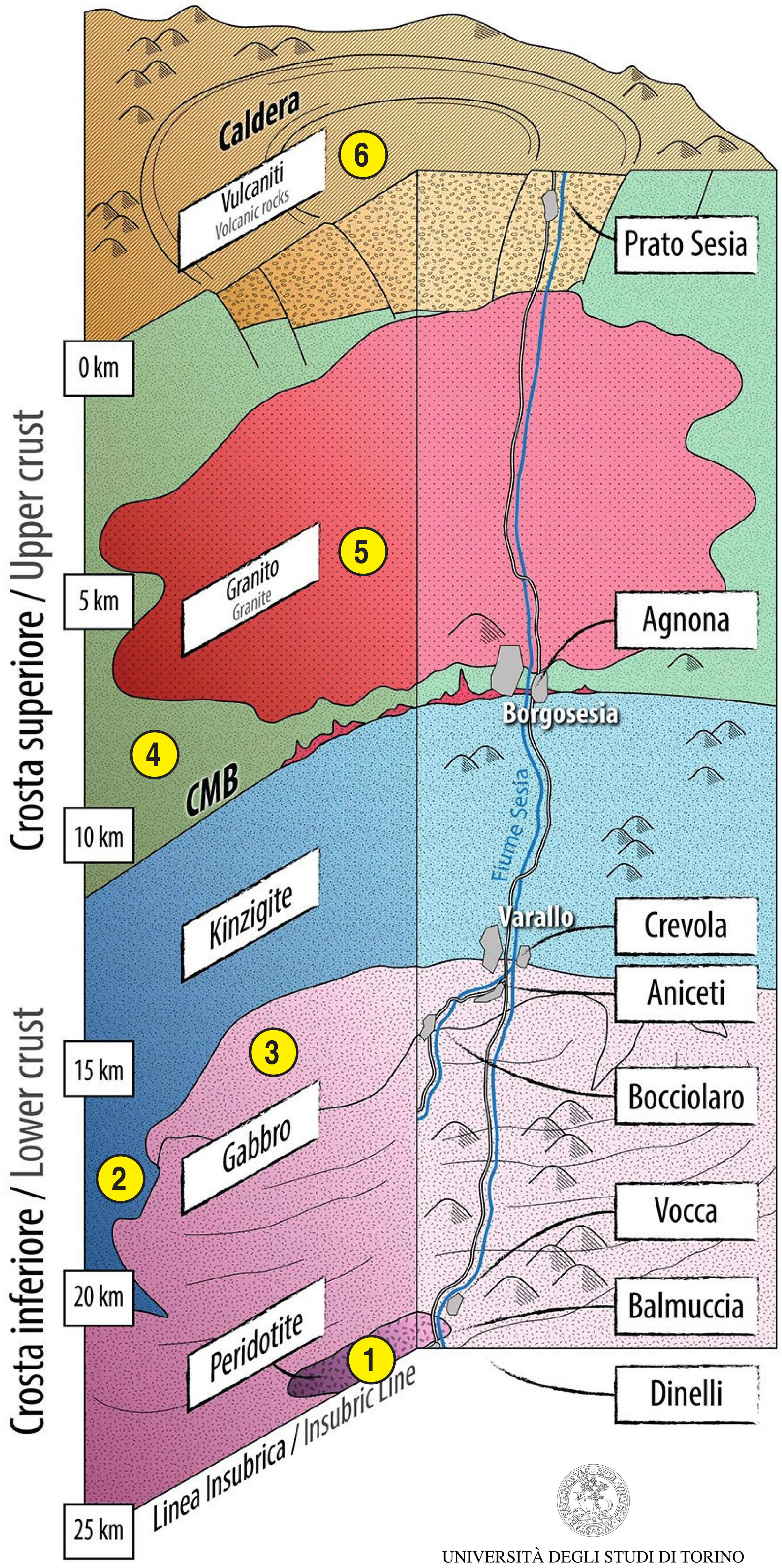
In Valsesia you can discover what happened hundreds of millions of years ago in an active supervolcano, crossing its geological structure, from the surface to a depth of approximately 25 km in the Earth's crust. Today, this area is an open-air laboratory: collecting various types of geological evidence, scientists can study the processes that led the supervolcano to grow and then to collapse into a caldera, after a major eruption. Thanks to the welth of data and scientific interpretations collected in Valsesia by geologists, and by the dissemination initiatives of Associazione Supervulcano, even the non-experts can discover the characteristics of the Sesia's supervolcano and reconstruct its evolutionary history. All you have to do is follow the Valsesia downhill: the supervolcano's geosites, from Dinelli to Prato Sesia, are proof of the different geological environments of the past, from the depths of the mantle to the Earth's surface, and they illustrate the magmatic and tectonic processes that occurred over the course of hundreds of millions of years.

About 295 million years ago, from the **mantle**, (1) that is the layer below the Earth's crust, some magma thrusted upwards and penetrated the **deepest part of the crust**, (2) forming the so-called **basic complex**. (3) The heat of this deep body was such that it started a partial melting of the **upper crust**, (4) thus forming **granite bodies**; (5) while, at the same time, the magmatic activity reached the surface.

About 280 million years ago, a super-eruption caused the volcanic system to collapse, forming a **caldera** (6) of at least 13 km in diameter: it is estimated that more than 500 km3 of magma were erupted. It was one of the most violent magmatic events ever recorded, and Valsesia still retains traces of it today, despite the subsequent geological vicissitudes.

In fact, about 190 million years ago, the Earth's crust slowly fractured and opened, forming an ocean that separated the ancient European and African continental margins: the Tethys. Only in the last 30 million years, during the formation of the Alpine chain, the collision between Africa and Europe caused an entire slice of the African crust, enclosing the ancient magmatic system of the supervolcano, to rotate and emerge.

The area of the supervolcano is now part of Sesia Val Grande Geopark (www.sesiavalgrandegeopark.it), recognized by UNESCO; more information on the supervolcano can be found on the website: www.supervulcano.it.



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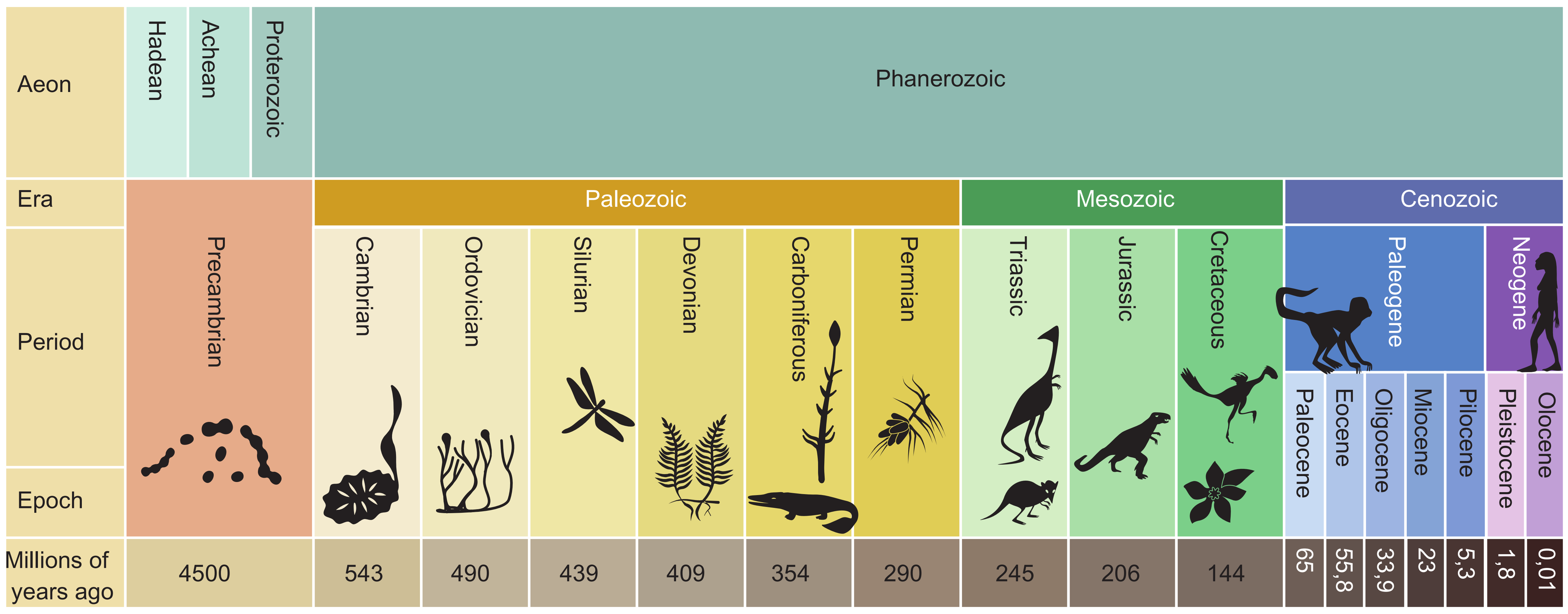
Volcanic rocks in Prato Sesia (photo by C. Leonoris)

The Geology of Monte Fenera

The Geology of Monte Fenera originates in the Permian, that is , the last geological period in the Paleozoic or (Primary) Era, which began about 540 million years ago and lasted approximately 300 million years and was characterised by the most extraordinary development of life forms on our planet. The volcanic rocks, which are widespread in lower Valsesia, date back to the early Permian or 280 million years ago.They consist of rocks formed from erupted lava of a reddish tint, sometimes a dusky brown and violet-red tuff (rock formed by the fusing together on the ground of the material ejected in an explosive volcanic eruption).

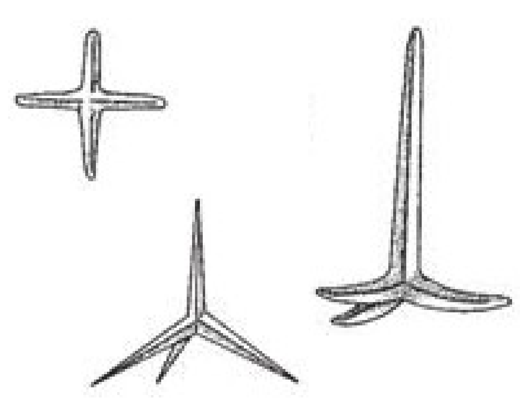


Geological time scale: (disegno di C. Flandoli tratto da Curtis et al. Introduzione alla biologia(C) Zanichelli, 2015)

Outcrops of tuff containing chunks of vulcanite and older metamorphic rocks (mica schists and gneiss belonging to the "Serie dei Laghi"), which emerge in the Eastern side of Monte Fenera and along Valle Strona in Valduggia, constitute the rocky substratum, basically the "pavement", of what is now known as Valsesia's Supervolcano.

Above the volcanites of the Permian Volcanic Complex (extended between the Biella and Lugano areas and formed between 280 and 255 milion years ago) we find totally different rocks, that is the sediments of a costal plain fed by alluvial inflows which testify to the existence of an ancient sea basin which in in the middle Triassic (Anisico 247-242) come to cover previously emerged areas. The Arenarie (Arena=Sand,beach) of Fenera Annuziata have this origin. In this Mesozoic sea (characteristic of the Mesozoic or Secondary Era, which began 251 milion years ago and lasted Just under 200 milion years) which originated due to the laceration of the Pangea (the supercontinent formed tens of milions years earlier), an immense gulf called Tethys was formed. In the westernmost sector of that great gulf, in the territories called by geologists

Adria and Apulia, began to sketch what would later become our country.
For millions of years, in a tropical climate, the remains of living organisms made up of calcium carbonate deposited on the seabed, forming the carbonate succession of Monte Fenera. The progressive advance of the sea is evidenced by the presence of a layer of metric thickness of arenaceous dolomites which constitute transaction sediments between the underlying sandstones (coastal environment) and the above dolomites (formed in a seadeeper carbonate platform environment (coral reef type). The dolomite of Monte Fenera (Dolomia di S. Salvatore) reaches a thickness of 300 m. Above this unit we find the first deposits of the Lower Jurassic (Lias, 195 Ma) that is dolomitic breccias (consisting of sharp-edged fragments of pre-existing rocks) and red, yellow, brown and gray sandstones (Arenarie di S. Quirico) greenish containing quartz, vulcanites and dolomites, with a maximum thickness of 60 m, which testify to sedimentation in a continental environment and subsequently in a marine environment that was gradually deepening.



Sponge spicules

Ammonite

Above 640 m of altitude and up to the top of the mountain, a powerful succession of sponge-like limestones emerges (the spicule is a microscopic structure present in the skeleton of sponges) called Spongolithic Limestones.
The lower portion is richer in silica while in the upper one increases the calcium carbonate (in fact it passes from siliceous spicules to calcareous spicules). This formation reaches an overall thickness of 250 m. and the top part, in Alpe Fenera, is rich in ammonite fauna (185 Ma).

Progettazione: Chiara Leonoris - Grafica: Mattia Sandrini

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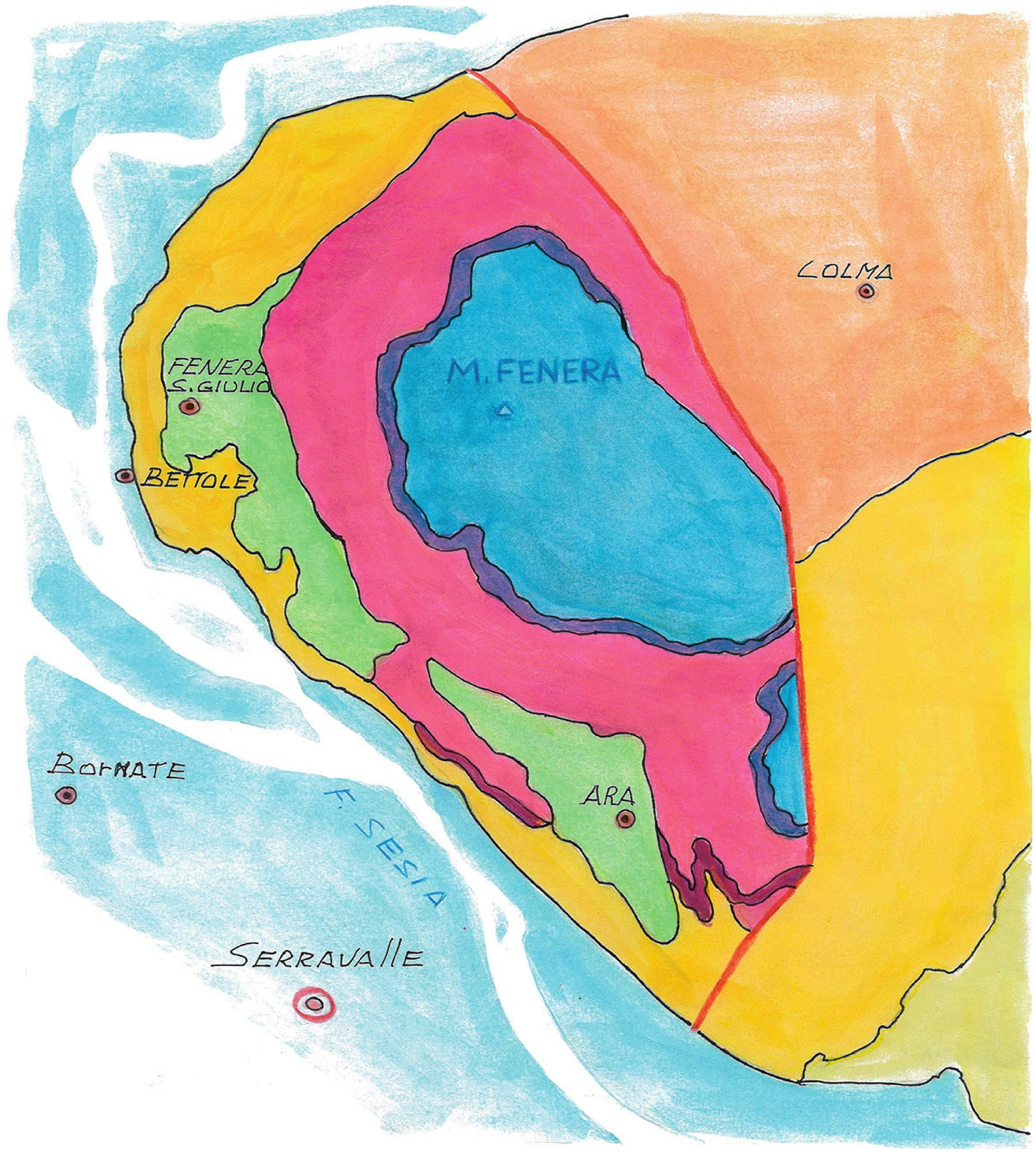
Geological map

A geological map uses symbols and conventional colours to represent the different rock bodies ("units") that appear on the surface in a specific area and their contacts. The accompanying legend describes the type of rocks and indicates their age. The legend follows a chronological order (i.e. referred to time), and presents the different geological units according to the principle of "overlapping layers" (from the bottom to the top "the most recent layers overlap the most ancient").
The fact is that there can be inverse sequences when the layers are refolded on themselves or when the rocks undergo a turnover because of the dynamic of the Earth's crust.



Tratto da Govi 1975

LEGEND

QUATERNARY

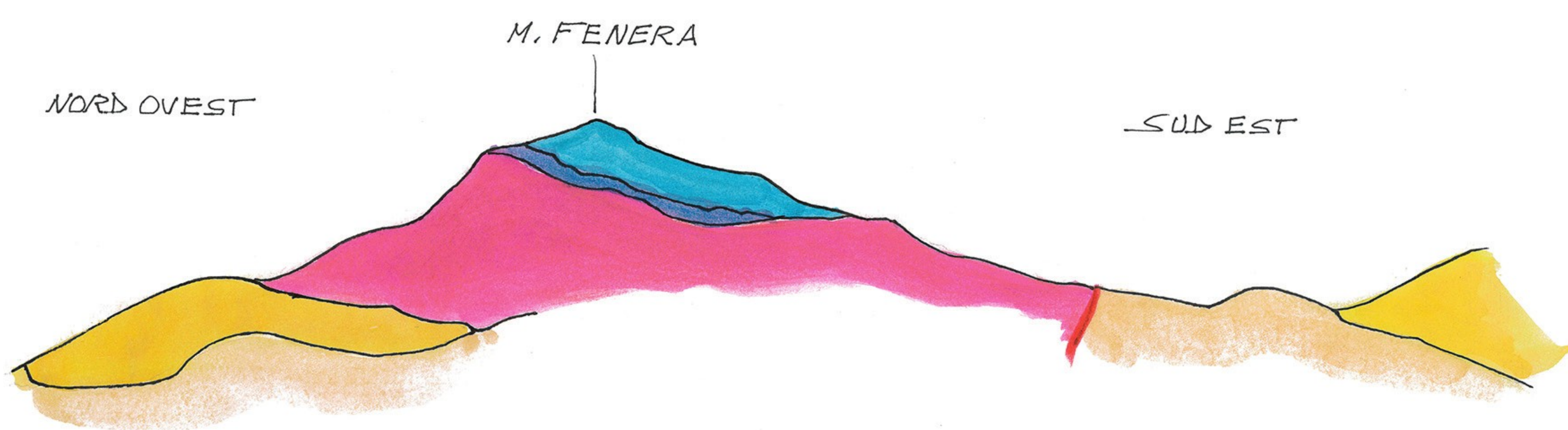
- recent alluvial deposits of the valley floor
- ancient ferrettized alluvial deposits (Villafranchian)
- Upper Pliocene – yellowish quartz sands of delta marine origin

MESOZOIC SERIES OF MOUNT FENERA

- Lower Jurassic (middle Lias) – grey flint limestones, spongolytic limestones and black fossiliferous limestones
- Lower Jurassic (middle Lias) – Breaches, red sandstones and micro conglomerates (Arenarie di S. Quirico)
- Middle Triassic (Anisian-Ladinian) – arenaceous dolomites, dolomites and dolomitic limestones
- Middle Triassic (Anisian) – grey sandstones (Arenarie di Fenera Annunziata)
- Permian Volcanic Complex – lavas and tuffs
- Pre-Carboniferous – Gneiss and micaschist (Serie dei Laghi)
- fault line

Geological section

A geological section represents a vertical cut of the Earth's crust, in which the different rock bodies and their contacts can be identified, from the topographic surface to the deepest layer.



Outline of the stratigraphic relationship

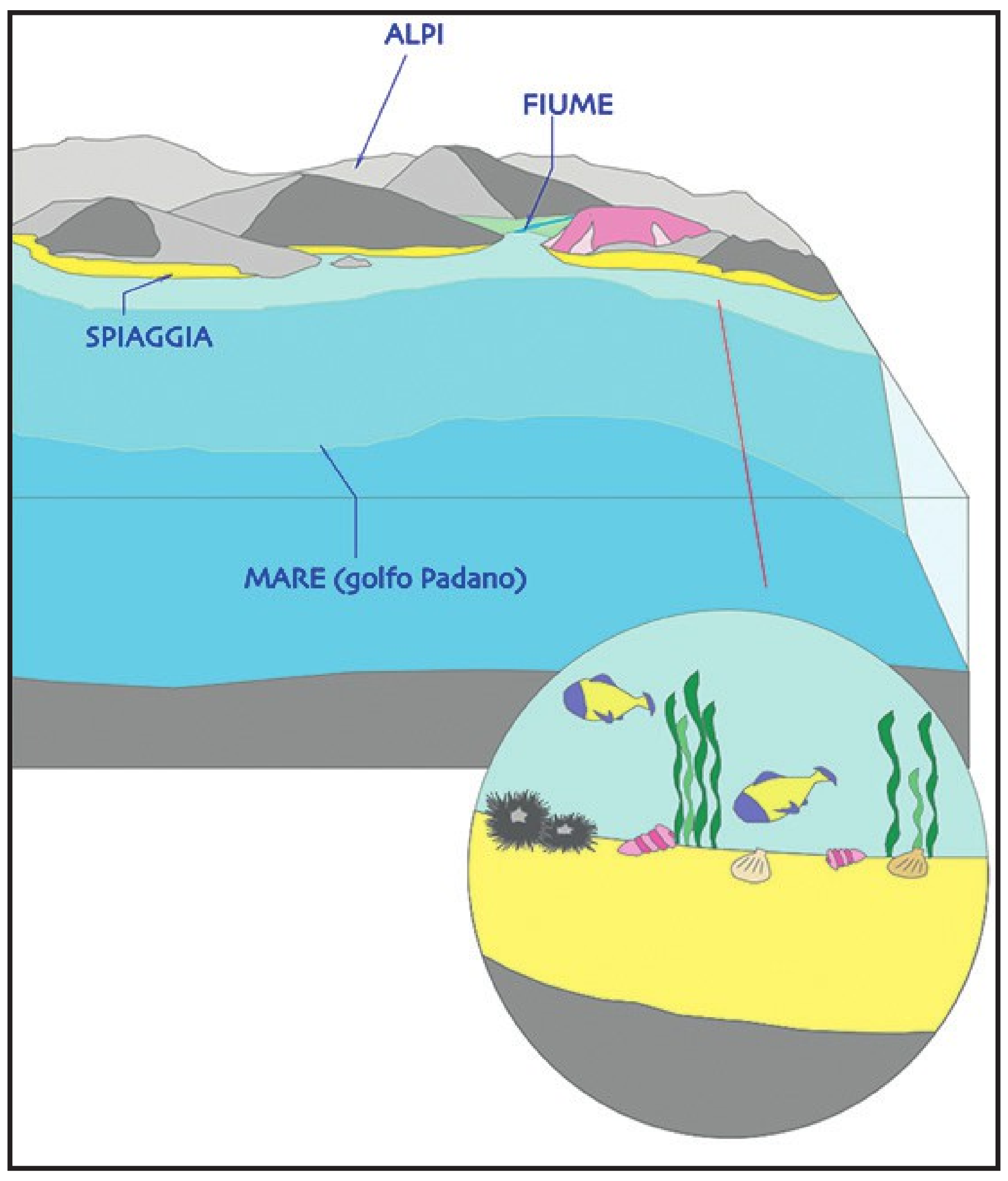
Lower Jurassic (Lias) Spongolytic limestones
Arenarie di S. Quirico
Middle Triassic (Anisian-Ladinian) Dolomia di S. Salvatore
Middle Triassic (Anisian) Arenarie di Fenera Annunzizta
Complesso Vulcanico Permiano: Tuffs
Lavas
Pre-Carboniferous Serie dei Laghi

Designed by Chiara Leonoris – Graph by Mattia Sandrini – illustration by Pietro Chiodo

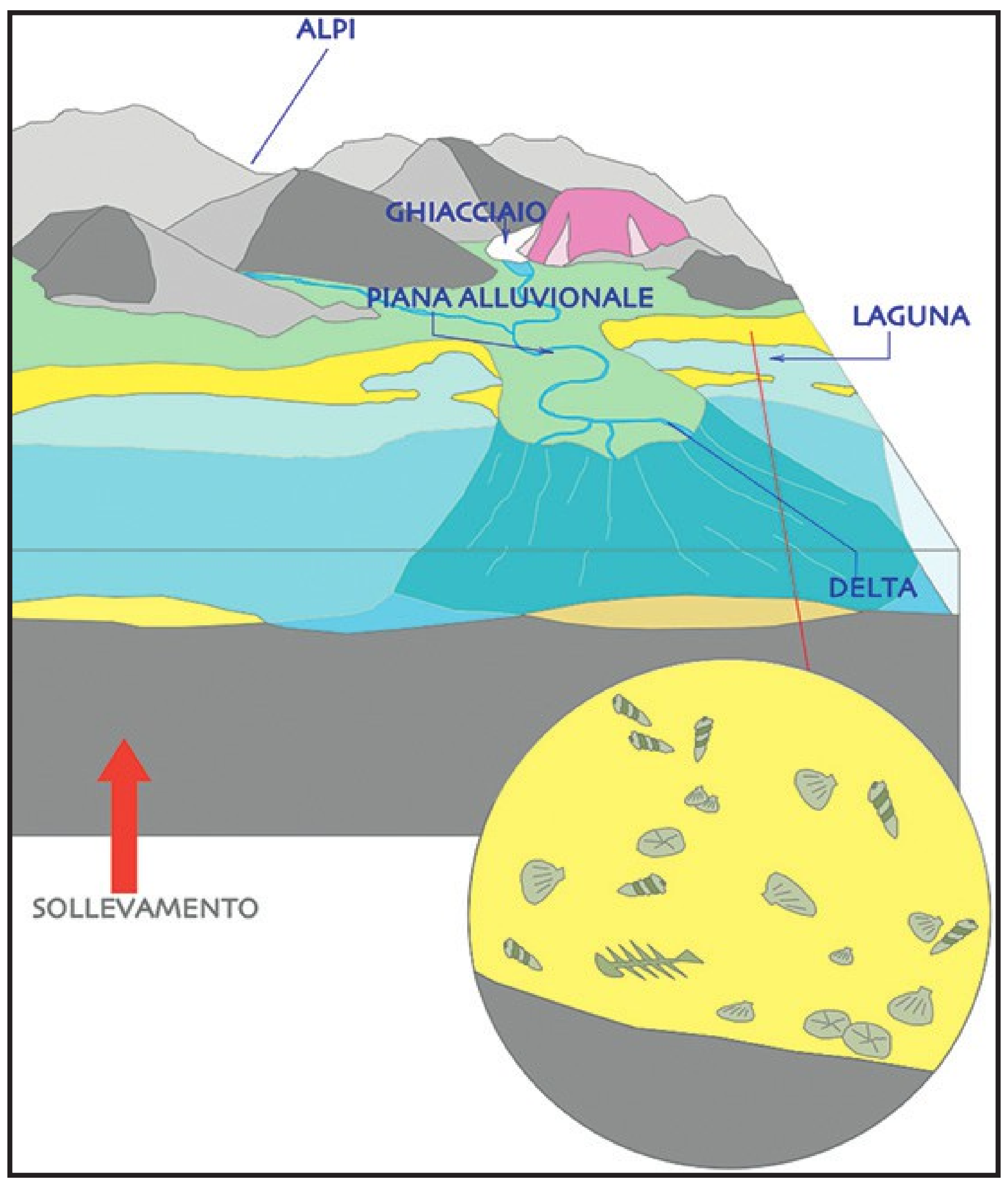
The Pliocene Sea

About 3-4 million years ago (**Pliocene - Cenozoic**), in a geomorphological context quite similar to the current one (the Alpine chain was already formed) there was a deep inlet of the wider Po basin.
In fact, during Pliocene, the present day Po Valley was covered by the sea, a large area of the ancient Adriatic sea that extended westwards far beyond Turin and that penetrated in the valleys among the hills. In the towns of Grignasco and Prato Sesia, especially in the hilly area called Vaglio, there is proof of this ancient sea inside Parco del Fenera.

PLIOCENE from 6 to 1.8 million years ago



PLEISTOCENE from 1.8 million years ago



TODAY

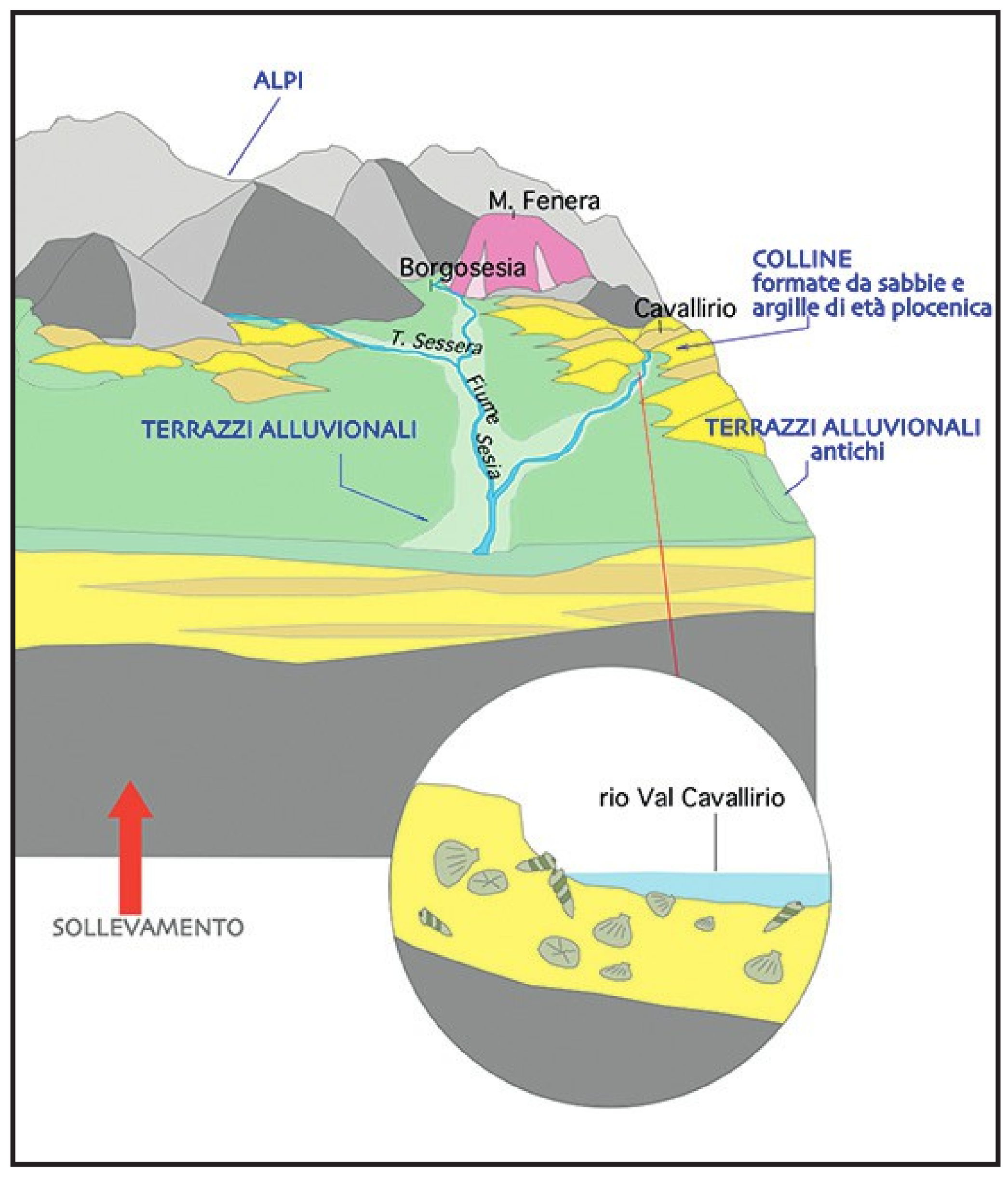


Photo 1 - Outcrop of sandy-clayey sediments (Pliocene)

Photo 2 - Lamellibranch and gastropod fossils in Pliocene sands

Walking along paths and country roads of this area, you can observe, especially along the riverbeds, small walls of **grey-light blue or grey-beige clays and sands** (photo n. 1).
These soft rocks are called "Tof" in the local dialect.

They can contain ancient fossil remains (photo n. 2) of molluscs, as well as corals, brachiopods, bryozoans, crustaceans and echinoderms (sea urchins, starfish and sea lilies), indicating a marine-type depositional environment.

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Testi: Pierluca Lanfranchini

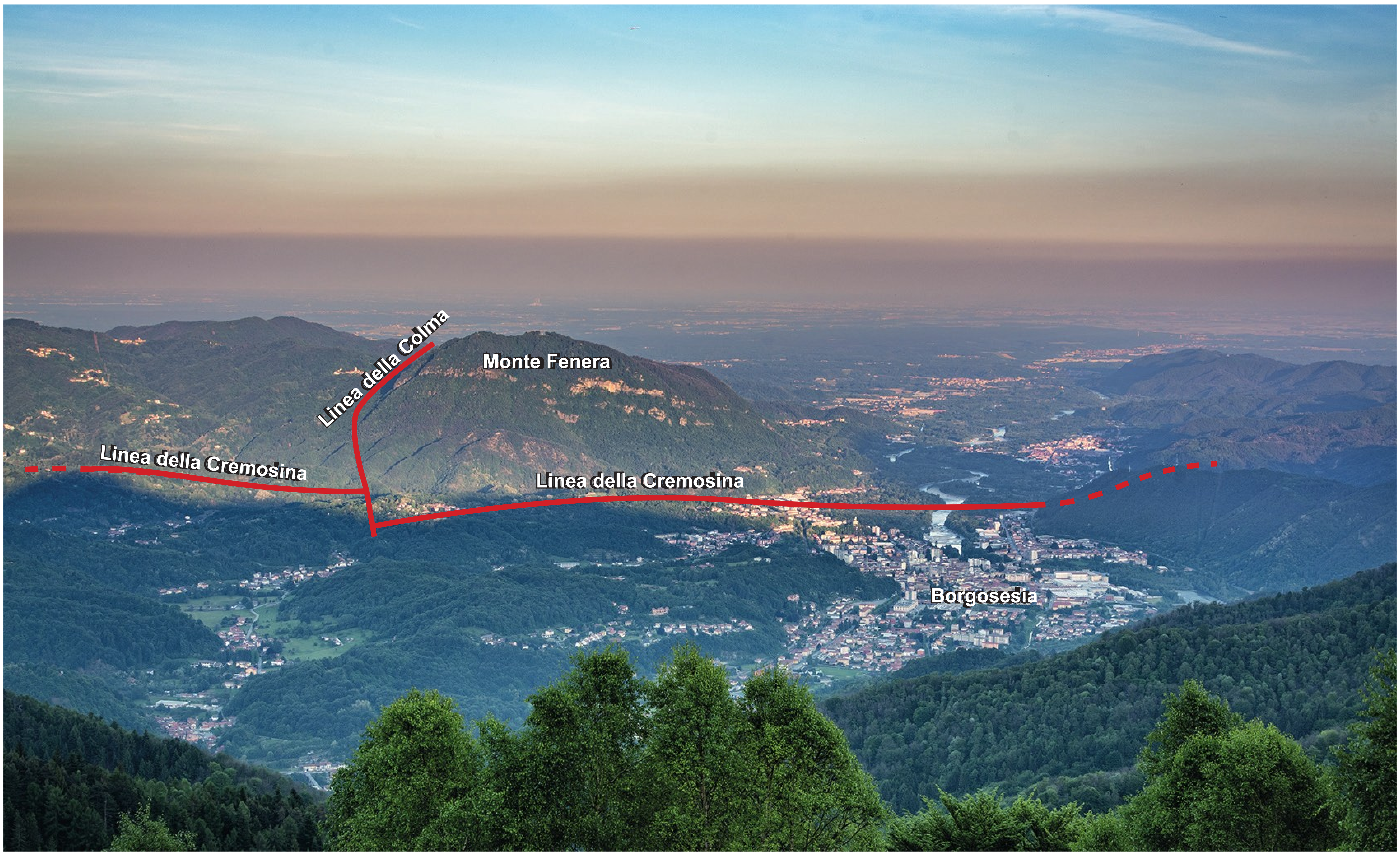
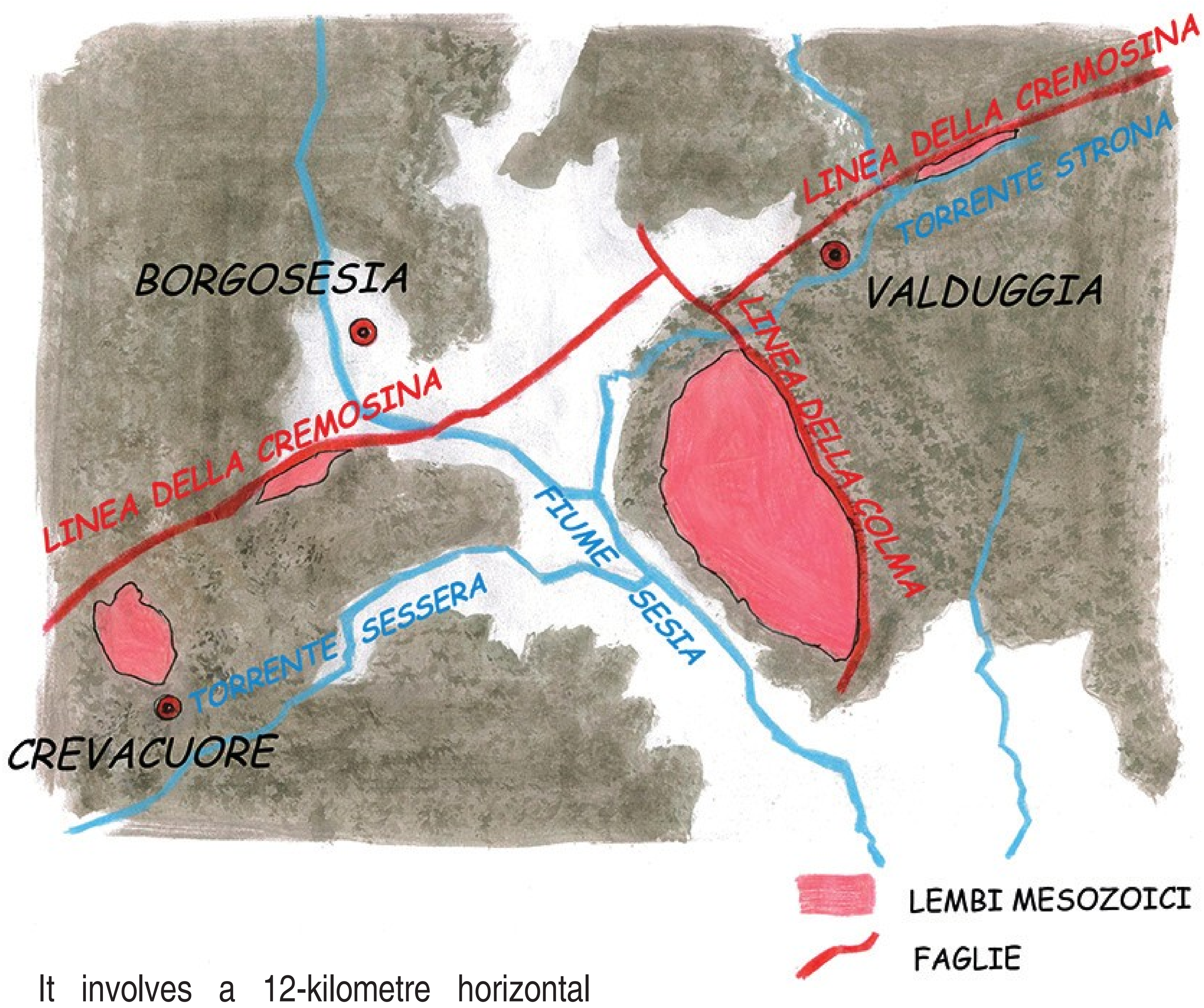


Foto M. Sandrini

Geological structure

Lower Valsesia is traversed by two tectonic contacts (faults), represented by lines on the geological map: the Colma and the Cremosina. The first one is associated with the fragmentation of the Earth's crust and the formation of the Tethys Sea (in the Mesozoic period).
It follows a NNW-SSE (W=west) direction and stretches out for about 5km on the eastern side of Monte Fenera bringing the gneiss of the “Serie dei Laghi” into contact with the Permian Volcanic Complex, or with the limestone rock of the Mesozoic (younger in age and higher up in the sequence of layers) resulting in a vertical displacement of the blocks of rock of about 400m.
The second fault line runs in an ENE-WSW direction and is associated with the Alpine Compression Cycle (the formation of the Alps as a result of the collison of continental plates between 60 and 30 million years ago)



It involves a 12-kilometre horizontal displacement towards the right (which means that the rock mass beyond the fault slid to the right) and a 10-kilometre vertical displacement (the blocks of rock to the north of the fault were raised to a greater height than those to the south.

Progettazione: Chiara Leonoris - Grafica: Mattia Sandrini - Disegni: Pietro Chiodo

REGIONE PIEMONTE

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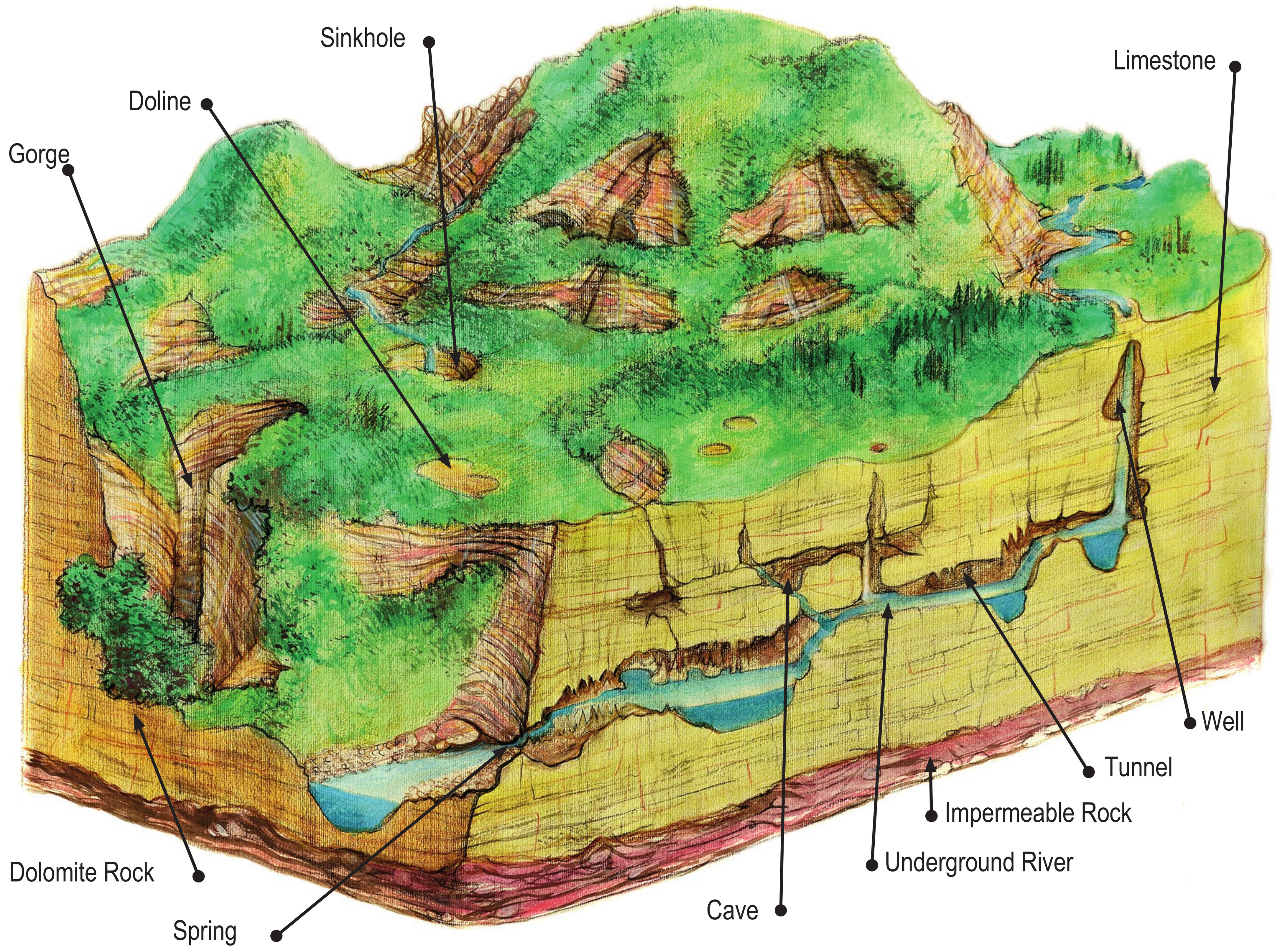
Karst system

Gorge: a long, narrow valley with steep walls and , sometimes, a dry bottom.
Spring: the water surfaces as the carbonate rocks come into contact the impermeable rocks below, which favours the development of luxuriant vegetation.
Sinkhole: a hollow where surface waters disappear underground.
Doline: circular depression that can be up to a kilometre in depth.
Tunnel: a horizontal cavity; where several tunnels intersect large spaces form, known as chambers, and small lakes can be found at the bottom of these.
Underground river: it runs through a tunnel and can be very long.
Well: a vertical cavity.
Cave: an underground cavity consisting of wells and tunnels.
Limestone: rock made up of calcium carbonate



Dolomite rock: rock made up of calcium carbonate and magnesium.

Impermeable rock: a layer of rock beneath the carbonate rocks, which is resistant to water erosion.

KARSTIFICTION → IS → the set of surface and underground phenomena which affect, spatially and temporally, a given complex of carbonate rocks. → IT TAKES ITS NAME → from the Carso, physiographic region near Trieste, where the dissolution of the rocks is particularly evident.

IT IS DUE ↓

to the action of rainwater which, with the addition of carbon dioxide contained in the atmosphere, becomes acidic and "dissolves" certain kinds of rock, mainly carbonates, such as limestone and dolomite, as stated in the following chemical formula (dissolutive phase) H2O+CO2+Caco=Ca (HCO3)2, causing the development of calcium hydrogen carbonate (better known as calcium bicarbonate) in aqueous solution.

→ Over time the water penetrates deeper and deeper, creating intertwining tunnels, wells and caves, often of considerable size.

↓ Water circulating in a karst system can evaporate and release carbon dioxide, depositing the salts within in the form of encrustations (construction phase) Ca(HCO3)2 = H2O+CO2+CaCO2.

→ When the groundwater in the limestone rocks discharges from an opening in the caves, a spring is formed: thus a stream originates which can flow until it joins a river.

↓ This river can still return underground and then re-emerge at another point.

Carbonate rocks

Terms of transition between limestone and dolomite

$CaCO_3$		$MgCa(CO_3)_2$
100% - 95%	Limestones	0% - 5%
95% - 90%	Magnesian limestones	5% - 10%
90% - 50%	Dolomite limestones	10% - 50%
50% - 10%	Limestone dolomites	50% - 90%
10% - 0%	Dolomite	90% - 100%

Stalactite: a concretion (of various minerals) hanging from the ceiling which took shape as a hollow little tube.
Column: a concretion that is formed by the union of a stalactite with a stalagmite.
Stalagmite: a concretion that develops upwards from the ground when water drips at an elevated speed.

Progettazione: Chiara Leonoris - Grafica: Mattia Sandrini - Disegni: Pietro Chiodo

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Karst of Monte Fenera

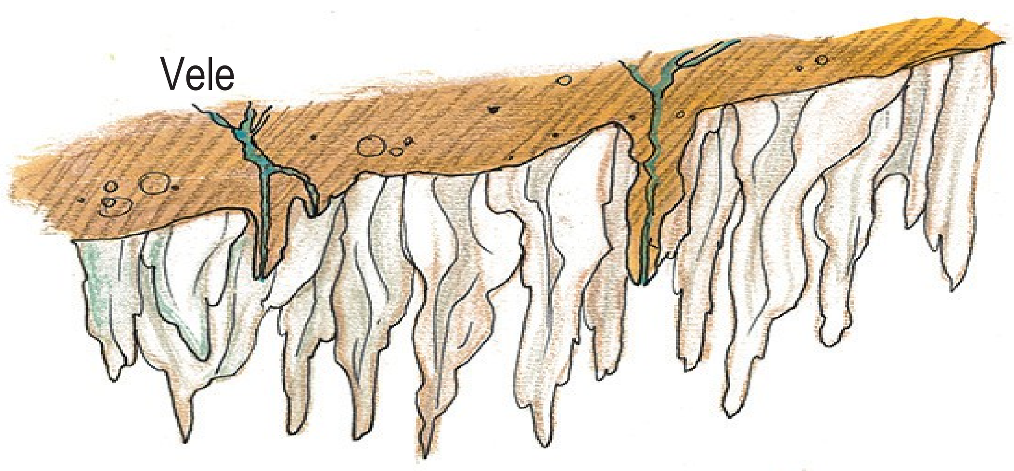
Monte Fenera is the only **carbonate massif** on the southern side of the central-western Alps. The presence of carbonate rocks (**limestone and dolomites** formed in a marine environment) allowed the development of a **karst system** made of numerous caves that, over thousands of years, were frequented by animals and humans since the Palaeolithic. Most of high mountain karst systems were formed just after the area had emerged from the sea or was going to emerge (starting from the middle-upper Eocene 40-35 million of years ago - myr) and has continued to evolve throughout the alpine orogenesis (i.e., the process of collision of crustal plates that formed the Alps). In that geological period there was a tropical climate with a probable marked rainy season that resulted in heavy river flows both outside (**epigean environment or epikarst**) and inside (**hypogean environment or endokarst**) of carbonate massifs. In this environment the alteration of the rocks is extreme and as a consequence the karst process is Accelerated.

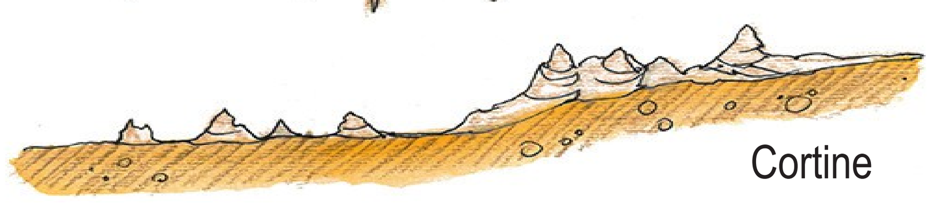
Also the formation of Monte Fenera's endokarst is very old and dates back to a period that goes from the **Oligocene to the upper Miocene**, i.e. between 30 and 11 myr. Proof of this is the presence in some caves (Ciota Ciara and Ciutarun) of massive fills of river material containing rounded pebbles of **serpentinites, prasinite, amphibolites, gneiss and acid volcanic rocks** from Alta Valsesia. The glacial origin of these deposits is not possible because the caves are at a higher altitude than the maximum extension reached by the glaciers (MEG). Even the marine origin is to be excluded because the deposits of Pliocene, (dating back to 5 myr) that emerged between Borgosesia and the plain, have reached the maximum altitude of 525 m. Since in upper Miocene (about 11-5 myr) there had been the deepening of the valley and therefore rivers could not deposit material at high altitudes, the pebbles found in the caves must have been deposited previously (prior to 11-13 myr) and so the caves were necessarily formed before the deposition of the pebbles found inside them.

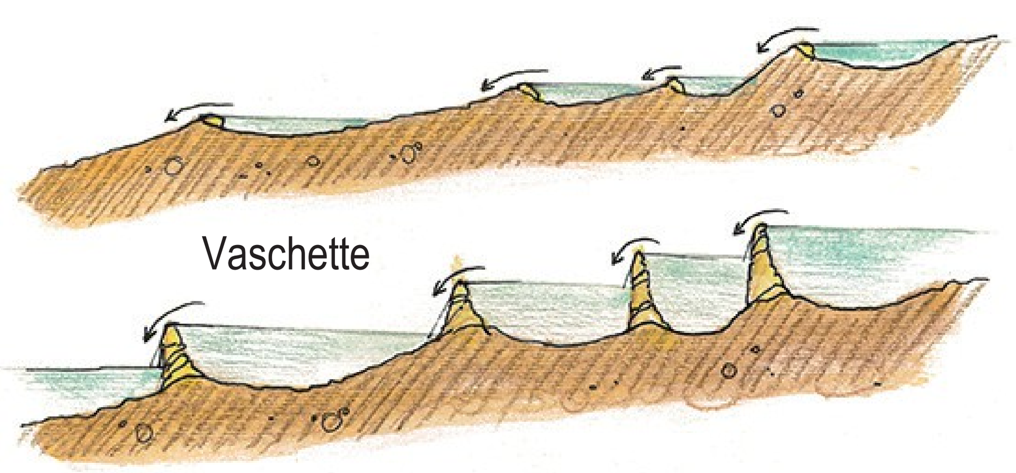
Speleothems of the caves

Besides most known chemical deposits like stalactites and stalagmites, there are other types of speleothems that form under particular conditions inside caves.

Flowstone and drapery: they form when a drop, before falling on the ground, runs along a certain stretch of the sloped wall depositing calcium carbonate.


Vele


Cortine


Vaschette

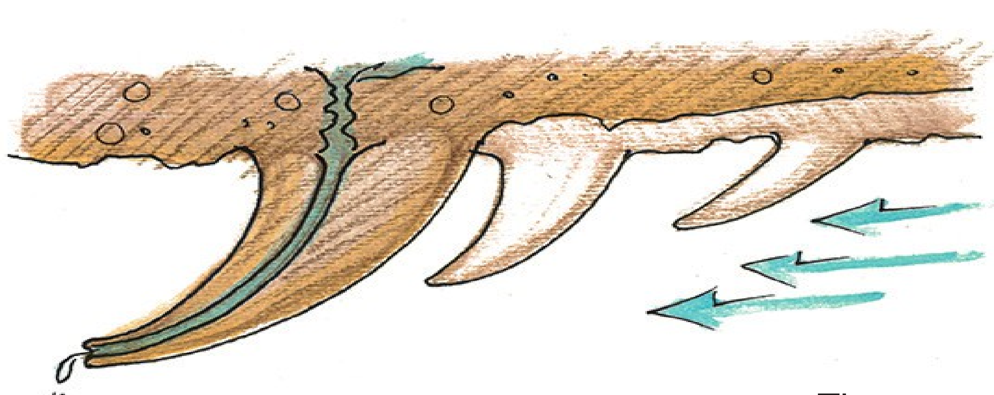
Rimstone dams: they are formed when a thin veil of water on the floor meets a slight rise of the floor and so creates a little pool. If a little calcite crystalizes on the edge, a small dam is formed and the pool reaches a stability, raising its edges increasingly. If there are sequential asperities on an inclined floor, then also rimstone dams are formed in sequence.

Eccentrics: they are those stalactites and stalagmites that have an abnormal or irregular shape and that do not follow the law of gravity in their growth. They can be formed by:

a) actions of very slow air currents that affect the growth direction of the stalactite, giving it the shape of an elephant's tusk.

b) germination of small calcite crystals. Germination is the union between various crystalline individuals that does not happen in parallel pattern, but according to well-defined and different for each species of mineral laws.

c) action of the drop's capillarity along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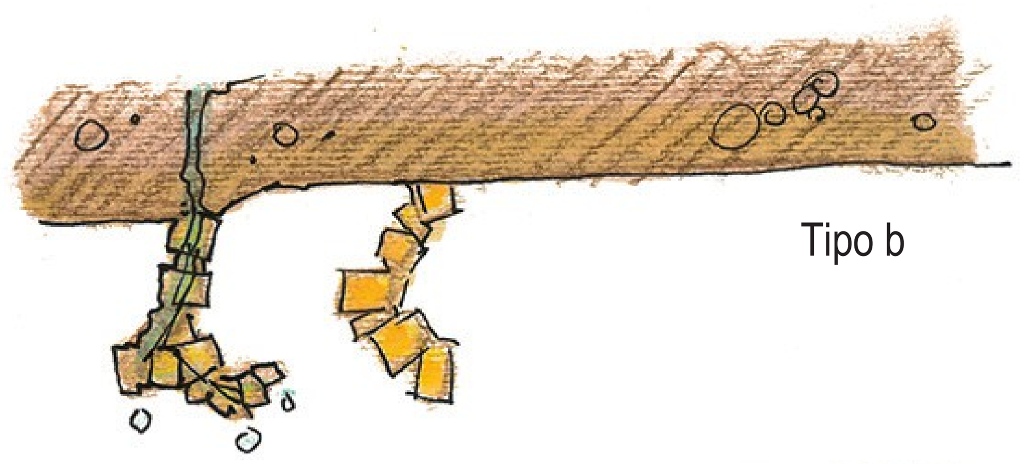
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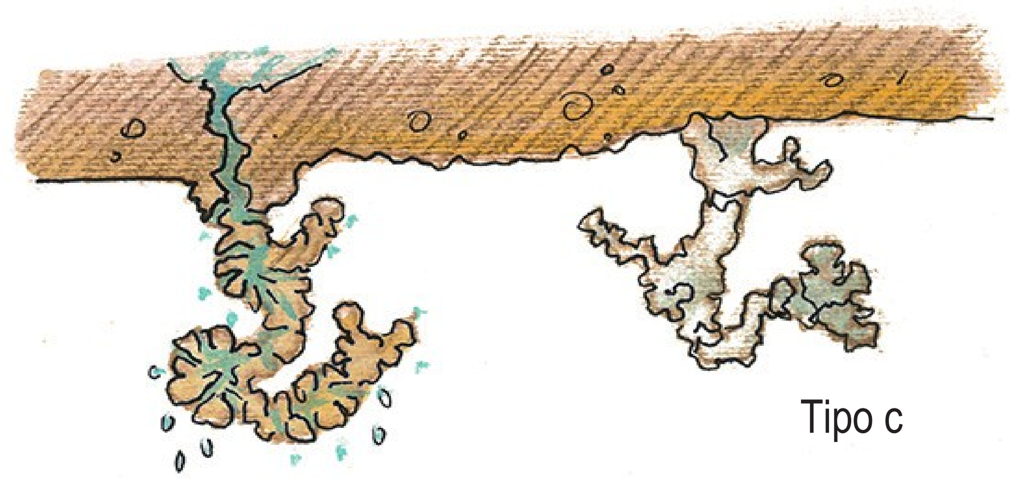
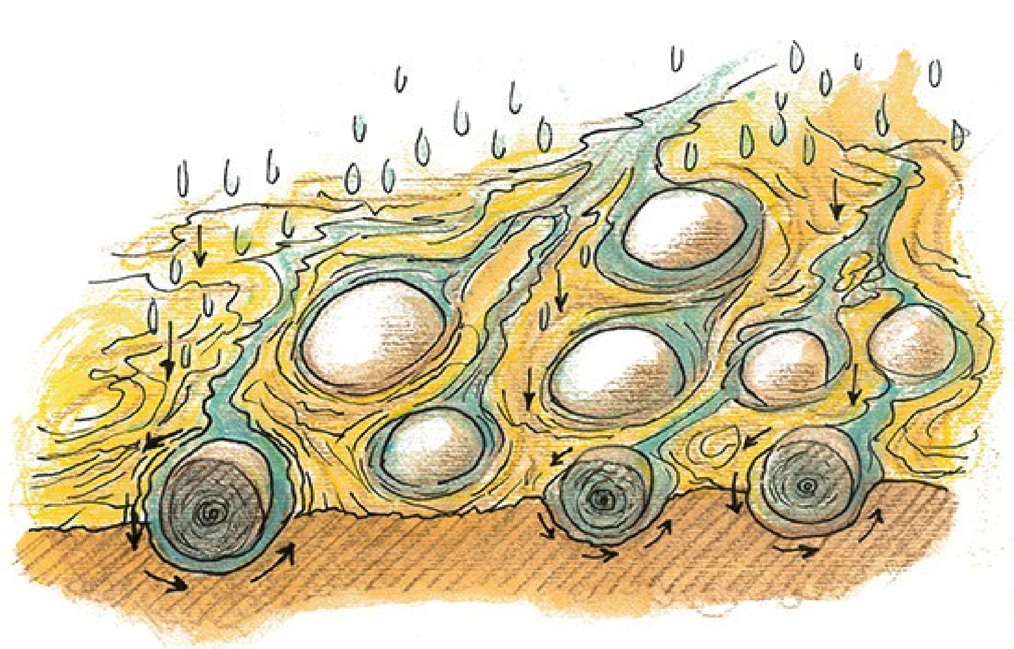

Tipo c

the speleothems.

Cave pearls: small calcite spheres that grow around foreign matter (for instance a grain of sand). They form in the small pools on the floor in the presence of a lot of dripping. Besides the growth, the dripping determines the constant spinning of the "pearls", that, in this way, take their spherical shape.



Designed by: Chiara Leonoris - Graphics: Mattia Sandrini - Drawnings: Pietro Chiodo

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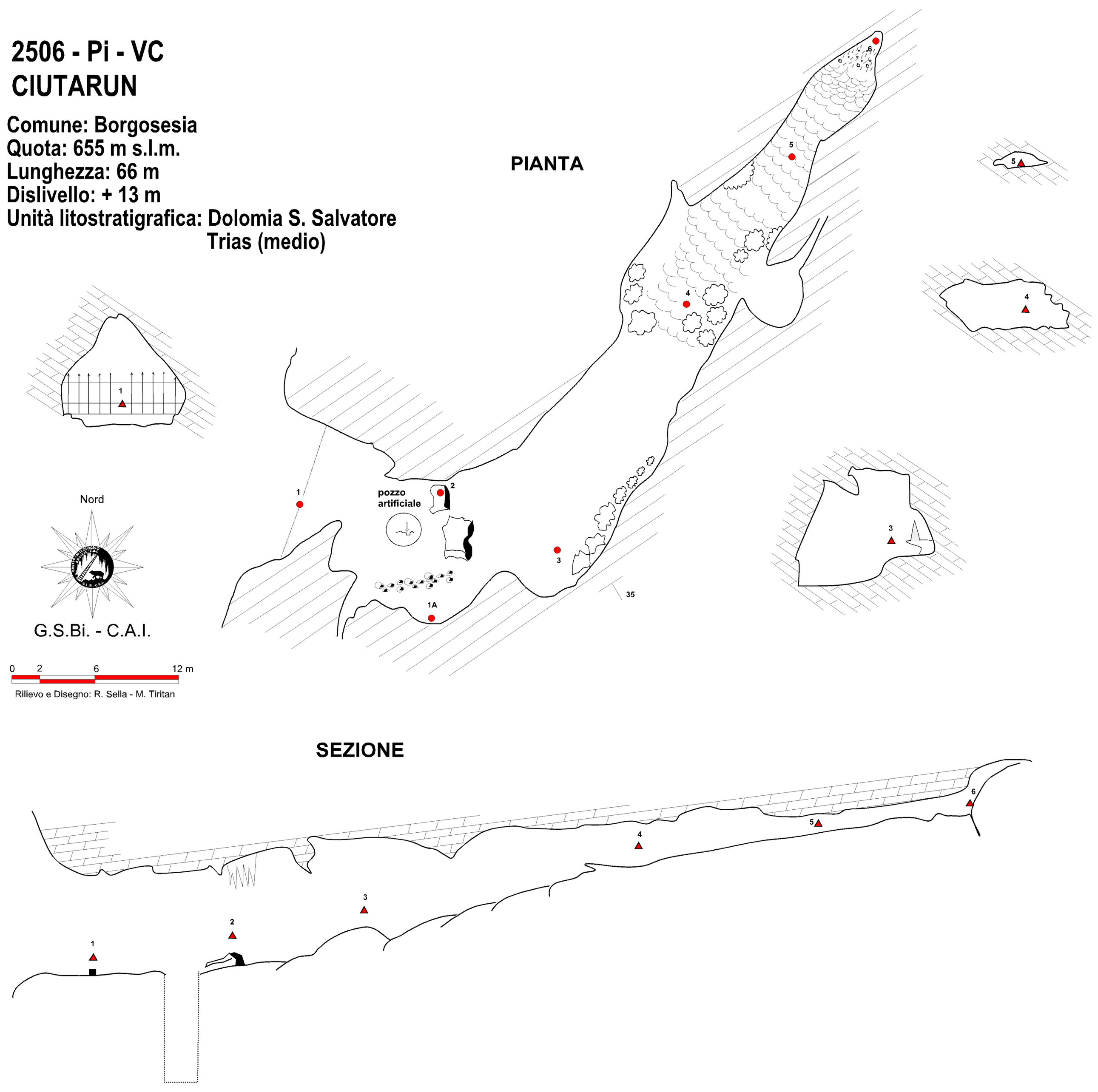



Foto M. Sandrini

Ciutarun

The Ciutarun, or Pertusa Tupa, is one of the best known and most important caves in Monte Fenera. A large, ascending cavity, it formed on joints (fractures), one of which is on its own axis, and was enlarged by dissolution. The entrance is very spacious (four meters in width and about ten meters in height).

Just past the antechamber to the right, there is a large drape of dark-coloured concretions,the result of iron oxide and/or manganese deposits. This agglomerate consists of high stalactites and curtains although the dripping has now ceased. The ground is covered in a great deal of debris (earth and gravel) caused by runoff and the collapse of blocks. There are also some large stalagmites, most of which are located on the right side of the cavity, a clear indication

that a considerable crack existed, which enabled the water to drip at a rather fast rate .

The cave ends in a small chamber obstructed by a landslide of various kinds of debris, which makes it impossible to proceed with the exploration.

Besides being of speleological and geological interest, the Ciutarun is also of particular relevance from the archeological and paleontological points of view. The excavations carried out over a number of years have led to lithic finds including quartz and local flint, which can be attributed to the Mousterian industry of the Middle Paleolithic, and also a human tooth (premolar) attributed to the Neanderthal Man. Remains of Ursus spelaeus, bison and hyena have also also been found.

Most of the materials are preserved in the Museum of Archaeology and Paleontology "Carlo Conti" of Borgosesia, while a selection of stone tools, together with human remains, are displayed at the Archaeological Museum in Turin.

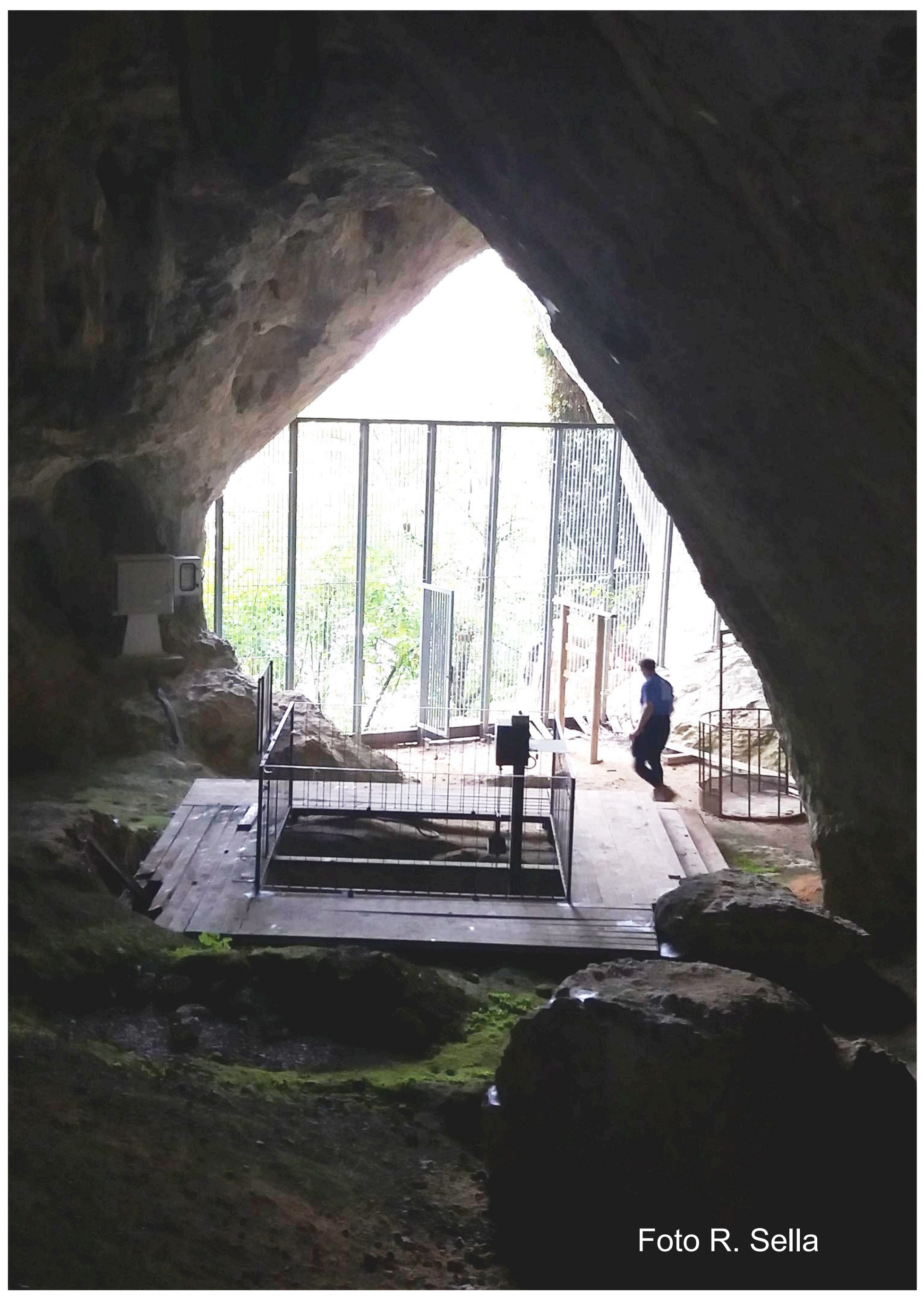


Foto R. Sella


Foto M. Sandrini


Alpioniscus feneriensis (Parona, 1880) foto: E. Lana

The excavations removed much of the stalagmitic crust that covered the tough argillaceous substratum. There are also numerous holes which have not been covered over, which testifies to the various surveys carried out over time. Although a well about nine meters deep was dug near the entrance, the bedrock still could not be reached. With regard to troglobites (that is, animals which spend their entire life cycle in hypogeal environments) the isopod Alpioniscus feneriensis, a terrestrial crustacean of a distinctive white shade, is reported to be present just like in most of the Fenera caves. The diplopod, Oroposoma emiliae, characterized by two pairs of legs for each segment, is to be found in some caves in Mount Fenera and shows the signs of adaptation to underground life, such as depigmentation, minimal eyes and a general, elongated shape which enables it to explore the cracks in the rock.

It can reach 2 cm in length and it feeds on decaying organic matter.


Oroposoma emiliae Manfredi, 1953 foto: E. Lana

Progettazione: Chiara Leonoris, Enrico Lana, Renato Sella,
Testi di: Enrico Lana, Renato Sella, Paolo Testa, Chiara Leonoris

Ciota Ciara

The CIOTA CIARA (that is Bright Cave) owes its name to the favorable lighting it receives from the two openings, facing West and South-West, both fairly wide and high, due to the enlargement of the internal chamber after the dissolution of the dolomitic rock and the detachment of large blocks from the ceiling. It is a large cave formed around some fractures, of which the main one is on its own axis. The upper area of the Ciota Ciara is called Ramo della Torre and has a certain abundance of chemical deposits. The total development of the cave reaches 200 meters. The floor of the main branch is completely covered with calcite flows. The main branch gradually narrows until it reduces to impassable tunnels, in a landslide.

Entering from the second entrance, on the right, and climbing the calcite flows (the use of speleological equipment is essential), you can reach a narrow tunnel crossed by a flowing rivulet which, through some rather narrow passages, allows you to initially enter a very small chamber and, after a short ascent on a calcite flow, leads, through a narrow crevice called Buca delle Lettere, into a wide chamber originated by dissolution, rich of concretion and called “Sala della Torre”. In the center of the cavity stands out a tall concretionary tower (that gives its name to the cave) about 7 meters high with a diameter of 4, made of stalactites and stalagmites joined together.

The cavity is completely paved with a carbonate crust. Isolated stalactites and others in drapery formation hang from the ceiling; some are flat and have been noticeably free from dripping for a long time. To the left of the Sala della Torre there is the Sala dei Pipistrelli, also originated by dissolution, whose walls are covered in pipe organ-shaped calcite flows; on the left there is another column of considerable size. There is an additional small branch that leads to a cavity from whose ceiling small stalactites hang, some of which still with their own dripping.

The presence of sandstone fragments in the Ramo della Torre suggests that in the past a tunnel connecting it with the higher layers was accessible, referred to the lithological unit placed above, called “Arenarie di S. Quirico”.

In 1963, during a small excavation done outside the Western entrance, some fragments of a skullcap were found together with some teeth attributed to Neanderthal man, associated/connected with lithic utensils of Mousterian industry (Middle Paleolithic).

Regarding the troglobiont fauna (i.e. that spends its entire life cycle underground), it's noteworthy the isopod Alpioniscus feneriensis, a terrestrial crustacean with the characteristic white colour because of the lack of pigmentation and without eyes, whose size reaches 10mm. It feeds on decomposing plant material, and can be found on the wood residues present in all the cavities of the mountain.

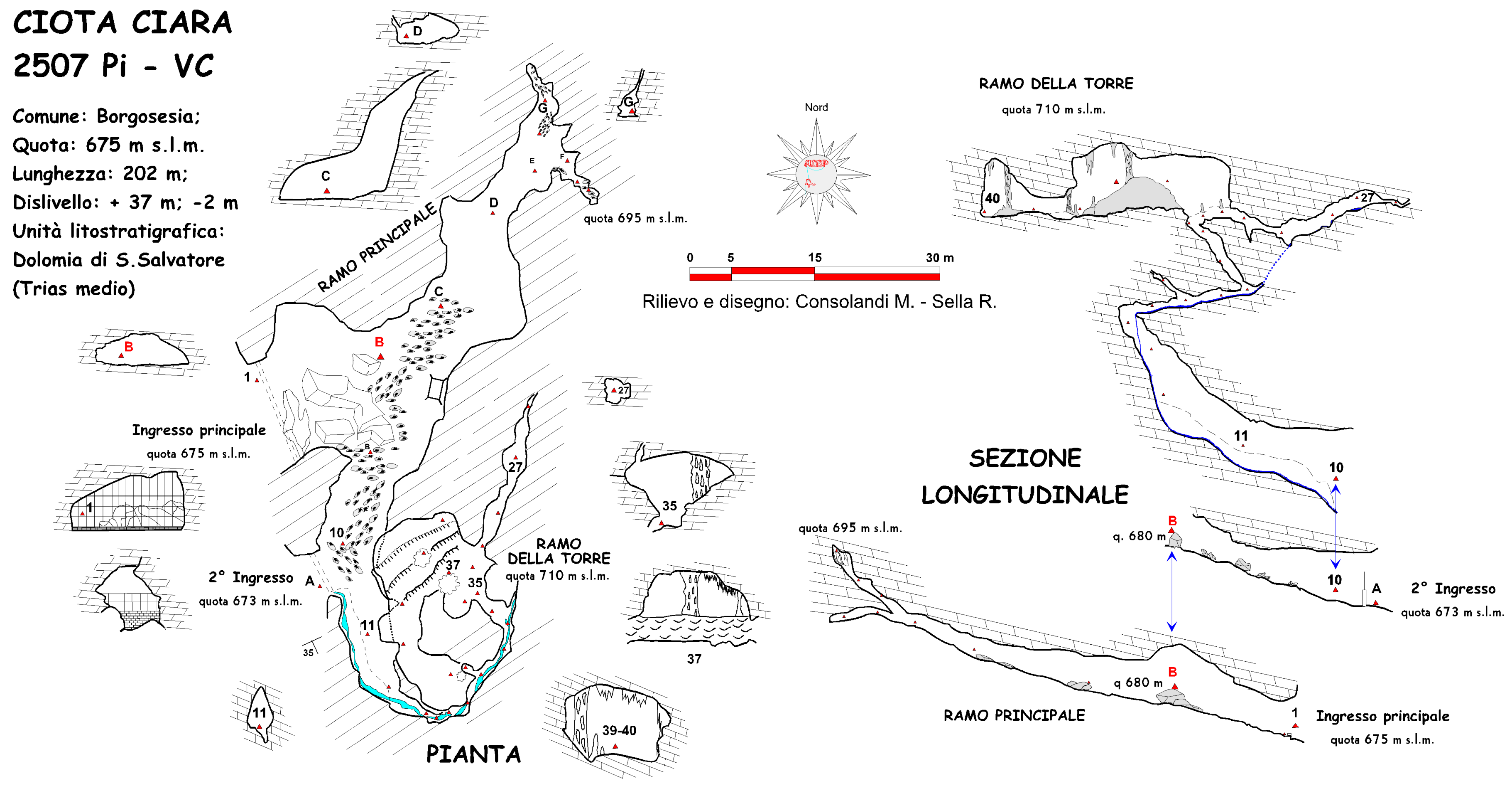
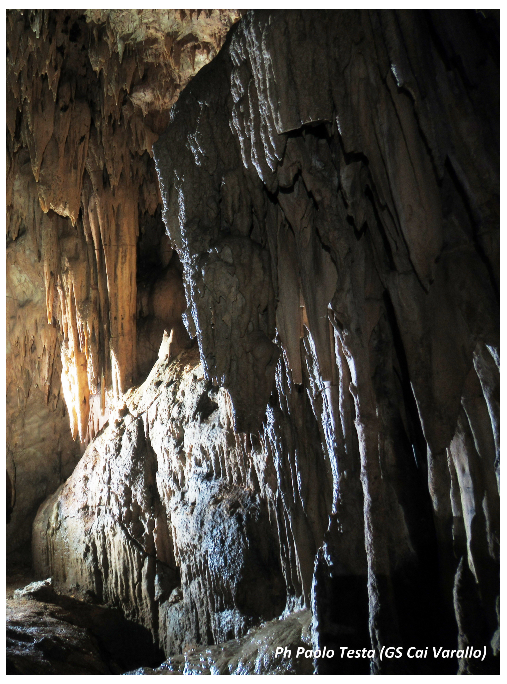
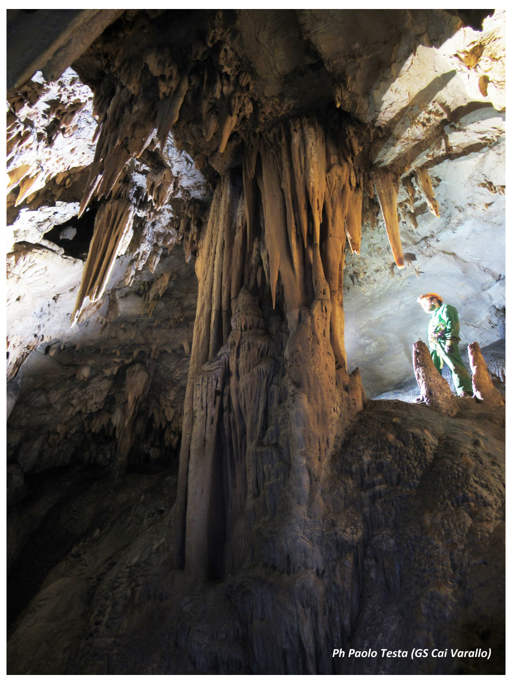


Foto M. Sandrini



Ph Paolo Testa (GS Cai Varallo)



Ph Paolo Testa (GS Cai Varallo)

The Niphargus shrimp sp. belongs to one of the most significant groups among the inhabitants of underground waters; although not highly specialized to underground life (troglophile), like other congeneric crustaceans, it derives from the ancient ancestors that have adapted to life in underground freshwaters as a result of marine regressions that have occurred throughout geological eras.

Alpioniscus feneriensis (Parona, 1880) foto: E. Lana

Another typical species of the mount Fenera's caves is the spider Troglohyphantes lanai, with strong adaptations to underground life, and whose body reaches the average size of 3-4 mm.

Like the name given to one of the cavities in the Ciota Ciara suggests, that is the Sala dei Pipistrelli, the Lesser Horseshoe bat (a small chiropter) and the Greater, which is bigger, spend part of their lives in this cave, hanging by their lower limbs and wrapping themselves in their wings during rest.

Niphargus sp. foto: E. Lana

Progettazione: Chiara Leonoris, Enrico Lana, Renato Sella,
Testi di: Enrico Lana, Renato Sella, Paolo Testa, Chiara Leonoris

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SESIA VAL GRANDE GEOPARK

THE CIOTA CIARA CAVE - The most ancient of the prehistoric sites in Piedmont

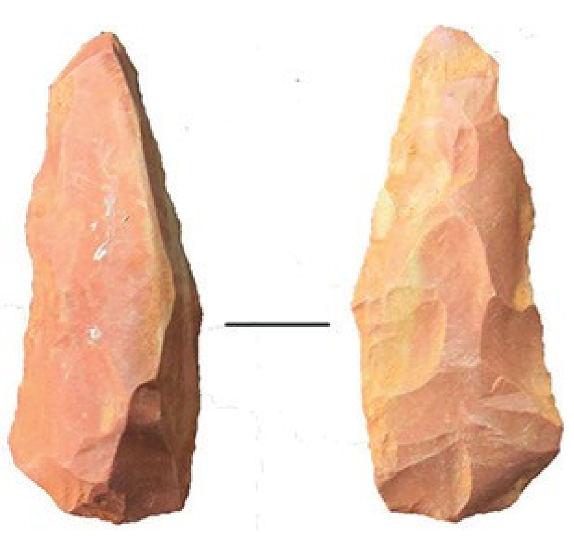
Research Background

The earliest scientific / archaeological investigations of the Ciota Ciara cave date back to 1953 when C. Conti carried out the first thorough inquiry. In 1964, G. Isetti probed the atrial area, which yielded evidence of lithic manufacture thus relating it to the Middle Paleolithic. In 1966 F. Fedele and F. Strobino, with the help of the G.A.S.B., conducted the first methodological excavation within the Cave. Systematic excavations, organized by the University of Ferrara, resumed in 1969.

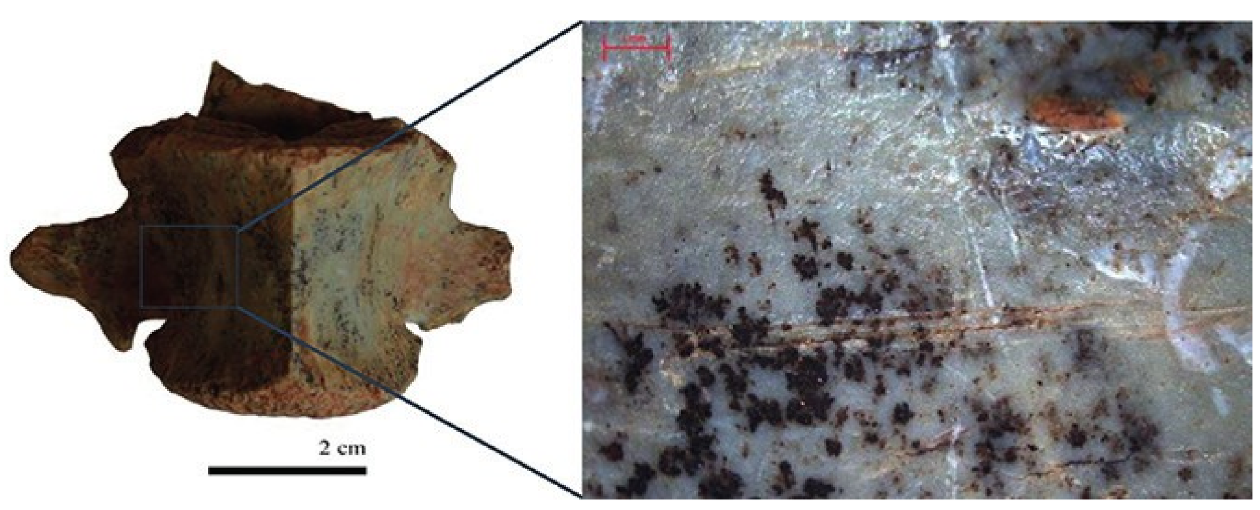
Human occupation

The atrial area of Ciota Ciara was occupied by human beings during the middle Paleolithic era more than 100,000 years ago. Homo neanderthalensis, a species found only in Europe and in the Near East, probably lived in the caves during the summer months. The area was chosen as a refuge because not only did it offer shelter, it also provided easy access to water, chippable stone and various kinds of huntable animals. In the most remote phases of cave occupancy, man probably dwelt there for rather short periods of time and it was most likely reserved for small groups engaged in hunting activities. In the middle phase of occupancy, the human presence must have been more numerous and the period of stay longer, eventually to diminish in the upper middle phase. At the time of the earliest occupancy, the climate must have been much colder and more arid than it is today but, as is clearly documented, it was to become progressively milder over time.

Human activities inside the cave



Neanderthal Man collected the rocks to be chipped in the vicinity of the site (quartz,various types of siliceous rock and even volcanic rock). Various methods were used to break off splinters. In some cases, the edges of the splinters were modified and shaped to serve different functions.



Signs of butchering left by stone tools on animal bones, show how bears Were also hunted, probably for their fur. The bones of vertebrates found during the excavations include animals that were brought to the cave by man or other carnivores and others which perished during hibernation.
The most commonly seen species are: the cave bear, the brown bear, the lion, the leopard, the lynx, the wolf, the fox, the badger, the chamois, the deer, the fallow deer, the aurochs, the wild boar, the rhinoceros and the groundhog.

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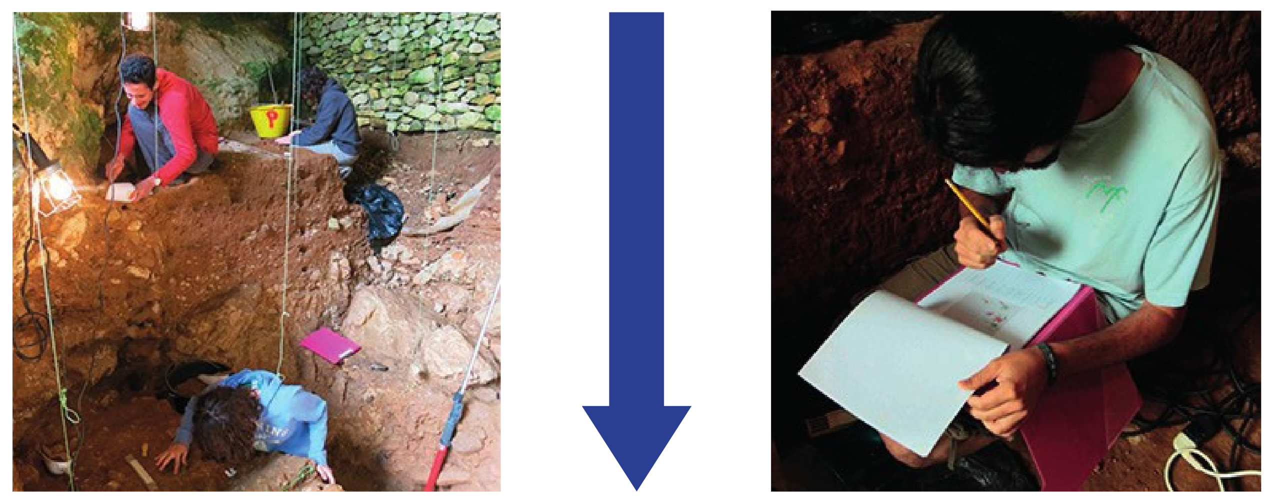
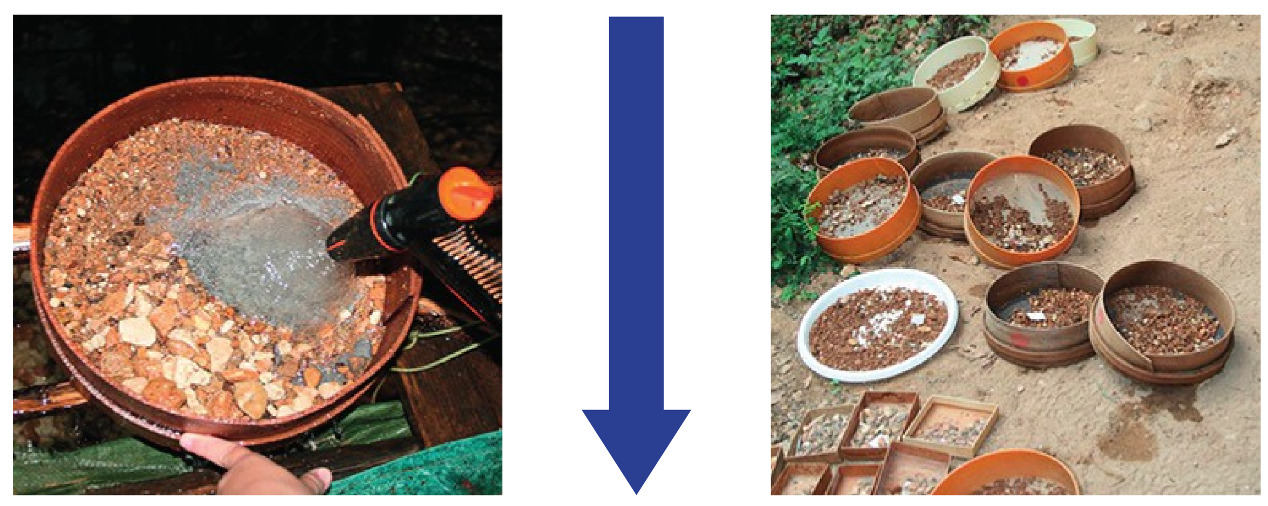
Excavations

The atrial area of the cave was investigated using the most modern of techniques for excavations and documentary evidence. The area had been divided Into 1x1m squares and all the findings were coordinated by identifying their positions on the x and y axes, recording their gradient and slope and reproducing them on a scale map.



The earth removed during the excavation operations Is washed using water and sieves with very fine mesh.



After being washed, the sediment is dried and then carefully sifted and gleaned for bones of small mammal and fragments of stone, which are too tiny to be perceived during excavations

Finally, all the materials found are washed and repaired if necessary, then tagged with descriptive label showing all the information regarding their exact position on discovery.

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Buco della Bondaccia

This cave known as the "Buco della Bondaccia", originally developed around two cracks which caused the formation of two separate passageways, which join together at the bottom. The large.700-square metre, 30-metre high chamber at the entrance on the main fracture, one of the most important in the mountain, resulted from the dissolving of the rock and expanded in time due to numerous collapses, evident from the gaps in the ceiling and the blocks deposited on the ground. Among these there is dolomite rock belonging to the The San Salvatore Dolomite, within which the cave is located, and sandstone, with which the cave is capped, and appertains to the Arenarie di San Quirico. On the right-hand-side of this large chamber there are calcite formations on the walls and the stems of broken stalactites. At the end of the chamber, the cavity narrows and then widens into a sinkhole measuring about 20m, known as the Pozzo della Sbarra. To penetrate this, spelaeological equipment and techniques are needed. The site narrows and widens repeatedly with alternating sinkholes and chambers.
The first attraction is the Sala del Soffitto Sospeso (where a huge rock dislodged from the ceiling and got stuck at a height of 15 metres), with its argillaceous floor covered in an impressive amount of guano (bat excrement), proof that the cave is visited by certain species of chiropter; then there are rimstone dams, raised deposits of calcite on the floor that form round pools of water. A narrow opening nicknamed Buca delle Lettere (Letter Box) provides access to another, 20 metre sinkhole and from there to La Sala del Fondo, clogged by stones and pebbles which also impede the water flow. At the intersection of the cave's second passageway (a vertical crack widened by water erosion known as Via dei Tre Amici or Via Nuova) with that just described there is a large chamber called Piazza d'Armi. Here, too, the ground is covered in guano.
Since there are no currents of air inside the cavity the temperature remains stable at approximately 9.5° throughout the whole year. Only in winter does it get colder by the entrance with a temperature drop to match that outdoors.
For many years, this cave was a genuine gym for groups of spelaeologists.
Among the troglobite species (who live underground), and this cave is the locus typicus , worthy of special mention is the spider Troglohyphantes Lanai, average sized (body 3mm) particularly well-adapted to life underground, whose eyes seem to be atrophied, no longer fulfilling their purpose, clearly afflicted by depigmentation but whose sensory bristles are highly developed. It spins its fine, impalpable webs, draped horizontally among the blocks of rock on the floor or in the fissures on the wall.

Troglohyphantes lanai Isaia & Pantini, 2010 (femmina) foto: E. Lana

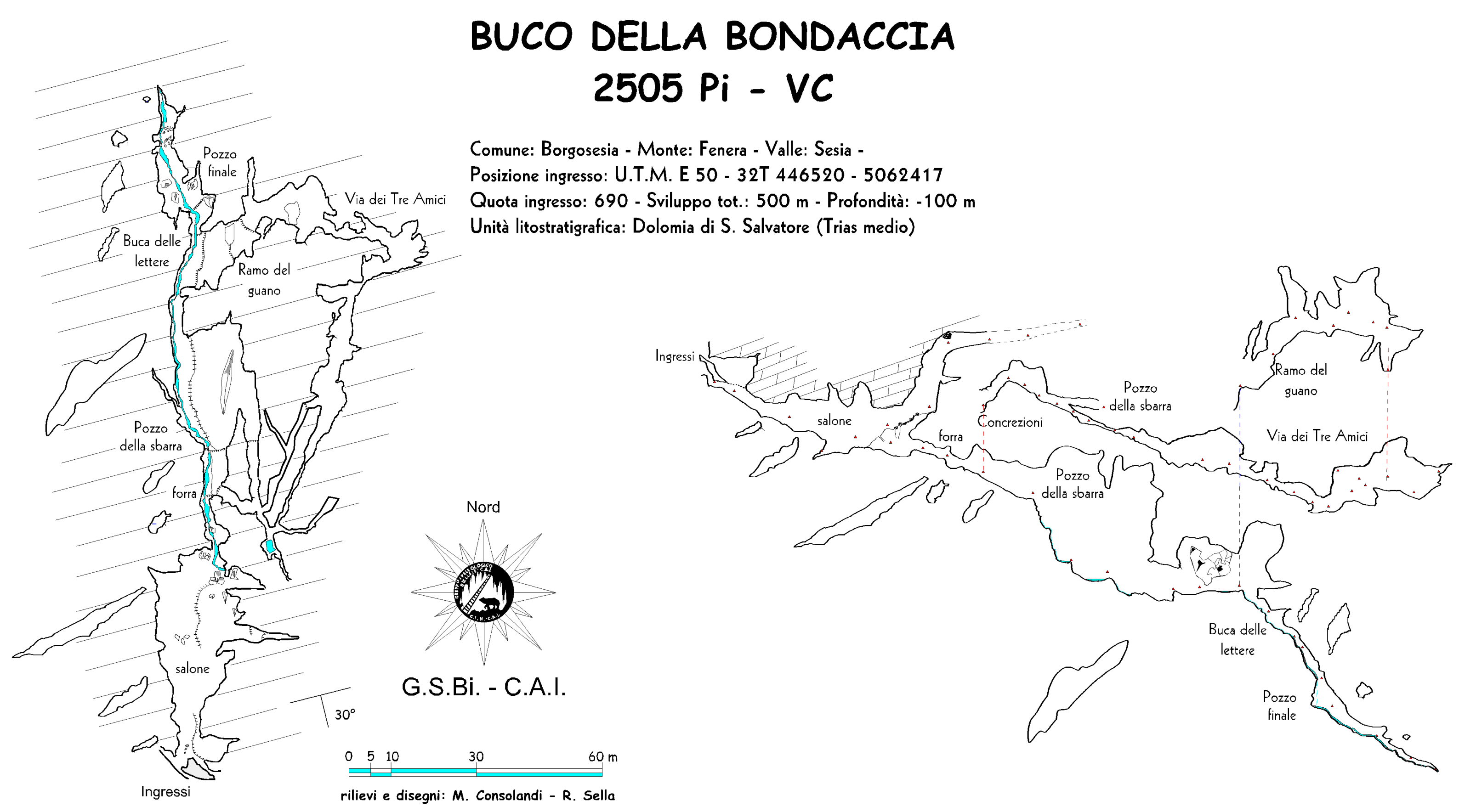

Foto M. Sandrini

The land dwelling crustacean Alpioniscus Feneriensis who can reach a size of up to 10 cm is found almost everywhere in the cave and is considered to be an indigenous specimen. Other biological species found in the cavity include the Oroposoma Emiliae, particularly well suited to life underground, and the aquatic shrimp Niphargus sp.

Both the Buco della Bondaccia and the Ciota Ciara are important places of hibernation for certain species of troglophile (cave) bats: the greater Horseshoe bat, the lesser Horseshoe bat and the greater Vespertilionid. The greater Horseshoe (Rhinolophus ferrumequinum) is among the most common chiropters in our area; it has a typical nose with cartilage that resembles a horseshoe, which explains its name. It can be distinguished from the Lesser Horseshoe bat (Rinolophus hipposideros) because the latter is smaller in size and, in fact, its body is no larger than a thumb.
Horseshoe bats hang by clinging with their back claws and they wrap themselves in their wings while resting (unlike other species). Its back is dark brown or grey whereas its underside is slightly lighter.
The last time chiropters were monitored in the Fenera Caves about 60 hibernating Greater Horseshoe bats were sighted in the Buco Della Bondaccia (undoubtedly the most important site).

The presence of so many exemplars makes Monte Fenera cave a significant conservation site at the national level.
Like other chiropters, Horseshoe bats are insect eaters and provide important trophic resources for the cave world as they supply nutrients for underground arthropods by means of faeces and the remains of insects they capture outdoors and devour underground.

Rhinolophus hipposideros (Bechstein, 1800) foto: E. Lana

Progettazione: Chiara Leonoris, Enrico Lana, Renato Sella,
Testi di: Enrico Lana, Renato Sella, Paolo Testa, Chiara Leonoris

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Grotta dell'Eremita

A stratified prehistoric site

THE CAVE AND THE EXCAVATION

Grotta dell'Eremita, or Tana dell'Armittu, (situated in the only calcareous massif of the Southern side of Central-Western Alps, Monte Fenera) is a small cavity of about 30 meters squared, on a little terrace in a dominant position above the valley. It consists of a single chamber opened inside the dolomite's layers; the soil seems to be sandy and flat and towards the atrial area of the cave two conduits link the cavity with the outside. Nowadays it seems that there is no important hydric activity and the light penetrates completely inside it. In the 80s, GASB (Gruppo Archeo-Speleologico Borgosesia) discovered a bone object dating back to the Bronze Age, which interested the Laboratoire d'archéologie préhistorique et anthropologie of the University of Geneva.

During the excavations, begun in 2012, many archaeological remains were found in the cave, among which ceramics, metal objects and animal bones, dating back to the different periods of the Bronze Age.

CHRONOLOGICAL DATA

The peculiarities of the archaeological site of Grotta dell'Eremita are worth emphasizing, since it is the only stratified site dating back to the Middle Bronze Age (MBA) in the Northern Piedmont area.

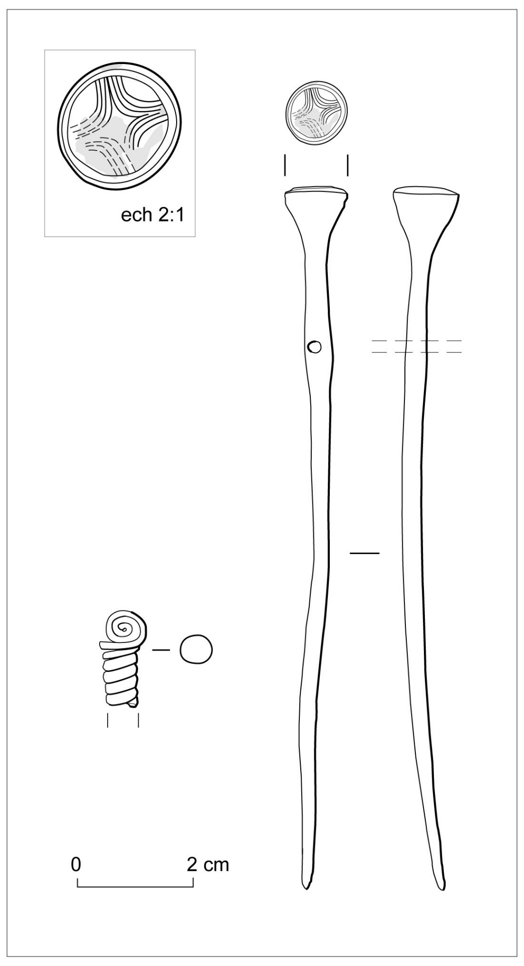
Most of the archaeological material comes from the different layers dating to this last period and it includes various ceramic fragments and animal bones' remains, sometimes burnt, which were mainly located in two areas: the first one in the deepest part of the cave and the second one in the centre. Most of these findings were found around the place of the discovery (during the 2012 survey) of some ornamental metallic objects.

To establish the chronology of the site, some carbon samples from the richest layer of the Bronze Age (US 19) were sent to the ETH of Zürich (Swiss Federal Institute of Technology in Zürich) for their dating: it was confirmed that they date back to the initial phase of the MBA (from 1387 BC to 1306 BC ± 28).

To date, very few lithic artifacts have been found consisting of an arrowhead and some laminate flint splinters; a bronze arrowhead was also discovered in the cave's atrial section.

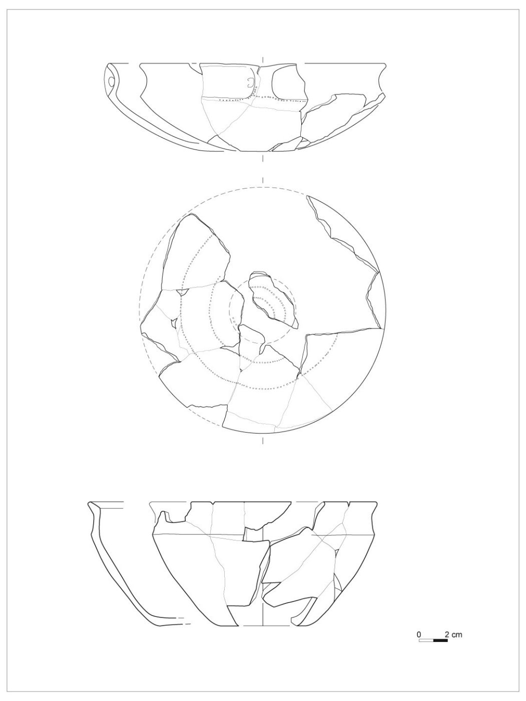
TANA DELL'ARMITTU 2690 Pi – VC
Comune: Borgosesia
Quota ingresso: 595
Unità litostratigrafica: Dolomia di S. Salvatore (Triassico medio)

La superficie interna della grotta prima dell'attività archeologica dell'Università di Ginevra nel 2012



Spillone e frammento di vago spiraliforme in lega rameica

Disegno e fotografia di vasi carenati e frammento ceramico con decorazione a impressioni digitali



Resti di fauna: difesa di cinghiale e rimontaggio di osso.

CULTURAL DATA

The most significant remains found in the cave are a pin and some spiral-shaped beads (parts of adornments) in a cupric alloy. This type of pin (with a truncated cone head, engraved with festoon motifs) has been found mainly in the North of the Alps in the initial phase of the MBA. The grains were more common in the North of Italy and for a longer period of time, starting from the Early Bronze Age.

The ceramic remains are made of thousands of elements; thanks to a technical-typological study, two different concentrations were highlighted: the first one dates back to the MBA while the second one to a final phase of the Bronze Age (from 1000 BC to 850 BC). For both the ceramic sets there are some analogies in the archaeological sites of the Northern and Southern Alps, in particular in Switzerland and near the Italian lakes (Lake Maggiore and Lake Viverone).

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