GEODIVERSITY IN PICTURES: GEOLOGICAL ATTRACTIONS OF THE GEOPARK

4.1 Introduction: the geodiversity and the geosites of the geopark

In the same way as biodiversity, geodiversity is defined as the diversity of non-living elements of nature - including its minerals, rocks, sediments, fossils, soils, landforms, topography, geological and morphogenetic processes, and hydrological forms. Geodiversity, besides having its own values, supports life in the Karst and thus it has a great influence on biodiversity and its evolution. From microscopic to macroscopic life, geodiversity is always present. Nowadays, the concepts of geodiversity and biodiversity lead to better conservation management and tourism improvement. Highlighted in the seventh point of the Declaration of the Rights of the Memory of the Earth, signed at Digne (France) in 1991, is the phrase: “we have always been aware of the need to preserve our memories – our cultural heritage. Now the time has come to protect our natural heritage. The past of the Earth is no less important than that of Man. It is time for us to learn to protect this Earth heritage, and by doing so learn about the past of the Earth, to learn to read this ‘book’, the record in the rocks and the landscape, which was mostly written before our advent”.

There is therefore a geological heritage represented by those places having a scientific interest which allows an understanding of the history or evolution of an area. These places, called geosites, are worthy of conservation and enhancement, and are part of what we call “natural heritage”, which is that set of biotic and abiotic aspects distinguishing an area.

Figure 4.1.1: The geosite Doberdò-Doberdob Lake. The area of the Nature reserve of Doberdò-Doberdob and Pietrarossa-Prelosno Lakes is characterized by a high level of geo and bio diversity (Photo: Roberto Valenti)

The natural variety of minerals and rocks, together with the geological, geomorphological, pedological and climatic processes, create the necessary conditions for the development of life and its variety. With this in mind, there is no doubt that the geodiversity of the Karst/Carso/Kras geopark is unique, so much so as to be recognized as a universal symbol of karst phenomena typical of temperate climates.

In this area, characterized by all kinds of superficial and underground karst features, by a particular hydrogeological network, and rare fossils, 61 geosites have been selected from the long lists of geologically and geomorphologically valuable natural features, officially listed in the Italian and Slovenian registers. These geosites are thus the icon sites to describe the geodiversity of the Classical Karst and its scientific value for the understanding of karst phenomena and the geological processes which created them.

In Italy, the geosites have been cataloged and described in the Geosites Inventory of the Friuli Venezia Giulia Region. Similarly, in Slovenia, such valuable natural features are designated a nature conservation status in a register maintained by the Institute of the Republic of Slovenia for Nature Conservation and are protected by the Nature Conservation Act.

Based on scientific criteria and depending on their importance and uniqueness, the geosites have been classified as being of international, national, regional or local interest. This classification is then associated with the prevailing geological characteristic, so that a geosite can be further described as being of geomorphological (GM), geological (G), paleontological (P), hydrogeological (H), or other interest.

The map and list of all geosites with a brief description can be found in the Annex I.

4.2 Geodiversity in pictures

Among all the recognized geosites in the Classical Karst, below are briefly described the most representative of the karst landscape, not only for their particular scientific interest, but also from a geotouristic perspective. The order of description is merely geographical, from NW to SE.

4.2.1 The karst lakes (geosite n. 3)

The southern part of the Isonzo Classical Karst sector is affected by a number of tectonic lines, trending WNW-SE, that give rise to elongated depressions (*polje*) occupied by four lakes directly fed by the waters of the Classical Karst aquifer. The northernmost and largest *polje* is the Doberdò-Doberdob Lake; to the south, two modest hills separate it from the Pietrarossa-Prelosno Lake and the Mucille-Močile and Sablici-Sabliči Lakes, located west and south-east of Pietrarossa-Prelosno, respectively. The *poljes* open up in the limestones, dolomites and breccias of the Lower Cretaceous-Upper Cretaceous, in which the gently sloping SE-bounded bedrock is locally conditioned by faults having a predominantly transcurrent character. Doberdò-Doberdob Lake *polje* lies between the Colle Nero Fault (Jamlje Fault) and a minor fault connected to the Brestovica Fault, the other three lakes are conditioned by minor faults and one of the lineaments connected to the Palmanova Line, the tectonic line of regional character along which the Karst Platform is overlain by flysch turbidites.

The lakes are the expression of the complex system of springs, karstic lakes and swallow-holes, which give life to the hydrogeological spring system characterizing the north-western sector of the Classical Karst. The waters flowing in the Isonzo Classical Karst sector have a dual recharge: the waters deriving from the influent character of the Soča-Isonzo and Vipava-Vipacco Rivers and the effective infiltrations occurring in the area. The former act as the main recharge in this sector of the area, sustaining the flow rates of all the springs from the Mucille-Močile to the Moschenizza-Moščenice Channel. During low water periods, when Notranjska Reka flow rates in Slovenia are very low (a few hundred litres per second), Timavo Springs are also largely fed by this resource. During floods, a greater influence of karst waters on the Soča-Isonzo component is instead observed. This influence is due to the increase in the piezometric levels in the karst sector which inhibits the recharge from the Soča-Isonzo.

Figure 4.2.1: February 2017, panoramic view of the Doberdò-Doberdob temporary Lake in a dry period. In the background, on the right, Mt. Castellazzo with a scarp due to the Colle Nero Fault (Jamlje Fault) (Photo: Chiara Calligaris)

Doberdò-Doberdob Lake, the bottom of which lies between 4 and 5 m a.s.l., is home to the karst water table, usually located at 4.8 m a.s.l. The water level is regulated by a few springs and several swallow-holes. During floods, the flow rate of the springs quickly increases and the swallow-holes are unable to drain all the waters, which causes a rise in the water level. During exceptional floods this can reach about 6 metres in a few hours. The speed with which the depression fills and empties means that the bottom of the lake is often free of water. Thus Doberdò-Doberdob is therefore considered an intermittent lake (Figure 4.2.1).

Permanent spring areas and swallow-holes regulating the water regime are also present at the Mucille-Močile. Their average level is at an altitude of 4.60 m a.s.l. and rises about 3.5 m during exceptional floods. Two spring belts of about fifteen and twenty points respectively with flow rates varying from a few litres per minute to several tens of litres per second recharge the Pietrarossa-Prelosno and Sablici-Sabliči Lakes. Until the 1960s, the hydrogeological behaviour of these lakes was entirely similar to that of Doberdò-Doberdob. Following a series of drainage works and the construction of two drainage canals which cut the natural thresholds present between Pietrarossa-Prelosno and Sablici-Sabliči Lakes and between the latter and the Moschenizza-Moščenice Canal, the hydrodynamics of this area was radically altered. However, the drainage network of this area is complex and articulated with numerous underground paths bringing groundwaters to feed a spring system now obliterated by the Monfalcone urban fabric.

In order to better understand the origin and groundwater flow of these waters, researchers have used different approaches over the years, and are still working on this topic. One of the used methods is the water monitoring through the evaluation of electrical conductivity as natural tracer. In addition to the data obtained with this approach, tracer tests with artificial dyes have been carried out since 2018 from some of the swallow-holes in the Doberdò-Doberdob Lake. The results showed that, unexpectedly, most of the tracer flows to the Timavo Springs. The Pietrarossa-Prelosno Lake springs, on the other hand, although geographically closest, are only marginally affected by Doberdò-Doberdob waters.

4.2.2 The "Villaggio del Pescatore" geosite (geosite n. 6)

The Villaggio del Pescatore geosite, located in the Duino-Aurisina – Devin-Nabrežina Municipality, is particularly relevant because, since the late nineties, two complete and exceptionally preserved fossils of a new genus of dinosaur, named *Tethyshadros insularis* have been excavated there. The two skeletons, that are still articulated, with almost all the bones in anatomical connection, were nicknamed Antonio and Bruno and are now displayed at the *Museo Civico di Storia Naturale* of Trieste. Other fossils belonging to the same genus has been found in the Villaggio del Pescatore site as well as animals such as crocodiles, teleost fishes and invertebrates, including decapod crustaceans. The geosite corresponds to an old stone quarry cut into limestone the layers of which are almost vertical and therefore exposed in a natural cross section. The stratigraphic organization of the rocks of the geosite is complex, but two main rock types can be recognized. One is composed of gray limestones that can be referred to the typical Upper Cretaceous rudist limestone and contain fossils fragments of rudist bivalves (bivalve molluscs that became extinct at the end of the Upper Cretaceous like dinosaurs). The other rock type is made up of finely laminated limestones. The thin laminae may be dark or greyish-white and are often characterized by a complex folding that testifies to the deformations which occurred when the sediment was freshly deposited and still not completely lithified (turned into a rock). The dinosaur fossils were found within these thinly-laminated limestones. Most notably, the skeleton of Bruno itself has been involved in the folding as can be spectacularly seen in the display at the museum (Figure 4.2.2).

Figure 4.2.2: Bruno, as it is displayed at the Civic Museum of Natural History of Trieste (Photo: Marino Ierman, Trieste Municipality - Fototeca Civici Musei di Storia ed Arte, Museo Civico di Storia Naturale di Trieste)

Bruno is the only dinosaur in the word lying on a fold of the rock that curves its skeleton by 180 degrees. Paleontological investigations have allowed the dating of these rocks to the Upper Cretaceous (Santonian-Campanian) and sedimentological and geochemical data suggest that the laminated limestone deposited in a confined marine environment, close to the emergent land and influenced by fresh water, conditions that may be approaching the blue holes (water-filled cavities near the sea that appear as blue holes) found in modern tropical carbonate platforms.

4.2.3 The olistoliths of Miramare Castle (geosite n. 27)

Miramare Castle is located on a promontory that stretches southwest into the Gulf of Trieste. In the vicinity of the Castle, scattered within the park surrounding it and also along the shore, the visitor can clearly see large blocks of whitish limestone. In total, approximately a hundred calcareous blocks with volumes ranging from about 500,000 m^3 to 1,300,000 m^3 have been identified. The blocks are made of rocks belonging to the foraminiferal limestones. Two blocks are particularly notable. One is located nearby the little port of Grignano. There, the limestone block on its northeastern side is clearly in contact with the well layered sandstone of the flysch. The sandstone close to the block, appears deformed by complex folds as if the limestone block has pushed against them. Historical photographs of the site, made prior to the building of the stone wall that is now below the limestone block, testify that flysch is found also beneath it and adjacent to its southwestern flank (Figure 4.2.3).

The other large and notable limestone block is located between the stables and the Castle itself, along the road that leads to the southeastern gate. Nearby the entrance of a tunnel, adjacent to the block, is a clayey, marly breccia with limestone fragments containing sparse nummulitids. This rock, completely different from the limestone, also testifies strong deformation occurring in the vicinity of the block. Both at Grignano harbor and nearby the castle stables the rocks surrounding the blocks display evidence of deformation. A final important clue about the origin of the Miramare limestone boulder is that mapping has revealed that the flysch deposits are

Figure 4.2.3: Miramare Castle olistolith pictured from the Grignano harbor (historical photo by Collezione Tomè, XIX – XX century)

also found above the blocks. This means that they are found *within* the flysch deposits. The clear evidence of deformation adjacent to the blocks has allowed them to be interpreted as *olistoliths*. Olistolith is a term used by geologists to indicate large rock boulders that are part of a landslide body. The sliding of the blocks within as yet incompletely consolidated sediments explains why the latter are deformed in complex ways. The whole Miramare promontory is likely made by the deposits of a large such submarine landslide that slid into the sea basin where the flysch sandstones were in the process of depositing, between 40 and 48 million years ago. The fact that the Miramare olistoliths are made of limestone belonging to the Foraminiferal limestones testifies that the carbonate platform deposits were also involved in the event although the mechanisms of emplacement and the provenance of the ancient landslide are still unclear and currently under investigation.

4.2.4 *Borgo Grotta Gigante – Briščiki karrenfeld (geosite n. 28)*

West of Borgo Grotta Gigante - Briščiki, beyond the railway line, between the station to the north and Prosecco-Prosek sports centre to the south, there is an area representative of the Classical Karst landscape developing on pure limestones, with sub-horizontal or poorly dipping layers, characterized by different thicknesses (Figure 4.2.4). The outcrops are rudist limestones where intact shells or fragments of rudists bivalve fossils are frequent.

On a sub-trapezoidal surface of just under a square kilometre there are three large and about twenty smaller dolines, the widest and most complete *karrenfeld* of the Trieste Karst. The most evident and rare example of roofless cave is also found, along with the entrances of a few dozen caves, including a cave that has returned hundreds of artifacts dating back to prehistoric times. Close to it is the *Grotta Gigante - Briška jama* (2/2VG), a cave with the world's largest hall in a show cave (Figure 4.2.5).

Figure 4.2.4: Karrenfeld at Borgo Grotta Gigante - Briščiki (Photo: Chiara Calligaris)

Figure 4.2.5: Panoramic view of the great hall and the Ruggero stalagmite (Photo: Grotta Gigante Archive)

Two of the three dolines, Koprivnik and Školudnjek, have the typical depressed sub-circular shape, a diameter of about 250 metres, a depth of 40 m, very steep flanks and a flat bottom.

The third, however, the northernmost called Murnjak, is elliptical, 450 m along its longest axis and running NNE-SSW, about 250 m wide and 30 m deep, with the eastern flank much more steep than the western one. Along the SW and NE margins of the Školudnjek, with particular abundance and variety on vast areas of outcropping limestone, rainwater has carved all the typical karst solution features including solution flutes, linear or meandering solution grooves, deep crevasses crossed by small rock bridges, grikes, covered karst and hums follow one another with continuity. But the

main characteristic of these *karrenfelds* lies in the size and frequency of the solution pans or kamenitzas (škavnice in Slovene) (Figure 4.2.6). Overall, in the area between the two circular dolines, almost 200 have been observed, of which about thirty have an axis greater than 1 metre and a basin close to or greater than one square metre. So much so that many of them have been adapted over time as drinking troughs for animals.

The alternation in the sedimentary succession of thick and thin layers generates successive decametric bands of covered karst or sparse outcropping teeth and intensely karstified rock, meadows, *grize* and *karrenfelds*, interrupted by large and small dolines which give rise to a unique and fascinating landscape.

On the SE edge of the Koprivnik there is a sort of natural trench, a few metres deep, about ten metres wide and about seventy metres long, of what remains of an ancient tunnel, which is a sub-horizontal cave whose ceiling has been slowly removed by surface karst corrosion, a *roofless cave* (Figure 4.2.7).

Near the railway line, near at edge of a small sinkhole, a small cave, Grotta della Tartaruga (1688/4530VG) had been obstructed by debris and earth up to the ceiling. The un-obstruction led to the opening of some small halls where concretions on the ceiling, thick columns and a basin of about 20 cm in diameter collecting the dripwater are present. The excavations brought to light multiple levels of occupation from the Mesolithic to the Bronze Age. Of particular importance is the D level, attributed to the Neolithic, in which abundant remains of vases, numerous tools and artifacts not retouched in flint, two axe blades and 2 axe-chisels in polished stone were found.

*Figure 4.2.6: One of the great solution pans (*kamenitza*) in the Borgo Grotta Gigante-Briščiki area (Photo: Furio Finocchiaro)*

Figure 4.2.7: The entrance of the roofless cave at Borgo Grotta Gigante-Briščiki (Photo: Chiara Calligaris)

4.2.5 Archeological caves

Among the many archaeologically important caves in the Slovene Karst, we should mention at least two, each of which is of particular importance not only at the national level, but also beyond. The Bestažovca Cave (geosite n. 43), 280 metres long and 43 metres deep, located in the Tabor hills which is on one of the highest lying caves above sea-level in the Slovenian Karst, and contains, among other geological and geomorphological attractions, many prehistoric archeological remains, including prehistoric drawings dating back at least 7,000 years, is a unique site for Slovenia.

Another archaeologically significant cave is Jama na Prevali 2 or Mušja jama (geosite n. 54), located southwest of the village of Matavun - in the hinterland of the Škocjan Caves - below the Prevala peak. An entrance shaft with three relatively small entrances divided by submerged blocks leads into 200 m long and 90 m deep horizontal cave. Below the shaft, in the entrance hall is a large cone of gravel, in which archaeologists have found a charcoal layer with burnt animal bones and hundreds of mostly bronze and also iron artefacts, i.e. offensive and defensive weapons (swords, spearheads, helmets), tools (axes, sickles, knives), parts of costumes (needles, fibulae, collars, bracelets, earrings) and metal utensils (kettles, buckets). These findings show the extraordinary influence that the Škocjan Caves and the surroundings had as a sacred place amongst European and Mediterranean cultures in the Late Bronze Age, around 1000 B.C.

On the Italian side, the Pocala-Pečina pod kalom Cavern (173/91VG), geosite n. 23, is one of the most interesting paleontological sites in Friuli Venezia Giulia Region. It is a protected cave in which abundant Pleistocene animal remains have been found, in particular the bones of cave bears (*Ursus spelaeus*). It extends for just over a hundred metres and is 20 to 40 m wide. The entrance (protected by a gate) opens into an elongated doline, remains of a roofless cave as revealed by concretions on the walls. It consists of a single sloping gallery with an uneven floor of fill and collapse deposits on which there are some concretions. First explored in 1893 by Ludwig Karl Moser and Giovanni Andrea Perko, it became famous for the extremely high number of cave bear finds discovered in numerous excavation campaigns. Between 1903 and 1929, important protagonists of archeological research of the time such as L. K. Moser, Carlo Marchesetti, Eugenio Neumann and Raffaello Battaglia excavated in the cave. Since 1998, the Civic Museum of Natural History of Trieste has undertaken new excavations, with the opening of a trench under the supervision of Ruggero Calligaris, the Museum's curator at the time, and Gernot Rabeder, from the University of Vienna, reaching the unexcavated layers that were thought to be impossible to find. Since the faunal composition in the cave is 97.5% cave bear remains, the Pocala-Pečina pod kalom Cavern can be defined as a 'bear cave' although the bones of other animals have also been found. The cave lion (*Panthera leo spelaea*) is the second most rep-

Figure 4.2.8: The cavern and deposits inside the Pocala-Pečina pod kalom Cavern (Photo: Luciano Gaudenzio and Sandro Sedran - Civic Museum of Natural History of Trieste archive)

resented animal (0.75% of the remains), followed by goats and sheep (*Capra hircus* and *Ovis aries*), aurochs (*Bos taurus*), wolf (*Canis lupus*) and deer (*Cervus elaphus*). In addition to animal remains, numerous Mousterian flint artefacts, i.e. from the Neanderthal culture, were also found. The fauna of the Pocala-Pečina pod kalom Cavern, from the Upper Pleistocene, has been dated to around 60,000 years ago based on the study of the cave bear teeth. Recently, some finds have been dated using the radiocarbon method. Of these, four are older than 45,000 years, which is the limit of the dating method (i.e. they are older than 45,000 years, but it is not known by how much) and one sample is dated 36,500-34,500 years ago. The finds from the Pocala-Pečina pod kalom Cavern are now on display at the Civic Museum of Natural History in Trieste.

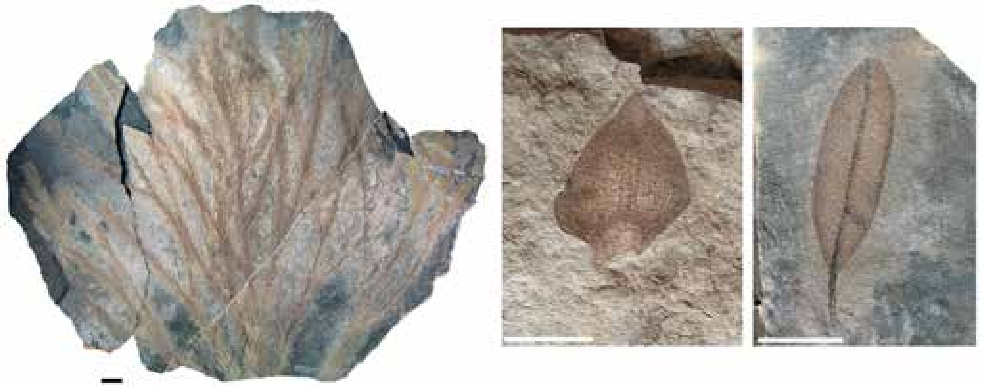


Figure 4.2.9: Plant fossils, found in Tomaj Limestone (from left to right: conifers Brachyphyllum *and* Araucarites*, and* Magnoliaphyllum*). Scale bar 1 cm (Photo: Bogdan Jurkovšek)*

4.2.6 Fossiliferous Tomaj Limestone (geosite n. 34)

The abandoned Kazlje Quarry in the Tomaj Limestone is one of the most important sites for fossil vertebrates, invertebrates and plants from the Late Cretaceous in the northern part of the former Adriatic-Dinaric carbonate platform. The paleontological findings from this site have been published in a number of scientific publications.

The Kazlje geosite is located in a forested area about 400 m southeast of the centre of the village of Kazlje. Tomaj Limestone is a thin-bedded to platy limestone, once used as roofing and flooring material. It occurs as individual horizons within the thick-bedded Upper Cretaceous rudist limestones and forms vertical walls up to 4 m high in the abandoned quarry. The limestone is dark colored and laminated. In the limestone layers nodules and lenses of chert occur, a hard, dense rock composed of microcrystalline quartz. The presence of pelagic fossils together with terrestrial plant fossils shows a good connection between the open sea and the lagoon where this limestone was formed about 84 million years ago. A large number and variety of well-preserved fossils, including plants, ammonites, fish, turtles, sea urchins, brittle stars, planktonic organisms and even imprints of soft-bodied jellyfish have been found in the Tomaj Limestone in the wider area and described in the scientific literature (Figure 4.2.9 and Figure 4.2.10).

Figure 4.2.10: Animal fossils of Tomaj Limestone (from left to right: fish Chirocentrites *and* Enchonodus*, turtle, ophiuroid brittle star, and ammonite). Scale bar 1 cm (Photo: Bogdan Jurkovšek)*

4.2.7 The Lipica rudist limestone quarry (geosite n. 45)

The Lipica Limestone, one of the Upper Cretaceous rudist limestone types, contains numerous varieties of limestone that differ both in structure and colour. This limestone represents the most commercially valuable rock in the Classical Karst area (Figure 4.2.11). Both the names of the limestone and the natural stone are derived from the village of Lipica.

Near the western edge of the quarry, younger and softer Upper Cretaceous-Lower Paleocene limestone beds overlay the Lipica Limestone. As a result, the terrain towards Lipica is less karstified and coal layers are frequently found between the limestone beds. Coal was mined in the 19th and early 20th century in this area.

Figure 4.2.11: The Lipica 1 Quarry lies northeast of the well-known Lipica Stud Farm. In this quarry, large blocks of massive Cretaceous limestone are exploited. The quarry is situated in the most economically promising part of the Lipica Limestone in the north wing of the Lipica syncline, a large bowl-shaped fold with an axis slightly plunging towards the southeast (Photo: Matevž Novak)

Rocks of the Lipica Formation were formed about 85 million years ago in the immediate vicinity of thickets of rudist bivalves that were the inhabitants of the shallow marine carbonate platforms and marginal areas of the Tethys Ocean during the Cretaceous period.

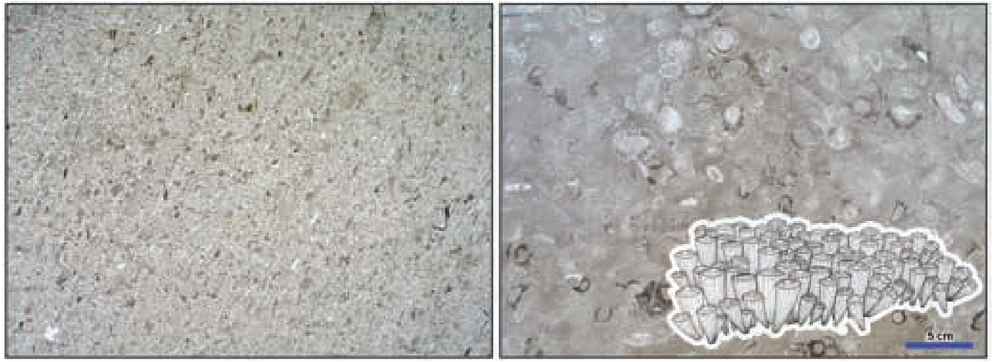


Figure 4.2.12: Today, two types of limestone are obtained in the Lipica 1 Quarry. The first is a light olive-grey, homogeneous, fine- or coarse-grained uniform ('unito') type with fossils or fossil fragments of only a few millimetres big (left). The other type is composed of a more fine-grained groundmass that contains mainly rudist shells and other fossil remains of different size. Due to their flower-like cross-sections this limestone is named the Lipica rosy ('fiorito') type (right). Besides rudists, both types of limestone often contain foraminifera, sponges and skeletal parts of other inhabitants of the warm, well-ventilated shallow marine environment of the former Adriatic-Dinaric carbonate platform (Photo and drawing: Bogdan Jurkovšek)

4.2.8 The Aurisina-Nabrežina roman Quarry (geosite n. 24)

In the broad, ancient mining basin known as Ivere, just inside the Karst ridge close to Aurisina-Nabrežina, a number of pit quarries (Figure 4.2.13) have been in operation since Roman times. The entire area is characterised by massive limestones from which large blocks are obtained. These are very pure, homogenous limestones with a light grey ground colour. The distinctions between the different varieties quarried depend on the size, classification, quantity and distribution of the fossils. The latter, almost always in fragments, are mainly thick-shelled lamellibranchs, mainly rudists with remains of different sizes and, subordinately, foraminifera, algal remains and rare bryozoans. Along the high, smooth walls, one can observe not only the different sedimentary structures, but also the traces of rudimentary ancient excavations and the evolution of excavation techniques over times. The layered strata, with an orientation running NNW-SSE and an inclination of 20°- 30° towards SSE, encouraged quarrymen to extract material even using tunnels inclined towards the sea.

4.2.9 Rosandra-Glinščica Valley (geosite n. 58)

At the southern border of the Italian Classical Karst there is the only example of a karst valley with surface hydrography of the area around Trieste: the Rosandra-Glinščica Valley (Figure 4.2.14).

The valley is deeply carved in Cenozoic limestone, marlstone and sandstone, with a morphology and hydrography largely conditioned by tectonics as well as by its lithology, i.e. folds, faults and different rock types, on which erosion and karst corrosion have created a particular hydrostructure. It is one of the few karst river valleys in Italy and is a complex geosite of international value. It also contains within it numerous other elements of geological interest such as limestone outcrops particularly rich in Alveolinid and Nummulitid foraminifera, intraformational marlstones and claystones, alluvial deposits and debris, sometimes cemented, short-range folds in the flysch, an important fault mirror (the Crinale Fault), a waterfall and a gorge with potholes and recessed meanders, a paleo-landslide and a landslide body with large boulders, a kilometre-scale cave system on the right side (inside Mt. Stena) and a cave rich in prehistoric animal remains on the left one, the Bukovec Spring and the Antro di Bagnoli-Jama karst springs.

Figure 4.2.13: The Aurisina-Nabrežina Roman Quarry (Photo: Chiara Calligaris)

Figure 4.2.14: The Rosandra-Glinščica Valley from the top of Mt. Stena (Photo: Furio Finocchiaro). In the background the Gulf of Trieste.

Privileged views of the Valley include those from the *Vedetta di Moccò* and *Vedetta di San Lorenzo*. From both the slopes overhanging the Rosandra-Glinščica stream are visible, those on the right of Mt. Stena enlivened by escarpments and rocky cliffs, spires, debris fans and large mobilized blocks, those on the left set on the side of the Mt. Carso anticline and the Crinale Fault, all expressions of a diverse lithology, of complex tectonics and remarkable geodynamics.

From the *Vedetta di San Lorenzo* you can also see the ancient, meandering Salt route and the church of Santa Maria di Siaris-Sveta Marija na Pečah, located in correspondence to the crown of the translational landslide along the northern flank of Mt. Carso-Griža/Mali Kras. The latter rapresents, the morphological expression of an anticline fold that towards the plain evolves into a knee fold and in a thrust fault on the turbidites of the flysch.

But the valley is characterized by the Rosandra-Glinščica stream, whose waters, initially supported by marls, after Bottazzo-Botač, fall down a suggestive 30 m waterfall highlighting the transition from flysch to limestone (Figure 4.2.15). Downstream of the waterfall, the stream carves a deep gorge, full of rapids, potholes, waterfalls, recessed meanders and tanks. The riverbed often changes direction following the main fracturing systems present in the rock mass up to the small town of Bagnoli-Boljunec. Along the stretch in the gorge the watercourse is fed by numerous small karst springs.

The valley is also hypogean karst, with Mt. Stena being a very special example with more than a hundred explored caves. The Fessura del vento Cave (930/4139VG), with its 143 m of difference in altitude is the deepest. The Gualtiero Savi Cave (5080/5730VG), with its 4,180 m in length, is the one with the longest development. These two caves, together with the Grotta delle Gallerie Cave (290/420VG) and the Martina Cucchi Cave (4910/5640VG) are part of a single vast and articulated complex of over 7 km of development, the result of an ancient karst evolution.

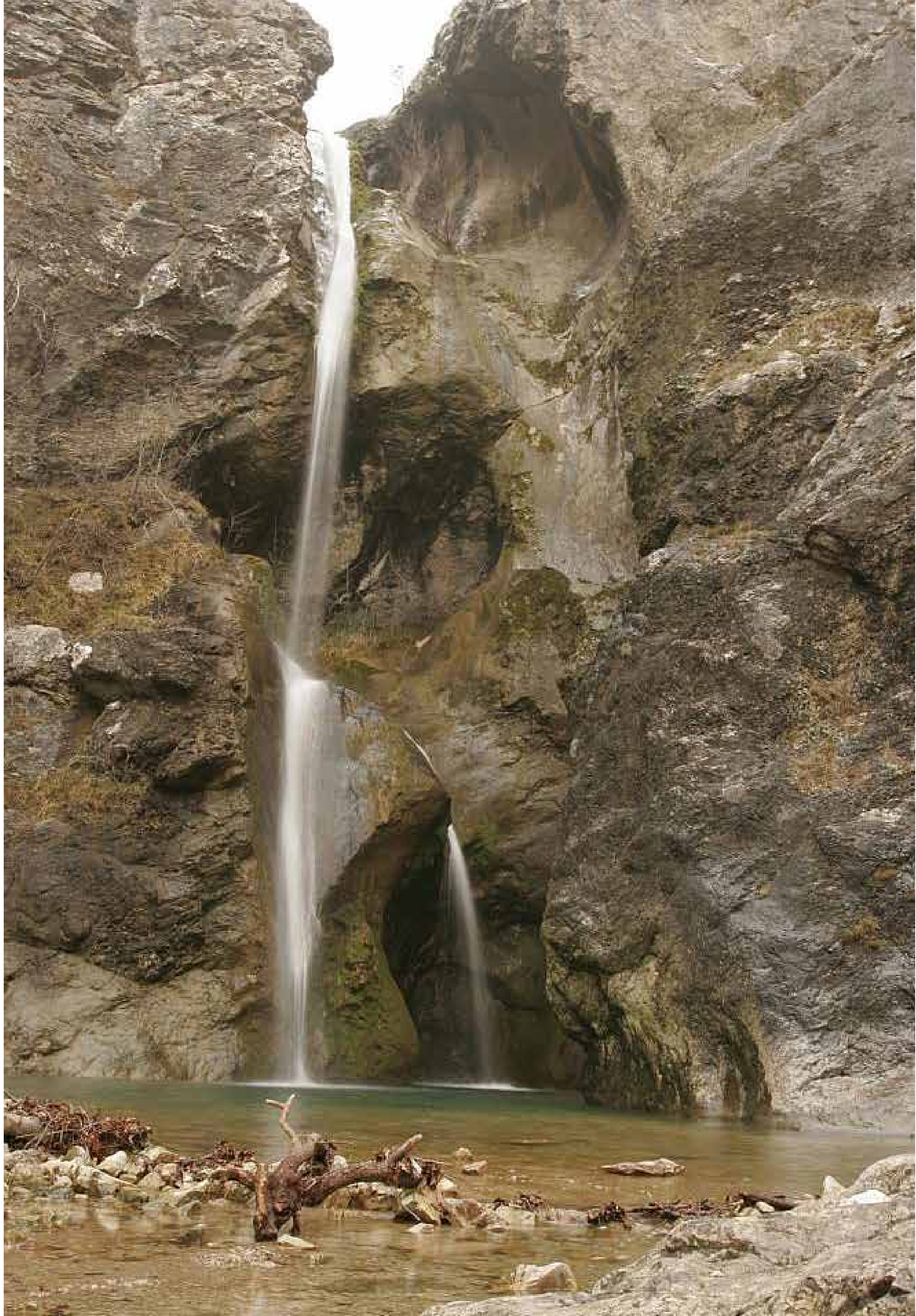


Figure 4.2.15: The Rosandra-Glinščica waterfall in low flow conditions (Photo: Franco Cucchi)

The valley is also home to unusual quaternary deposits. In front of the CAI refuge, to the hydrographic right of the Rosandra-Glinščica stream, rises a sub-vertical wall, a dozen of metres high, consisting of torrential alluvial and slope deposits, more or less cemented, which represents the only outcrop of ancient alluvial deposits in the karst environment of the Trieste area. The alternation of sediments with different genesis and grain size and their subsequent incision by the torrent witness the complexity of the geological evolution of the area, linked both to tectonics and to Plio-Quaternary climate changes.

A few hundred metres from the valley exit, at the bottom of Mt. Carso-Griža/Mali Kras, from an oblique fracture, waters flow out. This is the Antro di Bagnoli-Jama Spring, a cave which drains the karst waters of Mt. Carso-Griža/Mali Kras and Socerb-San Servolo Plateau.

4.2.10 Blind valleys of Matarsko Podolje (Odolina blind valey) (geosite n. 61)

Apart from the unique blind valley of the Notranjska Reka river sinking into the Škocjan Caves, the most characteristic and geologically interesting contact karst features are the blind valleys of Matarsko Podolje on the SE border of the geopark (Figure 4.2.16 and Figure 4.2.17).

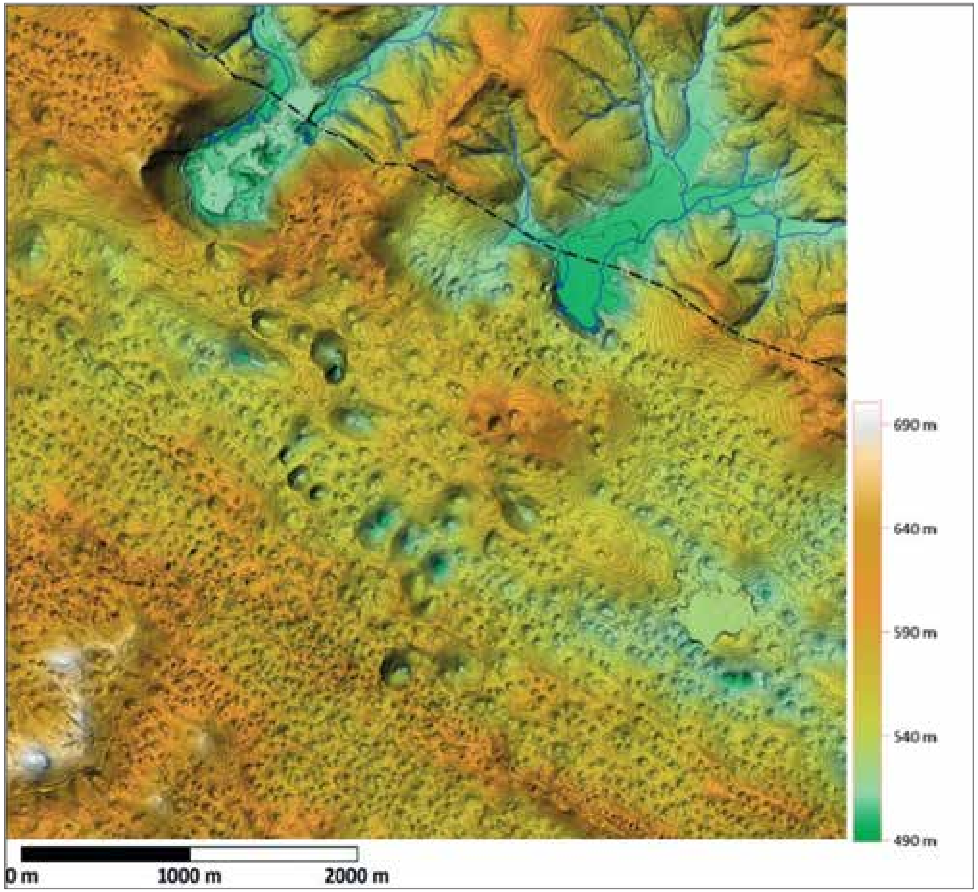


Figure 4.2.16: Contact karst with typical blind valleys. Surface streams flow from the impermeable flysch region of the Brkini Hills (NE) and sink into the levelled karstic surface of Matarsko Podolje (archive of IZRK ZRC SAZU)

Figure 4.2.17: The Brezovica blind valley is the most north-western and thus the shallowest blind valley of Matarsko podolje. Left figure: view to the NE towards the Brkini hills with a surface drainage system (Photo: Matej Blatnik); right figure: view to the SW over the karstified Matarsko podolje levelled surface.
(Photo: Matej Blatnik)

This is a system of 17 parallel surface streams that form a surface drainage system on the siliclastic flysch of the Brkini Hills that sinks near the contact with the carbonate rock under the 20 km long and 2 to 5 km wide levelled karst surface of Matarsko Podolje. Since the valleys are cut into the karst edge due to the uneven uplift of the area, the deeper valleys are on the SE part of Matarsko Podolje. The shallowest blind valley, Brezovica in the NW part of Matarsko Podolje, is cut only 50 m deep, while the deepest Brdanska Dana is cut 250 m deep into the limestone hills and its floor is 120 m below the levelled surface of Matarsko Podolje. At present, the karst water level is deep below the floors of the blind valleys even during floods. The recent gradient in the karst is so high that the old deposits are washed from the surface into the karst by suffosion processes.

Odolina (Figure 4.2.18) is a typical blind valley of Matarsko Podolje and one of the three located on the Slovenian side of the geopark area. The Odolina sinking stream drains an area of 4.3 km². Near the

Figure 4.2.18: The bottom of the Odolina blind valley is covered with coarse-grained siliclastic sediments of Quaternary age, derived from flysch. The stream on the left side sinks as a waterfall into originally phreatic 117 m deep ponor cave at high water flows (Photo: Matej Blatnik)

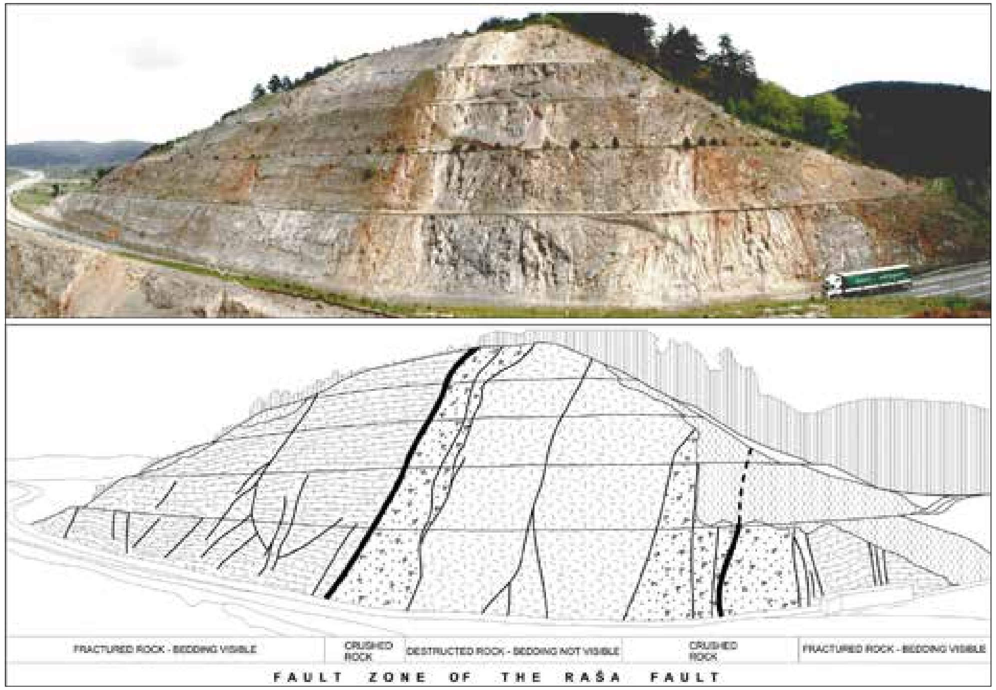


Figure 4.2.19: On the Zajčica section of the highway near Senožeče, we can see a cross-section of the almost 100-metre-wide fault zone. From the vantage point on the other side of the highway, where there is an explanatory board, we can see the typical zoning of rock deformation within the inner and outer fault zones. In the inner fault zone, we see crushed rock followed by the destructed rock in which the bedding is not preserved. In the fractured rock of the outer fault zone, the original bedding of the limestone is still visible. The northeastern tectonic block (left) consists of layered limestone of the Upper Cretaceous rudist limestone, and the southwestern block (right) consists of layered Upper Cretaceous-Lower Paleocene limestones.
(Photo: Ladislav Placer, Bogomir Celarc. Drawing: Ladislav Placer)

transition of the stream into the limestone, the narrow river valley widens and forms a blind valley 1 km long and 300 m wide, cut 60 m into the karst plain at its end. At normal water levels, the stream sinks into the riverbed immediately upon reaching the limestone, while during heavy rains the water sinks into the 117 m deep originally phreatic ponor caves. The bottom of the blind valley is covered with coarse-grained siliclastic Quaternary sediments derived from flysch. In the ponor cave of the Jezerina blind valley, for example, no significant deposits of clastic sediments have been recorded for the last 12 ka, as flowstone has begun to grow on alluvial sediments. These alluvial sediments are presently cut by river erosion, and alluvial dolines and sinkholes up to 25 m deep have formed on the floor of the Odolina blind valley.

4.2.11 The Raša Fault zone (geosite n. 38)

Several long, regional faults run through the Outer Dinarides in southwestern Slovenia in a NW-SE direction, which were formed in past geological periods. One of them is the Raša Fault (Figure 4.2.19), named after the Raša River on the edge of the Classical Karst Plateau. The Raša Fault runs almost in a straight line from the edge of the Southern Alps near Gemona to Ilirska Bistrica and further to the southeast, probably across the Velebit. It is one of the faults along which the North Adriatic Block is laterally displaced and thrust under the Southern Alps. Based on the location of the seismic foci, it is assumed that the Raša Fault is seismically active today southeast of Mt. Vremščica, while seismic activity along this fault in the Classical Karst and Friuli area is less reliable.

4.2.12 Caves of the Classical Karst

The geological evolution of the geopark is best reflected in the karst caves formed in the Reka/Timavo hydrogeological system. One of the largest cave spaces has been formed here, not only in Europe but also in the world.

The Škocjan Caves (geosite n. 53) are a 6,550 m long and 223 m deep cave system consisting of eleven karst caves, four of which have separate entrances on the surface (Figure 4.2.20).

These active and relict or fossil speleological objects are connected to the karst surface through the Mala and Velika dolina collapse dolines. Most of the caves were formed in the Cretaceous thick-bedded limestone and only a small part in Paleocene bedded limestone. Although Škocjan Caves can be defined as a water cave formed by the sinking Notranjska Reka River, the main cave is generally divided into a water part (Šumeča jama) and a dry part (Tiha jama). The river first sinks into the Mariničeva and Mahorčičeva Caves, 80 m below Škocjan Village at an altitude of 317 m above sea level. It then flows on the surface in the Mala dolina, crosses under the natural bridge

Figure 4.2.20: The Notranjska Reka river sinks into Škocjan Caves below Škocjan and Matavun Villages. Before disappearing into the underworld for the last time the Reka appears in Mala and Velika dolina collapse dolines (Photo: Matej Blatnik)

(called Okno) and finally sinks into a major part of the Škocjan Caves below the viewpoint in the 160 m deep Velika dolina at 269 m above sea level. In the central part of the Škocjan Caves, the Notranjska Reka River flows through several halls, and further into the Hanke Channel, which is the longest single cave channel in the caves, with a length of about one kilometre, a width of 10-15 m, and a height of up to 90 m, the largest underground canyon in Europe (Figure 4.2.21).

The Hanke Channel is followed by two large halls, the second of which, the Martel Hall, is the largest known underground hall in Slovenia and second largest in Europe. It is 308 m long, 89 m wide on average, 123 m at its maximum, 106 m high on average and 146 m high at the highest point. The volume of the hall is 2,550,000 m^3. At the end of the Martel Hall, in the Martel Lake, the lowest point of the cave is located at 214 m a.s.l. The Martel Hall (Figure 4.2.22) is followed by a 1.5 m high and 9 m long passage to the Marchesetti Hall. Behind the siphon of the Marchesetti Lake, another 680 m of passages have been discovered in the last twenty years. Under the ceiling of Martel Hall, a fossil tunnel about 350 m long was discovered in 2020, which cavers reached through an entrance dug directly from the surface.

The Tiha jama is a dry fossil channel of the Škocjan Caves. Due to difficult access from the direction of the Šumeča jama (70 metres steep wall), it was discovered relatively late compared to the other passages of the Škocjan Caves. The Tiha jama is 525 metres long and lies between 340 and 350 metres a.s.l. Today, access to the Tiha jama is through an artificially dug tunnel from the collapse doline Globočak, while the Tiha jama and Šumeča jama are connected over the Hanke Channel gorge with the Hanke Bridge.

Some 800 metres of undiscovered passage separate the Škocjan Caves from Kačna Cave (geosite n. 49), a cave west of Divača, with an entrance at an altitude of 435 metres (Figure 4.2.23). It is 280 metres deep and consists of a network of channels about 20.5 km long, located between 154 m and 290 m a.s.l. This currently makes it the third longest cave in Slovenia after the Migovec Cave system and the Postojna Cave system.

Figure 4.2.21: Up to 90 m high, the Hanke Channel - the largest underground canyon in Europe with the Hanke Bridge (Photo: Matej Blatnik)

Figure 4.2.22:
With a volume of over 2.5 million m^3 the Martel Hall is the largest known underground hall in Slovenia and second largest in Europe (Photo: Matej Blatnik)

Figure 4.2.23:
The 186 metres deep entrance shaft of the Kačna Cave widens into 60-metre-high entrance hall in the lower part (Photo: Matej Blatnik)

The first explorations of the cave were related to the search for water resources for the supply of Trieste and the search for the underground course of the Reka/Timavo River. The bottom of the entrance shaft was reached in 1891 by A. Hanke with the help of local people. In 1895, under the direction of J. Marinitsch, the locals built a path through the entrance shaft to facilitate access to the cave.

The entrance to the cave is a large doline, at the bottom of which opens a 186 m deep system of parallel shafts. These all eventually come together and end at the ceiling of the 60-metre-high entrance hall. The Kačna Cave has two distinct levels in terms of the position of the galleries which also differ in orientation. The river appears at normal water level in a siphon near the Risnik collapse doline at an altitude of about 200 metres a.s.l. and disappears in a drainage siphon at an altitude of 154 metres. Depending on the hydrological characteristics, the cave can be divided into three parts: 1) the active channels, which have gravitational profiles, 2) the high water channels with the highest permeability and 3) other channels

Figure 4.2.24: Vilenica, the oldest show cave of Europe. Tourists have been able to admire its beauties since the 17th century (Photo: Peter Gedei, Jamarsko društvo Sežana archive)

that discharge flood waters formed in different directions following different geological structures. During floods, the water level in the cave rises about 126 metres.

The question why the development of Škocjan Caves channels compared to the Kačna Cave channels experienced completely different development still remains open. The Škocjan Caves have a single, wide, oval channel that winds and splits, forming a canyon up to 90 m deep, while the Kačna Cave is characterized by two levels of main channels that develop at different heights.

All the caves where the Reka/Timavo River watercourse is encountered are extremely important from a scientific point of view, because they allow us to see and study the karst aquifer "in situ", which is often considered a "black box". In this way, we can directly verify the characteristics of the aquifer itself, which we can normally only determine using data from springs and/or sinkholes and precipitation.

For the study of the geological (tectonic) and geomorphological evolution of the area, the relict or fossil and roofless caves are of particular importance. They are older and lying higher in the vadose hydrogeological zone than the previously described caves, which still actively discharge groundwater. Between Divača and Sežana there are several rather large relict/fossil caves, which represent the former main drainage paths of the Karst aquifer formed in the flooded, i.e. phreatic, hydrogeological zone. During the later tectonic uplift of the Karst, they "hung" in a vadose hydrological zone and could be defined to some extent as the former, now abandoned underground riverbed of the Reka/Timavo River. A characteristic cave of this type is Vilenica (geosite n. 24) (Figure 4.2.24), one of the longest (841 m) and deepest caves in the Classical Karst. It is located in the Sežana Karst and with its current depth of 190 m and its location between Kačna Cave and the newly discovered water caves (Jama 1 v Kanjaducah, Brezno v Stršinkni dolini-Jama Sežanske Reke) it is perhaps still connected with the Reka/Timavo River in its lower part. The cave channels in the part of the cave that is arranged for tourist visits are spacious and decorated with beautiful flowstone.

Vilenica is considered to be the oldest tourist cave in Europe and probably in the world. The data show that the owner of the land, Count Petači, began to receive income from entrance fees as early as 1633 when he started to share it with the church of St. Mihael *in Lokva*. The cave was well visited during the tourist boom until the middle of the 19th century and was known as the most beautiful and largest cave in the Karst. Since 1980, literary evenings have been held in the cave, and since 1986, the Vilenica International Literary Festival - a meeting of poets and writers from all over Europe – when also Vilenica Prize is given to a Central European author for outstanding achievements in the field of literature and essay writing.

The Claudio Skilan Cave (5070/5720VG) (geosite n. 48) opens up near Basovizza-Bazovica and, with its depth of 378 m and total length of 6,400 m, is the deepest explored cave in the Classical Karst. Opened in 1990 and explored in the following years by the "Carlo Debeljak" Cave Group, which equipped the first shafts with ladders, it has two levels of sub-horizontal conduits. The former is located at a depth of about 40 m and is small, while the latter, at about 180 m of depth, consists of a series of large tunnels with diameters ranging from 20 to 40 m that run for more than 2 km in a NW-SE direction. Some of the galleries are richly concreted with impressive gour and stalagmite groups. It has a complex path with several large, deep pits which intercept groundwaters during floods.

Figure 4.2.25: The Skilan Cave, crystals in the terminal part of the Brena Branch (Photo: Sandro Sedran S-Team)

Figure 4.2.26: Lindner Hall, on the bottom of the Trebiciano-Labodnica Abyss during a flood in 2011 (Photo: Alberto Maizan)

In the sphere of speleology, the Trebiciano-Labodnica Abyss (3/17VG) (geosite n. 5) is certainly one of the best known caves in the world.

The development of trade that led to the city of Trieste becoming the busiest port in the Mediterranean in the 19th century brought about a rapid increase in population, which tripled within a few years.

The city authorities were forced to impose strict measures to ration the water available in times of drought. Various initiatives were then undertaken to find an alternative source. On the Karst Plateau, so-called “blow-holes” were identified (see Chapter 3.6) and in the most promising one, near the village of Trebiciano-Trebče, excavations were begun in 1840. Five months after starting the digging and at a depth of over 300 m, the quarryman Luca Kral and the miner Antonio Arich (Arič), coordinated by Antonio Federico Lindner, reached a large cavern, at the bottom of which the waters of the Timavo River flowed. For the period, this was such an extraordinary feat that for over eighty years the Trebiciano-Labodnica Abyss was the deepest explored cave in the world. A year after the discovery, fixed ladders were placed that allowed easy access to the cave and enabled the study and monitoring of the waters’ hydrodynamics. The cave became a point of attraction for speleologists and scholars from all over the world. Even today, part of the wooden staircase that was last renovated in the early 1900s can still be seen in the access pit to the large terminal cavern, which was named after Lindner. Cave explorations did not end with the discovery of flowing water, but continued over time. In the early 1950s, the first cave-diving explorations were carried out by Walter Maucci and Stefano Bartoli. This was an epic feat achieved with rudimentary equipment and gear that led to the exploration of more than 60 metres of flooded conduits and halls, allowing the reaching of a flooded hall called Lake Boegan in honour of the illustrious Timavo researcher. For the period, it represented a world record for the length of the siphon explored. In the years that followed, further cave-diving explorations were undertaken by numerous other groups until the current expeditions, led by a team of French cave-divers from the *Fédération Française d’Études et de Sports Sous-marins* (FFESMM) in Marseille, in collaboration with the *Società Adriatica di Speleologia* (SAS). In the summer of 2022 this led to the discovery of the exit siphon and the identification of a large new cavern (160 m long, 50 m wide and 60 m high) below the 7 Nani doline blow-hole near Trebiciano-Trebče (Figure 4.2.27).

Figure 4.2.27: Newly discovered cave in the summer 2022 (Photo: Patrice Cabanel)

Figure 4.2.28: The entrance to the Lindner Cave (Photo: Franco Cucchi)

The A.F. Lindner Cave (829/3988VG) (geosite n. 22) opens up near San Pelagio - Šempolaj at an altitude of 179 m a.s.l. and has a depth of 176 m for a total length of 825 m. The entrance is on the northern edge of the vast geosite called Karrenfeld at San Pelagio-Šempolaj and Lindner Cave, in an elongated doline, the relict of a cave section brought to light by surface levelling, part collapse doline, part roofless cave (Figure 4.2.28). The cave consists of a large main tunnel inclined at 40° to the SW, richly concreted, which is occasionally inundated during floods, in close connection to the Timavo Springs, less than 7 km away (Figure 4.2.29).

At first glance, quite insignificant, but scientifically one of the most important caves in the Classical Karst is the rather small 226 m long and 46 m deep cave Grofova jama Cave (geosite n.11) or Brezno na Gr-

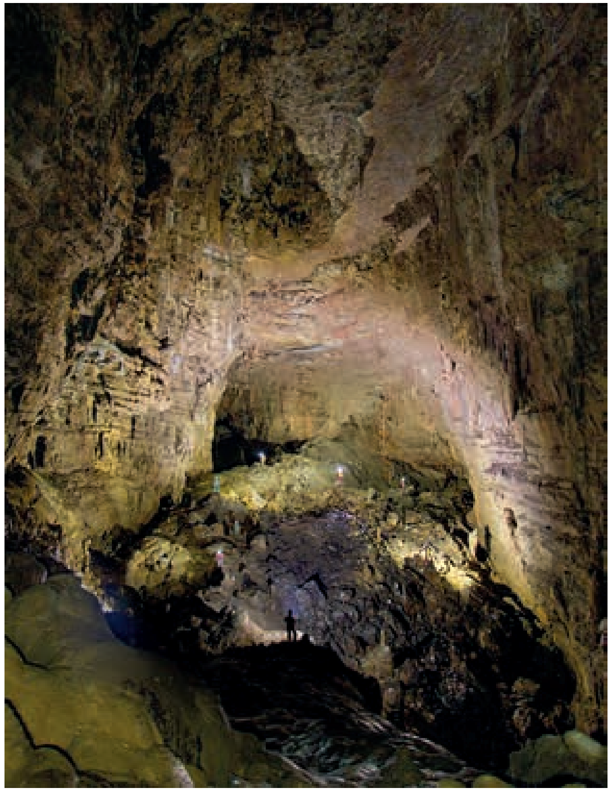


Figure 4.2.29: The broad conduit in the Lindner Cave (Photo: Sandro Sedran S-Team)

Figure 4.2.30: Grofova jama Cave was converted into a shelter and a field hospital during World War I. However, the special value of the cave is the section of the cave sediments consisting mainly of the clay mineral montmorillonite. (Photo: Bojan Otoničar)

madi (Figure 4.2.30). It is located on the northern slope of Mt. Grmada on the NW edge of the Classical Karst above Brestovica pri Komnu in the immediate vicinity of the state border with Italy at an altitude of 275 m, about 150 m above the flat surface of the plateau.

The special value of the cave is the profile of the clay cave sediments, several metres high, consisting mainly of the mineral montmorillonite. Recent research has shown that these are the oldest known cave sediments in south-western Slovenia. The montmorillonite fill derived from volcanic ash that had previously weathered on the surface, most likely from one of the eruptions of the Smrekovec volcano in northern Slovenia, but perhaps also from one of the volcanoes in the wider Mediterranean region. According to various dating methods, the montmorillonite clay was most likely deposited in the cave about 10 million years ago.

4.2.13 The Duino-Devin Cliff (geosite n. 9)

Between Sistiana-Sesljan Bay and the ancient fortress of Duino-Devin, sub-vertical limestone layers give a stretch of coastline a characteristic overhang. On a small scale, the cliffs offer elements of great interest such as surface karst features of rare beauty and development. It is also characterised by an outcrop of richly fossiliferous and petrographically distinctive rocks. Among the latter, special attention should be paid to the unusual condensed Lower Cretaceous-Paleocene lithostratigraphic succession. Discontinuous lenses of pinkish to brown calcareous breccia, bauxites and very rare vadose pisolites and concretised gour deposits of a Cretaceous paleocave precede the Cretaceous Paleogene transition by a few metres. The cliff reaches a height of 90 m and its edge can be closely followed along the Rilke Path, the walk that German poet Rainer Maria Rilke used to take during his stay at Duino Castle (1911-12) as a guest of Princess Maria della Torre e Tasso (*Thurn und Taxis*). Along the path, from which there is a wide panoramic view stretching from the Gulf of Trieste to Koper-Capodistria and the Istrian coast, to the Grado Lagoon and the outlet of the Soča-Isonzo River, one can observe all kinds of epigean karst morphologies, the whiteness of which stands out when set against the colour of the sea and that of the varied vegetation.

4.2.14 Timavo Springs (geosite n. 5)

The Timavo Springs at San Giovanni di Duino-Štivan consist of four outlets collected in three 'branches' from which most of the water infiltrating the Classical Karst emerges with an average output of 30 m^3/s, a minimum of 7.4 m^3/s and a maximum of 158 m^3/s. A complex system of flooded caves called the 'Timavo Complex' extends upstream, connecting the springs with the Timavo Cave (1844/4583VG) and the Pozzo dei Colombi Cave (215/227VG). Cave-diving explorations carried out over the years (in particular the 'Timavo' and 'Timavo System Exploration' projects) have reached a depth of 82 m below sea level and detected more than 1,500 metres of tunnels. Technical and logistical difficulties due to the turbidity of the water, with poor visibility (just over a metre in good conditions) and the depth and the speed of the current have prevented further exploration, but the underground course of the Timavo System is likely to have a total development of several tens of kilometres. The course of the river then continues for less than 2 km until it flows into the Gulf of Panzano in the Adriatic.

Near the first branch is the Church of San Giovanni in Tuba, built on early Christian foundations, while a short distance away is the archeological site of a cave that is the site of a Mithraic temple, the Grotta del Dio Mithra Cave (1255/4202VG), a place of worship in Roman times, while just over a kilometre away are the thermal springs at Monfalcone (geosite n. 4).

Figure 4.2.31: The central section of the cliff pictured from the sea (Photo: Luca Zini)

Figure 4.2.32: Timavo Springs, 1st branch (Photo: Luca Zini)

KARST AND MAN

Figure 5.1.2: The Cava Romana of Aurisina-Nabrežina Quarry: on the left the excavations on the slope, on the right the excavations in the tunnel (no longer active) (Photo: Giancarlo Massari)

5.1 Classical Karst stones

Limestone rocks are generally excellent building stones. The stratification also isolates large blocks that can be easily extracted, while the diagenesis ensures good geomechanical properties and the variety of colours allow diversity in architecture. Walls, churches, simple or impressive buildings, towers, bridges and paving stones are therefore scattered throughout the villages. This compactness, homogeneity and workability allow artists and craftsmen to create simple or magnificent works of art that decorate the houses and squares.

In some areas of the Classical Karst, sedimentary and diagenetic processes have favoured the formation of particularly compact, homogeneous and poorly divided horizons from which large blocks suitable for use as architraves, load-bearing columns, doorposts, window frames, and blocks from which statues, sculptures and urns can be made. This type of limestone is often called "marble of the Karst" (Figure 5.1.2).

Figure 5.1.1: People have always worked with stone in the Karst. Over the course time this ancient knowledge was in danger of vanishing, but it has been revitalized through the commitment of enthusiasts and experts passing on this ancient knowledge and the cross-border Partnership of Karst dry stone construction which started within the UNESCO program Man and Biosphere. The Kamenton action in autumn 2022 at Basovizza-Bazovica (Photo: Sara Bensi).

The stones of the Karst are not "marbles" in the geological sense, that is, they have not undergone metamorphic processes that have modified their original petrographic and mineralogical properties. They are limestones, carbonate organogenic sedimentary rocks. The chemical composition has a $CaCO_3$ content of over 98% and a $MgCO_3$ content of less than 1% with insoluble residues in traces. The imbibition coefficient is very low, the values of resistance to compression, flexion, impact and wear are excellent, and the thermal expansion coefficient is insignificant.

In short, from the commercial point of view all the stones are an excellent "marble", that is, a lithotype with a Mohs hardness of 3-4,

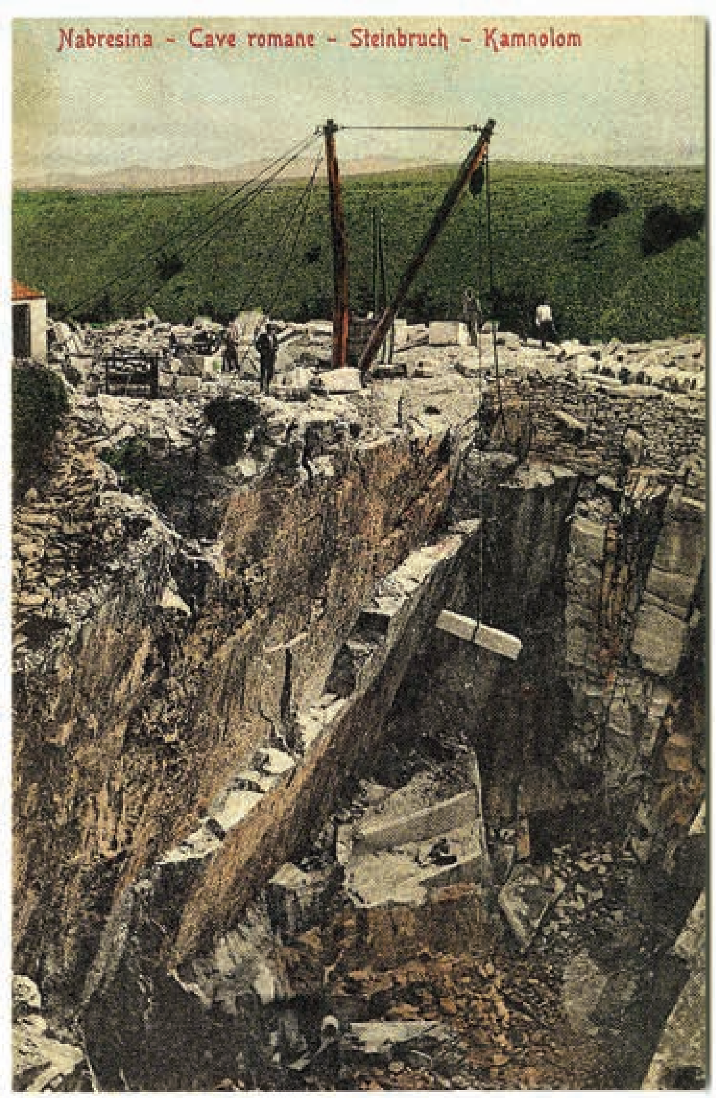


Figure 5.1.3: Photograph of Aurisina-Nabrežina Cava Romana on a period postcard

which can be polished and is suitable for decoration and usable in various fields of construction and furniture production.

Given the variability of the sedimentary environments that characterized the Adriatic-Dinaric carbonate platform in the Cretaceous, there are currently several types of ''Karst marbles'' on the market: *Aurisina Chiara, Aurisina Fiorita, Aurisina Granitello, Roman Stone, Fior di Mare, Repen Classico Chiaro, Repen Classico Zolla, Lipica unito, Lipica fiorito* and *Kopriva*. Besides the types still in production today, the Komen platy limestone (Figure 5.1.6), the colorful Karst breccia, the red or yellow flowstone and the black Gabria were all quarried.

The Aurisina varieties were widely used in Roman times, and the Repen and Lipica were used over time for domestic purposes given their substantial impermeability.

From the material traces and also from the written sources or oral tradition, it is clear that in the 18th and 19th centuries there were more than 400 limestone quarries on the Classical Karst. The oldest traces of stone extraction can be found in the Aurisina-Nabrežina basin in the upper part of the walls of the *Cava Romana* (Figures 5.1.2 and 5.1.3).

In addition to the large quarries used since ancient times, where the morphological and lithological conditions favoured the extraction of blocks, people opened small quarries from which were extracted the useful material for the construction of houses, sacral and public buildings, walls and roofs. Apart from the convenience of having the production sites close to places of use, the choice of materials had to take into account the chromaticity, uniformity, decorativeness, and the technical and physical-mechanical characteristics in line with the intended use: external or interior, ornament or structure, workability or hardness..

Since the earliest settlements, almost the entire population was involved in some way in the process of stone extraction. The local population specialized in the work in quarries or in stone cutting, organizing themselves into several stonemasonry workshops. Until the beginning of the 20th century, in this area practically every family had at least one member involved in one of the activities and gained modest income from it.

The process of stone extraction has changed over the centuries. In roman times, the work was done both in open pits and underground. Stone blocks were cut by digging grooves with picks and chisels, detaching them with wooden wedges, later with wet or iron wedges, before being beaten or forced with long iron levers. This was followed by a process outside the quarry with pointed chisels from large to fine and bush-hammers or hammers with teeth from large to fine, until blocks or suitable boulders were obtained. To move the stones, cylindrical rods, the *curuli*, were used, while to lift them *capre* using a pulley, the *trochlea*, and the *machinae tractoriae* (with several pulleys) were used. Transfers of stone over a distance saw winches employed, the *sucule*, while to hook the blocks, in addition to simply placing them in a sling (but the rope hindered the placing), the ropes were tied to nuts or studs placed on the side faces, or *ferrei forfices* were used. These were iron scissors or multi-element *olivelle* introduced into lateral holes or in the centre of the upper face.

Figure 5.1.4: Mausoleum of Theodoric in Ravenna with a roof, made of a single block of Aurisina-Nabrežina limestone (Photo: Franco Cucchi)

From the second half of the 1800s, explosives and gunpowder were used. In the early 1900s drills using compressed air and the helical wire came into use and employed extensively in Karst until the early 1980s. In recent decades, the most modern techniques require the use of a diamond wire or a diamond chain cutting machine.

Depending on the type of quarry, on a slope or in a pit or well, the way the blocks are handled has changed considerably over time. In the first type, the blocks were transported by inclined paths and winches. In the second type, the movement of the blocks (but also of the waste) could only be done with the help of powerful lifting equipment (derrick cranes), which until recently were indispensable in quarry operations. Nowadays, the lifting of block is carried out by powerful mechanical shovels.

The first to appreciate the limestone were, of course, the inhabitants of the *castellieri*, the fortified villages built on the hilltops. Apart from its use for the construction of ordinary houses, the use of Karst stone for larger and more important buildings began with the expansion of the Roman city of Aquileia and its port in 100 C.E.

At the beginning of the first millennium, the presence of Karst stone in *the X Augustean Region Venetia et Histria* was mainly related to sepulchral use, with urns sealed with lids, epigraphs, stelae and altars distributed along the two main routes, the *Via Julia Augusta* and the *Via Postumia*. Then Aquileia gradually gained strategic and economic importance, so the construction of temples, forums, theatres and other buildings began. The stone blocks arrived at the stonemasonry workshops in Aquileia, were worked on site and then distributed within the city and the surrounding area. The greatest distribution of Karst stone took place between the 1st and 3rd centuries C.E. The blocks were quarried in the Aurisina-Nabrežina area and sent to Aquileia or *Tergeste*, across the Adriatic Sea from the Sistiana-Sesljan Bay. In *Tergeste*, on the *Capitolium*, there were numerous monumental buildings made of karst stone, which allowed considerable savings compared to imported stone materials, but still guaranteed solidity and magnificence.

Among the blocks quarried in the quarry of Aurisina-Nabrežina, the most famous is the *ingens saxum*, the monolithic roof of the Mausoleum of Theodoric in Ravenna (Figure 5.1.4), which since 1996 has been a UNESCO World Heritage Site. It is circular, with a diameter of 10.76 meters and a thickness of 3.09 meters, which means almost 300 tons of rock! It is still a mystery how the block was ex-

Figure 5.1.5: Most valuable Karst stones are Lipica fiorito (top left) and Lipica unito (bottom left) from the Lipica Quarry (which correspond to the Aurisina Fiorita and Aurisina Chiara types from Aurisina-Nabrežina Quarry), then Repen (top right) and Kopriva (bottom right) types of limestone from the Doline Quarry (corresponding to Repen Classico Zolla and Repen Classico Chiaro in Italy and the boutique dark Kazlje limestone (Photo: Bogdan Jurkovšek)

cavated, how it was transported to Ravenna and how it was placed (around 520 C.E.) on the decagonal - circular structure of the mausoleum at a height of fifteen metres.

There is little evidence of the use of Karst stones in important constructions from the Middle Ages and until 1700s, when Trieste and its surroundings gained importance as a free port of the Habsburg Empire. After the construction of the Southern Railway, the line that connected Vienna with Trieste (1857), the period of greatest wealth began for the Karst quarries. The use of the Karst stone quickly spread throughout the entire territory of the Empire and beyond. Aurisina-Nabrežina became the most important processing and distribution centre for stone from the entire area of the Karst and also from the Istrian region. The Aurisina-Nabrežina quarry provided the stone for several famous monuments, including several representative buildings in Trieste (the Greek Orthodox Church, the Stock Market, Miramare Castle), in Vienna (Burgtheater, National Opera, Hofburg and Parliament), the railway station in Milan (1930), Budapest and other European cities, as well as the entrance to the Suez Canal.

Nowadays, in the Slovenian part of Karst only two companies own the concessions for limestone extraction. The first company quarries stone blocks in several locations including Kopriva (*Kopriva Limestone*), Doline (*Repen* and *Kopriva Limestones*) and Lipica (*Lipica unito* and *Lipica fiorito Limestones*) (Figure 5.1.5) (see also Chapter 4). The other small company has a quarry in Debela Griža pri Povirju (*Repen Limestone*).

As far as the Italian part of the Karst is concerned, in the Aurisina basin there is a small company and a consortium which includes some concerns that exploit several quarries. The quarried material is purely local: Aurisina chiara, Roman stone, Aurisina fiorito and Aurisina granitello. In the Zolla and Rupingrande area a third company quarries the Repen and Fior di Mare varieties.

The quarries in the Karst area were important, and must be preserved, because quarrying is part of the tradition and identity of the area. Nevertheless, it is necessary to take into account the aesthetic and the environmental vulnerability of the area. Abandoned quarries are often an impressive element of the cultural landscape, especially where quarrying and stonemasonry were the main economic activity of an entire area. They are perceived as “wounds” in the natural environment, but today they offer other possible uses. In all operating quarries and in potentially interesting deposits of dimension and technical stone, quarrying should be possible only if high environmental standards are met. Smaller quarries should be preserved to allow limited extraction of those karst (Figure 5.1.6) stone varieties suitable for restoration of authentic karst architecture.

Figure 5.1.6: Abandoned surface extraction of the Komen platy limestone in Gabrovica (Slovenia), used for roofing and paving (Photo: Bogdan Jurkovšek)

5.2 The Karst / Kras / Carso as a cultural landscape

Stone is the undisputed protagonist of the Karst cultural landscape, from prehistoric times down to the present day. It was this stone that enabled cultures to erect constructions in both urban and rural areas from prehistory, right up until the 20th century saw it give way to concrete. This centuries-old practice created a specific Karst landscape composed of a network of countless dry-stone walls and a variety of stone buildings – shepherds' shelters, houses and villages, hillforts and castles, churches and chapels. The same stone has been collected, cut, erected and used for civil, military and religious purposes for generations. The traces we can still find today are evidence of an uninterrupted will and ability to exploit this distinctive material of the Karst: its limestone.

The *castellieri/kaštelir/gradišče*

The oldest buildings in the Karst are its hillfort settlements *(*called *castellieri*, *kaštelir, gradišče)* dating back to the Bronze and Iron Ages, these were small villages, built on hilltops and fortified for defensive purposes. They are made up of stones placed one on top of the other, often erected dry and surrounded by one or more concentric walls of a fairly massive circular or elliptical shape, within which the inhabited area was laid out, and the perimeter of which could be usually up to one kilometer in length (Figure 5.2.1).

These settlements were generally located on hills or in dominant positions, following the natural configuration of the land. There are hundreds of them, in a range of shapes and sizes, depending on their age and the site's local morphological characteristics. The *castellieri/ gradišča,* which first arose as temporary camps for shepherds, later became permanent settlements and remained so for more than a millennium, from the 15th to the 3rd century B.C.E. They lost their residential function with the arrival of the Romans, when they were transformed into military garrisons and largely reduced to ruins during conquests. On the basis of the archaeological material found in these ruins, it has been possible to reconstruct the living conditions, uses and customs of the communities in the area of the Karst from the Iron Age through to the first Roman settlements. With the arrival of the Romans new urban patterns were introduced, creating commercial, administrative, and religious centres. New settlements were built in the plains below the forts, in the most favourable locations close to farmland, where in most cases they still stand today.

Figure 5.2.1: The prehistoric lowland hillfort settlement Debela griža near Volčji Grad (Photo: Roberto Valenti)

In the tumultuous time of Late Antiquity, when the foundations of the Roman state began to crumble in these places, the focus of settlement again moved to more remote and difficult to access places. Some hillfort settlements were re-fortified and used until the decline of the Roman Empire, while others have survived until the present day. This dual pattern - with settlements in the plain and hillforts above - characterises the Karst's cultural landscape to this day. In the Middle Ages, fortresses *(rocca/tabor)* as well as castles were built on the sites of former fortifications.

The Gradec at Rupinpiccolo-Repnič is a good exaple of a hillfort where the original walls were preserved enough to be partly reconstructed and presented to the visitor. On a low hill, in addition to the remains of the walls, you can see the gates of the *castellieri* from the early Iron Age.

Another important fortress is that of *Tabor* or *Rocca* of Monrupino-Repentabor (Figure 5.2.2). This place features the stratification of buildings from different periods, on a hill in a strategic position that on one side dominates the Karst of Trieste and, on the other, the Slovenian sector. It was initially a prehistoric hillfort, then a fortified Roman *castellum*, and finally a defensive fortress against the enemies. The hillfort of Monrupino-Repentabor, whose stone walls can be admired halfway up the hill, is the largest in the area, covering 1,600 square metres and one of the best equipped. It is the best-preserved *tabor* in the Karst. Tabors are fortified settlements, usually with a church, which served as refuges during Turkish invasions and are present throughout Slovenia. At that time, from the top of the Tabor they signaled the approach of a threat by lighting bonfires.

Figure 5.2.2: Community house of Rocca di Monrupino-Tabor (Photo: Sara Bensi)

A prehistoric settlement also occupied the whole upper part of the Štanjel hill located at the edge of a Karst Plateau. It controlled the better part of the Komen Karst as well as the passages through the Raša and Branica River valleys. According to the finds of an archaeological investigation, the beginnings of the settlement date back to the Bronze Age but most of the finds date back to the Iron Age. The rich layers of the settlement and the remains of prehistoric buildings built of dry stone walls confirm that the hill was intensively inhabited in the first half of the 1st millennium BC, in the Early Iron Age. The remains of Roman architecture and numerous Roman finds on the Štanjel hill reveal that this was an important Roman settlement and a late Roman outpost. In the late Roman period, a fortress or tower stood on top of the hill and was used by the soldiers to control the passage to the Vipava Valley. The area of Gledanica provides good visual communication with the mountain pass on Hrušica (*Ad Pirum*), through which the main Roman road ran from Italy (Aquileia) to the Ljubljana basin (*Emona*) and further toward Pannonia. The remains of a ruins on top of the hill is most likely a remnant of a tower from the 13th or 14th century. A village settlement was formed below the tower, which gradually transformed into a fortified *tabor*.

Also worth mentioning is the Slivia-Slivno hillfort, the remains of the wall and the ramparts can still be seen. It was built in the Middle Bronze Age, and was inhabited for almost the entire Iron Age. It is one of the most significant *castellieri* in the Italian part of the Karst and is known for its very rich archeological remains.

Vahta pri Kazljah is one of the largest and better-preserved *gradišče* in the Slovenian part of the Karst. This prehistoric site of extraordinary dimensions has a double ring of defensive stone walls, which are almost completely preserved. Of same importance and well preserved is the hillfort called Debela griža at Volčji grad. Hillforts in Brestovica, Sveto pri Komnu, Lipovnik nad Škrbino, Temnica,


Figure 5.2.3: Dry stone wall (left) and hiška (right) are characteristic cultural landscape elements of Karst (Photo: Sara Bensi)

Kobdilji, Škocjan pri Divači, Povir, Tomaj, Rodik and elsewhere have also been preserved.

Typical remains of architectures of the late Middle Ages are, in addition to the Rocca di Monrupino the preserved towers in Dolenja vas and Lokev. However, perhaps the most eminent example of medieval defensive architecture is the castle of Duino-Devin.

Dry stone walls *and hiške*

The local stone, already used in the Bronze Age for the construction of *castellieri/gradišča,* was also used as a building material for the dry-stone walls; a technique that it made possible to reclaim agricultural land, protecting soil and plants from the powerful, cold bora wind, and at the same time divide up properties. The low walls have become a characteristic feature of the landscape of the Karst Plateau, characterized by water scarcity and a shallow, rocky soil that, largely unsuitable for agricultural activities, is mostly used for grazing.

Outside the settlements, usually on the edges of the fields and next to the dry-stone walls, special circular, walled structures and a corbelled roof were built. These are called *hiške* and are primitive shelters used by shepherds or farmers who worked in the fields far from the villages (Figure 5.2.3). In almost all cases, they are simple architectural structures with a single room, sometimes using the large limestone blocks available in nature. The *hiška* is built with overlapping stone slates that once they reach the desired height, converge towards the center, forming a pseudo-dome. The average area of each is about 2 square metres (varying from a minimum of 0.8 to a maximum of 4.9 m^2) and the average interior height about 1.6 m. They are mostly cylindrical and prismatic in shape. The door opens into a shelter, facing away from the east - north-east direction, from where the bora blows.

The Karst house *(kraška hiša)*

The houses are usually small and single unit, sometimes with an additional, often separate kitchen *(spahnjenca)*; or slightly larger structures with a second floor and an external staircase, usually representing the residential part of a homestead with a walled courtyard *(borjač)*. The traditional Karst house is built of raw or semi-processed stone obtained sometimes also from the clearing of fields and pastures. The roof is constructed of wood (oak), while the roofing, initially of straw in the first phase, later saw stone slabs used and, much later, tiles. Together with lime and wood, the use of stone gave the inhabitants of Kras-Carso complete autonomy in the construction of their houses.

In Repen there is a Karst house, nowadays a museum, where you can discover the characteristic Karst architecture in all its facets and see furnishings, utensils and household items inside. It is a complex consisting of a closed courtyard *(borjač)* and stone gate portal *(kaluna)*. The house has a roof made of platy limestone, square windows with railings, doors with triangular and rectangular crosspieces and a set of stone stairs to reach the wooden balcony *(gank)* (Figure 5.2.4, left). Inside is the stone-paved kitchen with a bread oven, an open fireplace and a niche for the water tub. The buildings that overlook the courtyard include a stable, chicken coop, a manure pile, barn and a tool shed. Every two years at the end of August, the museum hosts a Karst Wedding (see Chapter 5.3), an important ethnographic event for local people (Figure 5.2.4, right).

The Karst House in Štanjel has also been renovated into a museum with an ethnological collection. There is a commercial part on the ground floor, and a living part on the first floor. Rainwater from the roof covered with stone slabs is channeled through the stone gutters into the monumental public well next to it, which testifies to the importance of water for the Karst. The house reflects the architectural peculiarities of the original karst houses built in the Romanesque and Gothic periods.

The Škrateljnova homestead in Divača is an impressive Karst homestead, that dates back to the 17th century, where the residential part was represented by the Skrateljnova hiša, a typical two-story karst house and a kitchen, added later. (Figure 5.2.4

and Figure 5.2.5). The facade of the building is very dynamic with steeply sloping roofs covered with tabular limestone slabs, while the roof covering the balcony is covered with brick tiles. The auxiliary buildings, including the hayloft and the stable, as well as the fenced pigsty and the wine cellar, have tiled roofs. The entire complex now houses the Museum of Slovenian Film Actors with a permanent exhibition in honour of the film actress Ita Rina, born in the town in 1907.

Figure 5.2.4:
Left - the Karst house in Repen (Photo: Roberto Valenti); right - a detail of the hause during the Karst Wedding in 2022 (Photo: Sara Bensi)

Figure 5.2.5:
The Škrateljnova hiša in Divača (Photo: Mitja Guštin)

Figure 5.2.6:
A fortified village of Štanjel (Photo: Jošt Gantar)

Villages

Over time, the shape of the villages has changed, stringing together houses and other buildings. In this way, long streets called *gase* were formed, so characteristic of Karst settlements in the Medieval period. Later, the houses were arranged around courtyards (*borjač*), with high stone walls, and a passage with a stone portal (*kaluna*). The buildings in the villages resemble each other in appearance and size. Even the architecture of the churches or fortresses does not differ too much from that of the houses. Limestone is the predominant material used in buildings and artefacts. Everything conceivable for domestic use that could be was made of stone, such as the linings of the wells, the guttering, the containers for lard and the feeding troughs for the animals.

Many villages, as a whole or at least in their centres, have preserved a Medieval design, with a network of streets connecting the individual homesteads. One of the most important showpiece of Karst architecture and culture is Štanjel (Figure 5.2.6). The compact village spreads out along alleys on the slope of the hill within defensive walls. On the eastern side the village gives way to the characterful Ferrari Garden from the period between the two world wars, designed by the important Slovenian architect Maks Fabiani. Below the entrance to the village stands a castle and a church, which together form a larger square with a fountain.

Sacral architecture

Almost every village in the *Kras-Carso* has its own church or at least a chapel, which are an all-important part of the harmonious Karst landscape. The Church of Our Lady of the Assumption in Šmarje pri Sežani is among those best-preserved (Figure 5.2.7), with an original Gothic style featuring a steep stone roof and a bell-gable above the entrance. The Church of St. Giles in Sveto near Komen is classified among the most important monuments of sacral architecture in Slovenia. The church has a unique octagonal nave, covered by an umbrella-shaped roof that is supported by a single, formerly wooden pillar. The Sanctuary of Monrupino-Repentabor preserves the 16th century structure of the buildings and walls, with the central body of the building resting on the internal shelf of the tabor, while the apse rests directly on the external cliff. In Rosandra-Glinščica Valley the ancient church of Santa Maria in Siaris - Sveta Marija na Pečah, built on a steep rocky spur, dates back to the 13th century. For a long time, it has been a destination for pilgrimages.

The castles

Above all, in the northern sector of the Karst stand the remains of castles, forts and fortresses of Medieval and modern foundation. The most notable is perhaps the Habsburg residence of Miramare Castle (Figure 5.2.8), overlooking the sea. To reach it, Maximilian of Habsburg had the railway station built in the mid-19th century along the historic Wien-Trieste railway line.

In the southernmost section of the Karst there are ruins of Medieval military buildings, which were built to protect the traffic connections and trade routes to Istra and Ljubljana, such as the castle of Moccò (*Muhov grad*) in Rosandra – Glinščica Valley.

The first railway

To connect the city of Wien with the southern part of the Habsburg Empire, and the port of Trieste, the "Südbahn" or "Southern Railway" was opened in 1857. To obviate the difference in height between Divača and Trieste, the railways had to be laid out amidst dolines and other Karst features, thus becoming an important component of this part of the Karst. For the same reason, between Trieste and Monfalcone, in 1928 a new Trieste coastal road was opened (the *Strada Costiera Trieste*), which crosses the Karst slopes just before a natural tunnel (Crepa Magna) up to Sistiana-Sesljan and offers wonderful views of the intertwining of rocky layers, across the bay, on the high slopes, on the cliffs below and across to Duino Castle on one side, and Miramare Castle and the city of Trieste on the other.

Figure 5.2.7: Church of Our Lady of the Assumption in Šmarje pri Sežani (Photo: Fabiana Pieri)

Figure 5.2.8: Miramare Castle in the Gulf of Trieste (Photo: Giancarlo Massari)

Military arcitecture

The numerous testimonies of the World War I and II left on the ground are 'open-air museums' where you can visit trenches, forts, tunnels, mule tracks and military shelters in a good state of conservation.

5.3 Agriculture, traditions and geoproducts of the geopark

The Karst is an area with a millennia-long history, which can still be read in both the material and abstract culture. Agriculture has always shaped the landscape and is reflected in its agri-food production, cuisine and popular festivals.

The area of the geopark is a distinctive place with a range of natural characteristics. These affect human activities, in particular agriculture and subsequently the local cuisine and related traditions, that have developed over time, and are still kept alive today. There are many local products, customs, and habits, often differing from one village to another. This chapter presents the most typical and important ones that represent the backbone for the sustainable tourism offer of the geopark.

5.3.1 Agriculture

Taking into consideration the geographical and historical context and adding all the natural characteristics of the geopark area (geological, hydrological, botanical, climatic and so forth) we can see that the area it covers is more or less a rural one, with small settlements where agricultural activities have been the main source of survival for centuries.

Traces of prehistoric land use and field division in the Karst suggest that the main activities were the breeding of cattle, small and large, as well as farming. The natural vegetation was forest that was extensively cleared, mainly for grazing, the production of hay and for cultivation. Deforestation accelerated water and wind erosion, which gradually transformed the Karst into a barren landscape over the last millennium. In the 19th century, systematic reforestation began, first unsuccessfully with oaks (*Quercus spp*.) and later, with greater success, using black pine (*Pinus nigra*). Economic changes and the development of the non-agricultural economy sectors in the second half of the 20th century contributed much to reduce the active farming population. The abandonment of agriculture led to intense natural vegetational succession of agricultural land, a process that is still ongoing. Another reason for the abandonment of fields and meadows is the unsuitability of Karst land for mechanized cultivation.

Figure 5.3.1: Grazing is a form of counteracting the loss of biodiversity due to natural reforestation (Photo: Roberto Valenti)

Throughout history the Karst and the neighbouring Brkini region have been a rural hinterland of Trieste. They supplied the city with foodstuffs, firewood, handicrafts and other products as well as ice. The latter was cut from *kal* (shallow Karst ponds with standing water) in the winter and stored in ice caves-*denice* - either natural or man-made. The temperature in them was constant, so the ice was preserved for a large part of the year. In the summer, they cut the ice, both exporting it and selling it in Trieste.

Climatic and edaphic (soil) conditions enabled the development of viticulture and fruit growing which are important branches of agriculture with a long tradition in the Karst. Fruit commonly grown in orchards include cherries, plums, peaches, and walnuts, and are usually for domestic use and not sold. Fruit growing is especially important in the south-eastern part of the area covered by the geopark, in Brkini. Here the conditions are more suitable and from the crops, they also produce dried fruit and brew and distil spirits. Other activities that also take place here include agricultural tourism, olive oil manufacturing, dairy farming, and cheese-making.

Viticulture is probably one of the most renowned local branches of agriculture and a major source of income. Despite the fact, that the Karst soil is rocky and barren, the area is a recognized wine-growing region with using major international grape varieties, but especially important are the autochthonous ones including Glera, Vitovska, Malvasia, Refosco, and Terrano (Figure 5.3.2).

5.3.2 Geoproducts

The geological nature of the area influences local production and in particular agro-food production, which are outlined in this section.

Teran (Terrano)

Terrano (Slovene *Teran*) is a Slovenian and Italian wine variety (not to be confused with a completely different grape variety also called Teran, which is indigenous to the Croatian part of the Istrian peninsula), bearing the mark of the recognized traditional denomination. It has been cultivated since antiquity, mentioned in Roman and Greek sources, as well as medieval German ones, and in the "Glory of the Duchy of Carniola," by the Slovenian natural historian and polymath Valvasor from the 17th century. It is a member of the Refosco family of grape varieties, but it gets its distinctive taste and colour from the Karst soil, known as the *terra rossa*. As such, it is inextricably linked to the specific carbonate bed-

Figure 5.3.2:
Karst vineyard landscape
(Photo: Bogdan Jurkovšek)

rock and is undoubtedly one of the most typical geoproducts. *Terrano* wine is produced solely on the Karst Plateau, both on the Slovene and Italian sides and is the principal red wine grape in this area.

Kraški pršut (Karst prosciutto)

Kraški pršut belongs to the group of Mediterranean air-cured hams and has an EU-protected geographical indication (PGI). The protection of the *Kraški pršut* comes from the natural and climatic characteristics of the Karst region, from the tradition and the transfer of knowledge of the locals to today's generation, from its long-standing reputation, and above all from its distinctive quality. It is a pig hind leg or thigh, dry-cured for a minimum of 9 months according to the traditional recipe which, together with the special Karst climate with the bora wind, develops the typical texture, colour, smell, and taste of *Kraški pršut*. The Karst climate is also reflected in other dry-cured meat products that are typical for the area: *zašink* (pork neck), pancetta, salami and so forth.

Brinjevec (Karst Gin)

Brinjevec (or *Brinovec*) is a strong alcoholic drink (between 40% and 50% alcohol), also produced within the geopark area. It is distilled from the ground and fermented Juniper (*Juniperus communis*, Slovene *brin*) berries only, and it differs from similar drinks that have different alcohol bases with added juniper flavour (compound Gin, Slovak *Borovička*, Dutch *Jenever*, Serbian *Klekovača*, etc.).

Brkinski slivovec (Brkini plum brandy)

This is a plum brandy made from local autochthonous plums. *Brkinski slivovec* is made in special copper pots solely in the south-eastern part of the geopark area and is a protected drink with a geographical indication (GI) under Slovenian regulations.

Karst honey

As a result of its geographical position and climate conditions, the Karst has a unique floral composition of grasses, clover, herbs, forest, and shrubs that offer varied foraging for bees, rich in aromatic substances, which is reflected in the specific, full, and lively aroma and intense colour of the honey produced.

In Slovenia, beekeeping has a long and rich tradition, and honey is produced under strict regulation and only by a nationally protected bee subspecies – the Carniolan honey bee (*Apis mellifera carnica*). Therefore, Slovenian honey (PGI), including Karst honey (PDO), is protected under national and EU legislation.

About a hundred beekeepers are active on the Italian side of the geopark, mostly small or medium-sized businesses, for a total of about a thousand beehives in the area. A special mention is merited for the Marasca cherry honey PAT, so-called "morello cherry" honey derives from the nectar of the Dog cherry or St. Lucia cherry (Prunus mahaleb), a shrub that typically grows on the carbonate substrates of the Karst.

Karst cheese

As it was mentioned above, the area covered by the geopark has a long tradition of dairy farming as well as a specific floral composition with lot of herb species. This results in a rich, distinctive aroma and taste of cheese, even without any additions to it. A specialty of the area is the cheese, made by a local farmer near Aurisina - Nabrežina, with a unique ripening process that makes it one-of-a-kind. Maturation takes place for the most part in a 70-metre-deep Karst cave and is also called *Jamar* (the Slovene term for speleologist or caver) for that reason. There is also a wine cellar in Komen, that ages indigenous Karst cheese under controlled temperature and humidity in an old štirna, a traditional Karst well, six metres below ground.

Tergeste olive oil

Tergeste extra virgin olive oil (PDO) is produced in the Italian part of the Karst, from Duino - Devin to San Dorligo - Dolina, and obtained from the *Belica Bianchera* olive varieties, which must make up at least 20% of the groves, combined with other common varieties. *Tergeste* oil is golden-green in colour with a fruity aroma and a light to mild piquant taste. With its rather delicate flavour, Tergeste is perfect for salads, vegetable-based cream soups, pasta, rice or fish dishes (Figure 5.3.3).

5.3.3 Cuisine

Karst cuisine, like its cultural landscape, is an intertwining of Mediterranean, Germanic, Romanesque and Slavic influences, especially distinguished by its commitment to local, preferably home-grown, ingredients. Karst cuisine is frugal and without unnecessary expense.

In the past dishes were simple, the food they prepared was very much tied to the season and to what they grew at home. The main role was played by vegetables: cabbage, potatoes, beets, beans, peas and corn. They ate various stews 2 to 3 times a week, most with frequently *polenta* – maize meal, and buckwheat. Sweet dishes, desserts and white bread were not on the menu on an ordinary day, they were a special treat on Easter, Christmas and other holidays.

As the Karst was a rural environment, they bred pigs in almost every homestead. In winter, normally in December,

Figure 5.3.3:
Olive growing has become increasingly popular in recent years, with the production of quality oil recognised in the supra-regional sphere (Photo: Cesare Grazioli)


SAMATORCA
PRAPROT
PREPOTTO
TERNOVA
ALTA

they butchered them and processed all the parts of the pig. This was a family feast, as it filled their larder for the whole year. They made *prosciutto*, *zašink*, *pancetta*, sausages and *salami* that were then dried and cured in the bora wind. These are very typical for the area and are often served to visitors as a welcome. Fresh dishes were also made, including blood sausages, crackling, brawn and fresh meat. Offal, such as the liver, heart, and brain were prepared as a snack for the butchers.

The Karst's forests and meadows represent a botanical paradise in the spring and summer months. Wild asparagus, savory, nettle, dandelion, yarrow, plantain, sage, mint and lemon balm are just a few of the ingredients that can be incorporated into many traditional dishes such as minestrone, *frtalje*, risottos or a meat offering as well as some contemporary dishes such as cheese spreads and cream soups.

Before going into detail about the main dishes of the local cuisine, it is useful to introduce a typical public eating place in this area, where one can enjoy typical dishes: the so-called "*Osmice*".

Osmica (pl. *osmice*) (osmiza) is a traditional form of selling wine and other homemade products from home, which only lasted eight days a year. Now it lasts longer in some places, but osem means "eight" in Slovene, hence the name osmica, meaning eight days. Written sources report that the right to open an *osmica* dates back to the time of Emperor Charlemagne, renewed over the centuries by successive ruling authorities. With this decree, winegrowers were given permission to sell their wine at home for eight days a year. Today, this local specialty is a popular form of tasting local delicacies and socializing on farms. Karst *osmice*, which some farms open twice a year, serve excellent wines and typical Karst dishes. They are recognizable by a wooden sign and a bunch of ivy that stays fresh for approximately eight days (Figure 5.3.4).

Figure 5.3.4:
(a,b) The osmice are a place for socialising and meeting the local gastronomic culture. (Photo: Rodolfo Riccamboni, FOTODAMJ@N);
(c) „Frasco“, a branch of ivy indicating the presence of an open osmiza (Photo: FOTODAMJ@N)

Some of the most typical Karst dishes are:

Jota - perhaps the most famous Karst dish. Beans and sauerkraut or turnip are cooked together with a piece of dried meat (pancetta, *pršut*, sausage...), potatoes, cumin, garlic and bay leaves to create a stew or thick soup that is perfect for staving off the cold bora wind in the winter.

Mineštra - a thick soup or a stew made with vegetables, often with the addition of pasta or rice. There is no set recipe for it since it can usually be made out of whatever vegetables and herbs are

Figure 5.3.5: The tradition of preparation in tablecloths of cooked štruklji is passed on from generation to generation (Photo: Jože Požrl - Sežana Municipality Archive)

available. It can be vegetarian, contain meat, or contain an animal bone-based stock (such as chicken stock). A special variety is barley minestrone with pork meat (Slovene *Ječmenova mineštra s svinjskim mesom*). It is a recognizable and highly appreciated dish by Karst people, made of barley, potatoes, beans and pork.

Frtalja (from the Venetian word fritaia, which means "fried") - an egg omelette, especially common in the springtime, as at that time there are many plants and vegetables available such as wild asparagus, wild hops, herbs such as fennel, mint and chicory, tomatoes and young garlic sprouts as well as spices. They are added to egg and some other ingredients (small bits of stale bread, *prosciutto*, mushrooms, wine). The quantity of ingredients is never exactly defined however, the main part being herbs and vegetables, with eggs and flour only there for binding them together.

Štruklji - a type of strudel, a traditional Slovene dish, composed of dough and various types of filling (cottage cheese, walnut, tarragon, dried fruit...) in the form of a roll. With many variations throughout the country, and there are also some that are typical of the Karst. They are traditionally cooked in white cloth, but if they don't have any filling, they are called ˝deaf˝ štruklji and cooked without using a cloth (Figure 5.3.5).

Krompir v zevenci - from the vats in which cabbage has been soured, they take the remaining liquid, called *zevnca,* add some garlic, pepper, and sometimes a piece of pork. In this mixture, they then cooked peeled potatoes and dress them with cracknels or onions.

Žouca - this is a type of offal, a mandatory dish every Easter. Pork legs, ears, tail, tongue, or some better pieces of meat are well washed and put in cold water. They are slowly and evenly cooked for seven to nine hours (these are "magic" numbers) until the meat starts to come away from the bone. While cooking, the water boils down to three quarters. The pieces of pork are taken out of the broth. Then it is strained and cooled to remove the excess fat that accumulates

Figure 5.3.6: An overview on Karst tastes
(Photo: Jože Požrl - Sežana Municipality Archive)




on the surface. The cooled bits of pork are cleaned and shaped into even pieces and distributed in a deep dish and the broth poured over them. Slices of hard-boiled eggs, black peppercorns, and bay leaf are added and cooled for several hours.

Supe - This is prepared from bread a few days old, that is cut into 2 slices, 3 centimetres thick. These slices are soaked in milk and whisked eggs with a pinch of salt. They are fried in hot oil and, while still warm, sprinkled with sugar. It is no wonder that this rich dish is still a favourite with children today.

Fancli z dušo - a type of fried dough, that has a special salty filling or "soul" (Slovene *duša*), made of salted anchovies. These are a typical dish on Shrovetide.

Figure 5.3.4: (d, e) In the osmica you can get to taste really local products and the typical Karst wine, Teran or Terrano, while enjoying the marvelous landscapes that the Karst offers (Photo: FOTODAMJ@N, Fiorella Bieker)

5.3.4 Events and traditions

Local communities keep alive customs that have been preserved in all Karst villages and reflect their Slovenian, Italian, German and Istro-Venetian origins. Many *šagra* or *opasilo* (celebrations) and traditional holidays are held in the Karst, especially in spring and summer. There are also some events that are more recent in origin, but have been accepted and are growing in importance.

Tourist promotion websites offer an exhaustive overview of the events promoted throughout the calendar year, but here we highlight some of the most important and characteristic ones, which best describe the local culture.

Pust (Shrovetide)

The celebration of *Pust - Pustovanje* (Carnival) is very widespread and important on the Karst. It is among the first festivals in the calendar year, it is supposed to drive away winter and is a harbinger of spring. People dress up in a range of characters - called *šeme* - to form a procession. The procession then goes around the village and visits homesteads, where they get treats such as *fancle*, *štraube (crostoli)*, wine, eggs, sausages and money.

First of May celebrations

In most places in Slovenia, including the villages in geopark, this celebration is associated with the installation of the *Mlaj*, tall trees, usually a pine or a poplar, with peeled trunks, green tops and decorative wreaths on which are hung fruit (oranges, apples) and a fluttering flag on top. The *Mlaj* is set up the eve of May 1st. In some places, it is accompanied by bonfires.

Majenca

One of the most characteristic festivals is the Majenca: it is held at the beginning of May in Dolina (a hamlet of San Dorligo della Valle-Dolina) and consists of music and dances. A celebration with ancient origins, it has been held every first Sunday of May in the very heart of the village. For the occasion, the so-called "*maj*" is raised (a fir trunk about fifteen metres high on which a cherry tree is placed), and the unmarried village boys invite single girls to dance under the

Figure 5.3.7: The Majenca*, an example of a traditional ancient Karst spring festival (Photo: FOTODAMJ@N)*

tree to celebrate spring. This is a festival where the whole community takes part, including cultural and other associations, the Municipality, local winemakers and olive growers (Figure 5.3.7).

Teran and Kraški pršut festival

On the Slovenian side of the geopark, Praznik terana in pršuta (Terrano and Karst ham Festival) in August is the most important festival of the Karst people and all lovers of Karst cuisine and customs. With its rich gastronomical, oenological, cultural, sports, ethnological and entertainment-social programs, it attracts visitors from home and abroad to the Karst. At several events that connect the destination, several local providers present themselves, with a hospitality offer that includes the famous culinary specialties of the Karst and Brkini regions, but especially Teran and Kraški pršut.

St. Martin's day celebrations (Martinovanje) on the Karst

When the smoke-tree turns red, the other colours of the Karst also take on a special hue. These are the colours of love, the coherence of the people of Karst with nature and their devotion. In Autumn, the tastes are mature so the locals organize *Martinovanje* party (St. Martin's day is November 11th) in several locations throughout the geopark and provide culinary treats and a tasting of Karst wines.

Karst pre-wedding traditions

An interesting custom also takes place a day or two before a wedding for the newlyweds. This custom has been preserved in the Karst with small variations from one village to another to this day. Two days before the wedding, young, unmarried boys and girls, create a "*koluna*" for the newlyweds, which means that they put up two *Mlaj* trees (usually peeled pine trunks with a green top) in front of the entrance to the family homestead, and decorate them with juniper and ivy branches and stolen flowers. They hang up a sign between the two *Mlaj* trees, wishing all the best to the newlyweds.

Kraška ohcet (Traditional Karst wedding)

Every two years, the *Kraška ohcet* takes place in Monrupino - Repentabor. This a folklore event lasting several days, reviving a 19th -century wedding. It starts on a Thursday evening dedicated to single boys and girls and ends on Sunday when the wedding takes place in a stone church in Tabor, followed by a wedding lunch with typical dishes and dancing until late in the evening. The event is particularly spectacular also thanks to the spontaneous participation of numerous, more than 500 local inhabitants dressed in the traditional costumes of the Karst (Figure 5.3.8).

Figure 5.3.8: The Kraška ohcet *- Traditional Karst wedding in Repen (Photo: FOTODAMJ@N, Igor Grilanc)*

BIOLOGICAL PECULIARITIES OF THE CLASSICAL KARST

6.1 Introduction - the geodiversity and biodiversity of the area

The Classical Karst is an area where abiotic and biotic features work hand in hand to develop a unique landscape. Due to the area's natural resources (geographical position, rocks, climate) and centuries-old traditional human activities (mowing, grazing, burning, building dry stone walls) the Karst is a remarkably diverse landscape and a varied mosaic of habitats with extremely rich flora and fauna. Here there are many endangered species of plants and animals, many of which are rare and endemic. Among the latter, the cave species stand out. The area is of great scientific importance for the study of various plant and animal groups, with a focus on caves. High biodiversity also means a better quality of human living environment. The interdependence of the abiotic and biotic parts of nature are clearly visible and spread across the entire area of the Classical Karst. Iconic examples include the Škocjan Caves, Doberdò-Doberdob and Pietrarossa-Prelosno Lakes, the valley of the Rosandra-Glinščica and the Duino-Devin Cliffs, where a diverse flora and fauna develops on geologically and geomorphologically different elements.

Figure 6.1.1: Illyrian iris (Iris cengialti subsp. illyrica) *on the edge of the Rosandra-Glinščica Valley (Photo: Roberto Valenti)*

The Karst region is an area rich in biodiversity. The main factors that over time have favoured the development of this richness of life are, on the one hand, the border area between three important biogeographical regions, i.e. the Mediterranean, the Continental and the Alpine and, on the other, a lively, harsh and often bumpy geomorphology, not very suitable for intensive use by humankind, which has favoured the natural evolution and conservation of ecosystems.

The convergence of three biogeographical areas is a remarkable reason for the cross-contamination, mutation and selection of new species, for which the Karst is also recognized, along with the richness of its habitats and the species of important conservation value. Proof of this is the fact that more than half of this territory is fully included in the Natura 2000 network, which protects the habitats and species of greatest conservation value at a European level.

The presence of rocky environments, unsuitable for agriculture, is a multiplying factor in facilitating the conservation of biodiversity and natural selection. In particular, the underground karst environments constitute genuinely extreme environmental contexts, in which flora and fauna of exceptional rarity and ecosystemic value find space.

In quantitative terms, the Classical Karst has:

- ✦ 23 habitats, of which 5 are recognized as priorities by the European Habitats Directive on the Italian side and 16 habitats, of which 10 are recognized as priorities on the Slovenian side;
- ✦ More than 200 species of birds, of which 72 are included in Annex I of the European Birds Directive (2009/147/EC);
- ✦ 27 animal species among mammals, reptiles, amphibians, fish and invertebrates protected by the Habitats Directive (92/43/EEC), of which 4 are priority;

- over 500 species of butterflies;
- several endemic species of flora and fauna.

Prior to the introduction of the most representative and the most peculiar flora and fauna species which the visitor to the Karst may come across during a geo-excursion, it is appropriate to present the main habitats of the Karst. The most representative six of them are: woods and scrub, karst dry grassland, calcareous thermophilic scree habitats, cliffs, water bodies and underground environments.

At the Carsiana Botanical Garden in Sgonico-Zgonik it is possible to experience the most representative habitats of the Karst.

Woods and scrub

In ancient times the Karst was covered by oak forests which, following deforestation and grazing for thousands of years, were progressively destroyed. Today only a few fragments of these ancient woods still exist.

The Karst scrub is the most represented environment on the Karst Plateau. It quickly established itself after World War II with the abandonment of grazing. This formation is the degradation product of the ancient Karst forests. Its composition reflects the geological and environmental characteristics present in most of the Karst where the residual soil layer and the permeability of the rocky substrate are some of the factors that determine the development of a sparse tree cover, mostly characterized by specimens that are shrubby rather than arboreal, with little standing timber. The tree layer is in fact represented by elements with a slender stem and reduced vertical development.

Karstic dry grassland

It is where the wood gives way to ancient pastures that one of the most peculiar environments of the area has been created: Karst grassland. This zoogenic formation occupies a recognizable part of the geopark's surface. It was generated by the pressure of grazing animals, mostly cattle, sheep and goats, which, over the millennia, have selected a grass cover resistant to trampling and grazing (as well as to the usual aridity and poverty of the soil).

Calcareous thermophilic scree habitats

Very localized, but extremely interesting, are the perialpine calcareous thermophilic scree habitats. These represent an environment in which plant colonization is made difficult, both by dryness as well as the instability of the substrate and constant exposure to atmospheric factors. They therefore host a peculiar plant community, mostly limited to a low herbaceous layer.

Cliffs

In the coastal area of Trieste, the Karst reaches the sea, forming high cliffs, characterized by vertical rock faces, rocky towers and scree that are subject to strong insolation, wind and salinity. This environment relegates the vegetation to sparse shrub and herbaceous strips formed by communities typical of Mediterranean scrub.

Water bodies

One of the peculiarities of the Karst environment is an almost total absence of surface water. This condition is mainly due to the permeability of the heavily fractured bedrock. The water therefore flows preferentially along underground channels, leaving the surface free of aquatic environments.

The main exceptions on the Italian side of the Classical Karst are the Pietrarossa-Prelosno and Doberdò-Doberdob lakes, in the Isonzo-Soča karst, and the Rosandra-Glinščica stream in the province of Trieste. The ponds, small depressions in the ground where the collection of rainwater was facilitated with the addition of clayey material, were used for watering domestic animals and as a water supply for local populations. They are rapidly disappearing due to lack of maintenance.

Figure 6.1.2: The Karst cornflower (Centaurea kartschiana) *endemic to the Duino-Devin Cliffs (Photo: Roberto Valenti)*

Underground environments

We cannot speak of Karst without pointing out the richness of its underground environments. The various systems of sinkholes, vertical wells, caves and caverns, hidden in the subsoil, provide the biocenoses with another type of habitat. The flora colonizes it by responding to the gradients of brightness, and to the variations of humidity and temperature, which lead to an ordered succession between phanerogams, ferns, bryophytes / liverworts, and finally, chloro- and cyanophytes.

6.2 Flora

The area of Classical Karst is floristically very rich. It belongs to the sub-Mediterranean phytogeographical province. The predominant primary vegetation was once forest. Humans reduced the forest areas through logging and burning. On deeper soils, farmers established meadows and maintained them by regular mowing. On areas with sparse soil and on rockier areas, on the other hand, they grazed. Grazing, erosional processes and occasional fires transformed the pastures into rocky areas, especially on the slopes. In the middle of the 19th century, afforestation of the degraded karst soils began. A few decades ago, however, the scrubbing over of the pastures and meadows came about due to less use.

The most widespread forest communities are the sub-Mediterranean thermophilic forests of hop hornbeam and flowering ash (*Ostryo-Quercetum pubescentis*). In the past, sub-Mediterranean forests of oaks and autumn moor-grass (*Seslerio autumnalis-Quercetum petreae*) thrived in the Karst, but these have been largely cleared. Today, hop hornbeam and autumn moor grass (*Seslerio Autumnalis-Ostryetum*) can also be found in the Karst, while beech forests (*Hacquetio-Fagetum*) thrive on shady slopes in the foothills. A large part of the Karst is covered by secondary stands of black pine (*Pinus nigra*), which was used to reforest bare areas in the 19th century. An important habitat in the Karst is dry grassland (mainly *Carici humilis-Centaureetum rupestris*) (Figure 6.2.1). This is one of the most colourful and floristically rich grassland communities in Europe.

*Figure 6.2.1: Amethyst eryngo (*Eryngium amethystinum*) and rock knapweed (*Centaurea rupestris*) (next page, with spotted fritillary (*Melitaea didyma*)) are typical plants for karst dry grassland (Photo: Roberto Valenti, Tina Klanjšček)*

A special feature of this area are endemic species such as the Justin's bellflower (*Campanula justiniana*) and Karst cornflower (*Centaurea kartschiana*) (Figure 6.1.2). Some species have a classic habitat in this area, such as the *Pedicularis friderici-augusti*. In the Škocjan Caves and in the Velika dolina there is an interesting occurrence of glacial relicts growing in the colder air at the bottom of the collapse dolines, with auricula (*Primula auricula*), silver saxifrage (*Saxifraga crustata*), Alpine yellow or two-flowered violet (*Viola biflora*) and rock scurvy grass (*Kernera saxatilis*). In addition, there are thermophilic relicts, remnants from the interglacial period including southern maidenhair fern (*Adiantum capillus-veneris*), spiny asparagus (*Asparagus acutifolius*), prickly juniper (*Juniperus oxycedrus*) and yellow crisp-moss *Tortella flavovirens*. The latter survive the winter because of the warm air that rises from the cave in winter. The simultaneous occurrence of plants with such different ecological requirements is a rarity in nature.

Among the most iconic floristic elements of Karst are certain shrubs. In autumn, smoke-bush (*Cotinus coggygria*) (Figure 6.2.2), common dogwood (*Cornus sanguinea*), Cornelian cherry (*Cornus mas*), and blackthorn (*Prunus spinosa*) dress the dry rocky karst landscape in warm colours.

Some of the species are threatened with extinction and are listed in the IUCN Red List of Threatened Species, such as ragged-robin (*Lichnis flos-cuculi*) due to the overgrowth and human encroachment on nature and the marsh plants due to pond abandonment. However, some species are protected even though locally they register healthy populations, because of a risk of extinction at European level.

Figure 6.2.2: Smoke bush (Cotinus coggygria) *dresses in autumn the landscape of Karst in reddish and yellowish colours (Photo: Roberto Valenti)*

6.3 Fauna

The geopark also has an extraordinary variety of animal groups, both on the surface and underground. Numerous caves in the Karst area form the habitat of a large number of animal species, making it a hotspot of biodiversity in cave fauna. A branch of biology - speleobiology - is concerned with the study of the cave fauna, which is very diverse in this area. The underground has specific ecological characteristics, for example an absence of natural light, dependence on food from external ecosystems (limited food intake), a connection with external ecosystems through water, and stable conditions due to low variations in chemical and physical parameters. In the course of evolution, animals have developed adaptative mechanisms to the cave environment, such as slow reproduction, a longer life cycle, fewer offspring, elongated limbs and tentacles, an increased sense of smell, touch and taste, the absence of eyes and a lack of of pigment. Because of these adaptations, many subterranean organisms are endemic, with some are limited to very small areas. Subterranean organisms are highly endangered because habitat destruction or pollution can spell the end for a species. The most important caves that contain rich fauna and are significant from the point of preserving the underground fauna in the Karst region are the Škocjan Caves, Dimnice, Dolenca, Belinca, Kačna Cave, Grotta Gigante-Briška jama Cave, Grotta di Trebiciano-Labodnica Cave, Dio Mithra Cave, Azzurra-Zidaričeva pejca Cave, Gallerie Cave, Noè-Pečina v Rubijah Cave, and Regina del Carso-Kraljica Krasa Cave.

Animal species that are strictly bound to underground habitats are called troglobionts. One of the most recognizable representatives, and a symbol of the Dinaric Karst natural heritage, is the proteus (*Proteus anguinus*), also called the olm, European cave salamander, or locally, in Slovenian – because of its pale skin – "the human fish" (Figure 6.3.1). It was the first specialized cave animal in scientific literature, already described in 1768. However, not all cave-dwelling species are troglobionts. Animal species that are not completely adapted to cave life also live in caves or at their entrances, e.g. bats, and they are called troglophiles.

Figure 6.3.1: Olm or European cave salamander (Proteus anguinus) *is adapted to life in caves. The eyes visible in this juvenile individual, are completely atrophied in the adult stage (Photo: Jurij Hajna)*

Figure 6.3.2: The cave cricket (Troglophilus neglectus) *(Photo: Luca Dorigo)*

Both terrestrial and aquatic fauna are found in Karst caves. The aquatic fauna includes crustaceans, for example, amphipod *Niphargus*, the cave shrimp *Troglocaris*, the copepods *Cyclopoida* and *Harpacticoida*, the isopod *Titanethes dahli*, and others. The terrestrial fauna includes cave crickets (*Troglophilus neglectus*) (Figure 6.3.2), spiders and beetles, as well as many species of snails. Among the most important species is the endangered slenderneck beetle (*Leptodirus hochenwartii*) (Figure 6.3.3), the first ever scientifically described cave animal (in 1832), which has since been recorded in more than 13 caves in the Karst. The largest cave animal in the area and worldwide is the proteus. It is the only European amphibian that lives in the underground watercourses of the Dinaric karst. Its geographic range includes north-eastern Italy, southern Slovenia, Croatia and Bosnia and Herzegovina. It is completely adapted to life in the dark, has no eyes and no skin pigmentation. It also retains the external gills and other larval features into adulthood (neoteny). Proteus has been found in several caves with active water currents. The slenderneck beetle and the proteus are listed as species of European conservation concern in the EU Habitats Directive and in the IUCN Red List of Threatened Species. The Speleovivarium of Trieste is a caving museum in an underground environment where it is possible to see many species of fauna and flora from the Karst caves.

More than twenty bat species have been recorded in the Karst, including the greater horseshoe bat (*Rhinolophus ferrumequinum*), the lesser horseshoe bat (*R. hipposideros*) (Figure 6.3.4), the common bent-wing bat (*Miniopterus schreibersii*), the long-fingered bat (*Myotis capaccinii*), and the greater mouse-eared bat (*M. myotis*). Bats occur in larger numbers in several areas of the Classical Karst.

Figure 6.3.3: The endangered slenderneck beetle (Leptodirus hochenwartii) *(Photo: Slavko Polak)*

One of the largest habitats for bats is in the Škocjan Caves, where they are most numerous, with several thousand individuals. In the caves the bats also have their offspring and hibernate in winter.

The second underground habitat in the Karst is epikarst. This is the uppermost layer of rock beneath the soil, through which water seeps from the surface. The study of epikarst fauna is relatively new, so this type of fauna has not been studied extensively. The fauna has been studied so far in the Classical Karst area within the extensive Natura 2000 area on both sides of the border and due to

Figure 6.3.4: The lesser horseshoe bat (Rhinolophus hipposideros) *in the Fessura del vento Cave in Rosandra-Glinščica Valley (Photo: Luca Dorigo)*

the presence of previously protected natural areas. In the Škocjan Caves, for example, 12 species of true subterranean epikarst animals have been discovered from the drops of infiltrated water, of which as many as five are new species of small copepod crustaceans. The species *Elaphoidella karstica* is endemic of the Škocjan Caves - only one individual from a single stream of infiltrating water was found.

Insects are abundant in the Karst region, including endangered European beetle species for which the Natura 2000 site is designated, including the aforementioned slenderneck beetle (*Leptodirus hochenwartii*), the European stag beetle (*Lucanus cervus*) and the beech longhorn beetle (*Morimus asper funereus*). In all probability a Natura 2000 site will also be designated for the great capricorn beetle (*Cerambyx cerdo*). Also characteristic are the predatory bush cricket (*Saga pedo*) (Figure 6.3.5) and the endemic eastern stone grasshopper (*Prionotropis hystrix hystrix*).

*Figure 6.3.5: Predatory bush cricket (*Saga pedo*) - a species protected by the "Habitats" Directive, it is among the largest arthropods in Europe (Photo: Roberto Valenti)*

Butterflies stand out in terms of the number of species in the Karst. The karst area is extremely diverse, with over 500 species of butterflies and moths. Of the endemic species and subspecies, three have been reported: a subspecies of Assman's fritillary *Mellicta britomartis* ssp. *michieli*, and two moths, *Nyssia graecarius* and *Dyscia raunaria*. Of the endangered European species in the Karst, four species have been included in the Natura 2000 network: the eastern eggar (*Eriogaster catax*), the Anker moth *Erannis ankeraria*, the marsh fritillary (*Euphydryas aurinia*) and the false ringlet (*Coenonympha oedippus*) (Figure 6.3.6).

*Figure 6.3.6: The false ringlet (*Coenonympha oedippus*) is protected by the Natura 2000 network (Photo: Tatjana Čelik)*

Natura 2000 sites have already been designated for many bird species (e.g. the woodlark (*Lullula arborea*), the European nightjar (*Caprimulgus europaeus*), the Eurasian hoopoe (*Upupa epops*) (Figure 6.3.7), the European honey-buzzard (*Pernis apivorus*), the Eurasian eagle-owl (*Bubo bubo*) and the Eurasian scops owl (*Otus scops*), as relatively high densities of European nesting sites have been found in the Karst.

Species, threatened with extinction, and protected species linked to aquatic habitats are found in the geopark including the European freshwater crayfish (*Austropotamobius pallipes*), the alborella (*Alburnus alborella*), a fish native to the Rosandra-Glinščica torrent, and among amphibians the Italian crested newt (*Triturus carnifex*), the yellow-bellied toad (*Bombina variegata*) and others can be found.

Figure 6.3.7:
The Eurasian hoopoe (Upupa epops)
(Photo: Roberto Valenti)

Figure 6.3.8: The horn-nosed viper (Vipera ammodytes) *(Photo: Roberto Valenti)*

Figure 6.3.9: The golden jackal (Canis aureus) *in the Rosandra-Glinščica Valley Natural reserve (Photo: Roberto Valenti)*

Dry karstic grasslands are an excellent habitat for a variety of reptiles. Among snakes, a black colour form of the western whip snake (*Hierophis viridiflavus carbonarius*), the Aesculpian snake (*Zamenis longissimus*), cat snake (*Telescopus fallax*) and horn-nosed viper (*Vipera ammodytes*) (Figure 6.3.8) all occur. Among lizards, European green lizard (*Lacerta viridis*) is very common, while the Dalmatian wall lizard or "Karst lizard" (*Podarcis melisellensis*), Italian wall lizard (*P. sicula*) and Dalmatian algiroydes (*Algiroydes nigropunctatus*) are less frequent.

The Karst area is also a habitat for carnivores; wild cat (*Felis silvestris*), lynx (*Lynx lynx*), golden jackal (*Canis aureus*) (Figure 6.3.9), wolf (*Canis lupus*), and brown bear (*Ursus arctos*) have all been recorded.

NATURE CONSERVATION

7.1 The geopark's protected areas. Protection of natural and cultural heritage

The value and the sensitivity of the Classical Karst is reflected in the numerous living species, natural sites and objects of cultural heritage, protected on the basis of the various laws, regulations or other legal acts at Slovenian and Italian state or local levels. These include the international conventions and regulations of the European Union, such as the Convention on Biological Diversity, the Convention on the Conservation of European Wildlife and Natural Habitats (Berne Convention), the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), the Ramsar Convention on Wetlands, the *Natura 2000* network covered in the Decree on Special Protection Areas, and others. These protected areas overlap in some parts, and the rules of conduct complement each other. While the named regulations focus more on the protection of biodiversity, habitat types, and individual animal and plant species that are rare or endangered, that is to say the biotic/living natural values, the special attention of geoparks is paid to the conservation of abiotic/non-living nature. Their intention is to emphasize that the environment is not of uniform importance to humans, but based on current knowledge and human values, with certain parts of nature being perceived as being more valuable than others. These are areas that are exceptional, rare, typical, well preserved, exemplar, or important for scientific research. Depending on their significance, they are designated as being of local, national or international/global importance.

Figure 7.1.1: Dry karstic grassland - The Val Rosandra-Dolina Glinščice Natural Reserve (Photo: Roberto Valenti)

The largest protected area of Classical Karst is the Škocjan Caves Regional Park, appearing on the UNESCO List of World Heritage Sites since 1986. In 1999, large parts of the park also became a Wetland of International Importance under the Ramsar Convention, in recognition of the outstanding value of these underground wetlands. A much larger landscape unit was designated as a Karst Biosphere Reserve under UNESCO's Man and Biosphere Programme in 2004. The Miramare Marine Nature Reserve is partially included in the area of the geopark and is also a UNESCO MAB site.

The area of geopark features 7 ecologically important areas, 72 natural monuments, 1,052 Karst caves and 164 other valuable natural features in Slovenian territory and 6 Natural Regional Reserves, 1 Biotope protected area and more than 3,400 Karst caves within Italy. Almost the entire area is also part of the *Natura 2000* network (Fiugure 7.1.2).

Since geoparks are informal protection categories that do not impose additional strict protection measures, the latter are determined by existing laws and regulations. The protection of the Classical Karst area thus follows the systems of protection of nature and culture in Slovenia and Italy respectively.

In Slovenia, the measures for biodiversity conservation and preservation of valuable natural features are defined by the Nature Conservation Act. Statutory regulations – The Rules of Defining and Protection of Valuable Natural Features and Decrees on Types of Valuable Natural Features – determine the national or local importance of these features, as well as the conduction and protection for various activities. Underground caves are further protected by the Underground Caves Protection Act. On the Italian side the main Laws and Regulations regarding nature protection are set at two levels: National and Regional. The Italian State adopted a framework law on protected areas in 1991 (LN 394/91), which has been amended several times over the years. The Friuli Venezia Giulia Region has its own legislation on protected areas which sets out in detail the implementation of the National Law at a local level with a Regional Law (LR 42/96). The regional legislation on nature conservation was also integrated in 2016 with the law for the protection of geodiversity (LR 15/2016), which represents a unique case in this field in the two countries.

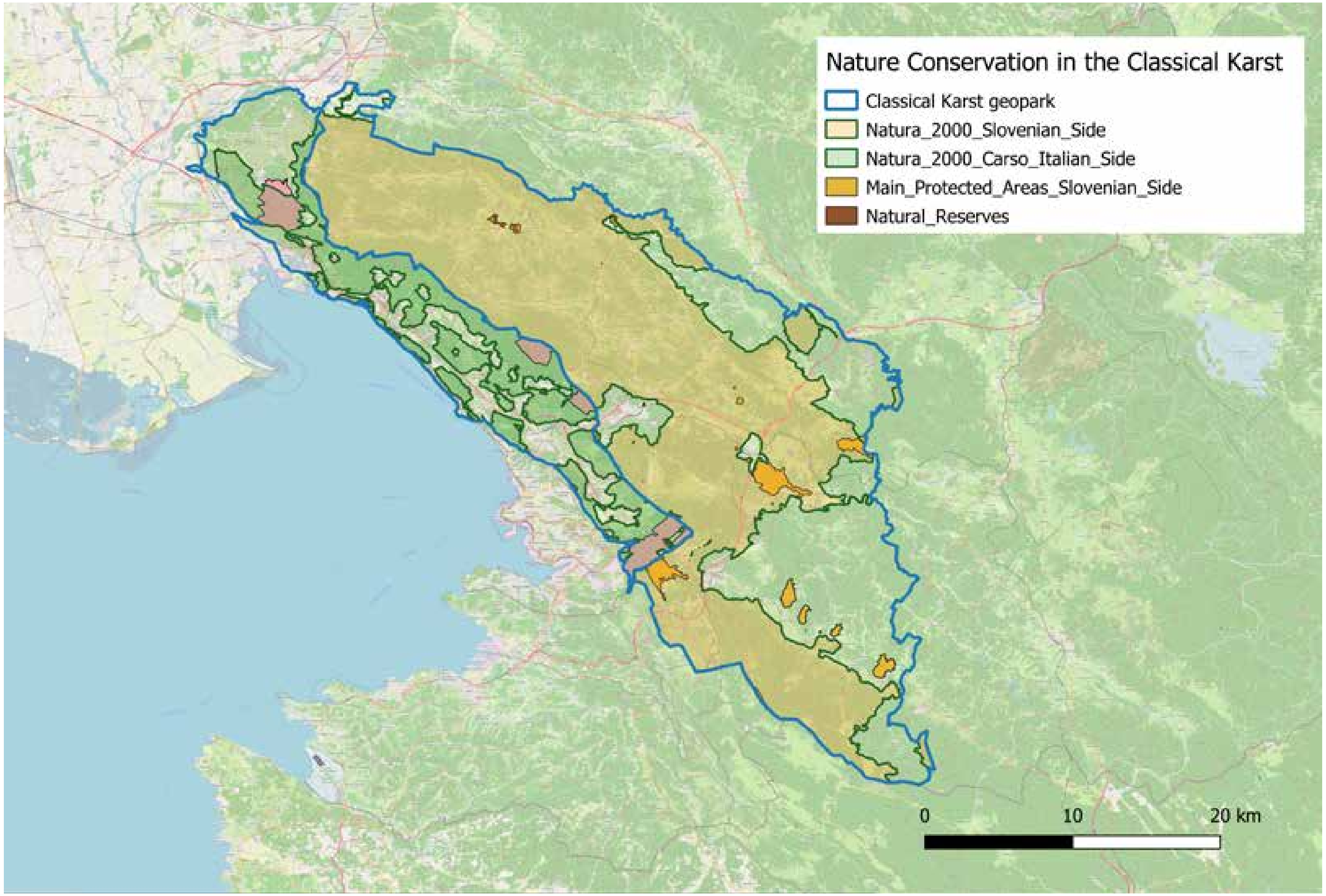


Figure 7.1.2: Legislative nature conservation areas in the Classical Karst (eco&eco , © OpenSteetMap contributors)

In addition to the protection of nature, as natural heritage is of fundamental importance to the existence of humanity, it is useful to take into account cultural diversity and heritage, which, in the Karst, are also impressive. Numerous archaeological sites, exquisite religious, public and vernacular architecture, World War I sites, protected landscapes, monumental trees and traditional crafts are protected as cultural heritage. In Karst, the characteristic cultural landscape is inextricably linked with stone as a traditional building material. Its quarrying, carving and its use is designated as an intangible cultural heritage. The skill of drywall construction; knowledge and techniques, which include the Karst drywall construction, was inscribed on the Unesco list of the Intangible Cultural Heritage of Humanity in 2018. Cultural heritage is also protected at national levels: in Slovenia by the Cultural Heritage Protection Act; in Italy by the Code of Cultural Heritage and Landscape (Legislative Decree 42/2004).

Captain Rudist is the geopark mascot. Created by Sergio Derossi, it represents the most common fossil in the Karst - the rudist bivalve that lived in the Cretaceous period and became extinct along with the dinosaurs. The limestones of the Karst are crammed full of rudist fossils.

7.2 Code of ethics for geopark visitors

All geoparks are committed to protecting their natural and cultural heritage, with special attention to the preservation of important geosites. They take steps to educate visitors about the value of geosites and raise awareness of the need to protect geodiversity.

All geopark visitors should follow both the lists of permitted activities and restrictions as well as the simple Code of Conduct for their own safety and to minimize impacts on the natural environment.

RESPECT NATURE.

- ***Learn about non-living nature and contribute to its conservation by following the rules of geoethics.*** Obtain information on geological and geomorphological values and protected areas. Do not damage rocks and do not extract or collect rocks, minerals, or fossils. In caves, never break, damage, or take speleothems (dripstones, crystals, cave pearls) or other anything else from the cave inventory. Collect geological material only where it is allowed and regulated. If you suspect that you have made a geological find of significance, you should report your discovery to the visitor centre.
- ***Learn about living nature and contribute to its preservation.*** Obtain information on protected animals, plants and habitats. Refrain from picking plants or hunting and gathering animals. Do not encroach on dens, nests, nesting sites, or feeding areas. Do not introduce non-native animal and plant species. Pick plants, mushrooms, and wild fruits only where allowed and regulated.
- ***Do not disturb animals.*** Warn the animals of your presence by speaking, so that they can retreat. Do not approach or feed livestock or wild animals. Keep your dog under strict control or on a leash. Do not make unnecessary noise.
- ***Use trails.*** Use hiking trails to minimize your impact on nature and to ensure your own safety. Respect barriers. If you must cross cultivated land, stick to the edges.

- ***Enter caves according to regulations.*** Enter tourist caves or open caves with controlled access only when accompanied by an official, qualified guide. Visit caves in a manner that does not endanger the cave, the cave inventory, or any living creatures.
- ***Leave no trace.*** Take all your waste with you and dispose of it in designated litter bins or at municipal collection sites. Do not light fires on the Karst, given the high risk of fire and the absence of surface water necessary to extinguish them.

RESPECT YOURSELF AND OTHERS.

- ***Know your capabilities and take them into account.*** Plan your visit in advance and adapt it to the weather conditions, your skills and abilities. Take the proper footwear, clothing and other equipment, and make sure you have enough food and drink, together with some reserves.
- ***Be considerate of other visitors.*** Give priority to those weaker than you on trails. Hikers have priority over cyclists and cyclists have priority over motorists.
- ***Take care of safety.*** Look out for your own safety and the safety of others. Keep away from rock faces. According to your knowledge, your assessment of the circumstances, and the way you react to them, try to help others to the best of your ability without jeopardizing your own safety. In the event of an accident, call 112 and follow instructions.
- ***Drive and ride only along designated roads.*** Drive your motor vehicle or ride your bicycle only on designated roads and trails. By doing so, be aware that driving in a natural environment is restricted.
- ***Park in parking places.*** Park your vehicle only in designated parking areas and in a manner that does not obstruct trails or gates. Be a role model for others.

RESPECT PROPERTY.

- ***Do not violate property rights.*** Do not walk across cultivated fields, growing crops, vineyards, orchards, or near beehives. Do not pick fruit, agricultural products, or firewood without the owner’s permission. Close the gates of any pasture fences you open.
- ***Avoid worksites.*** Avoid sites where forestry work is being undertaken. Visiting operating quarries or mines (whether operating or idle) is allowed only with the permission of the operators and under the conditions they specify.

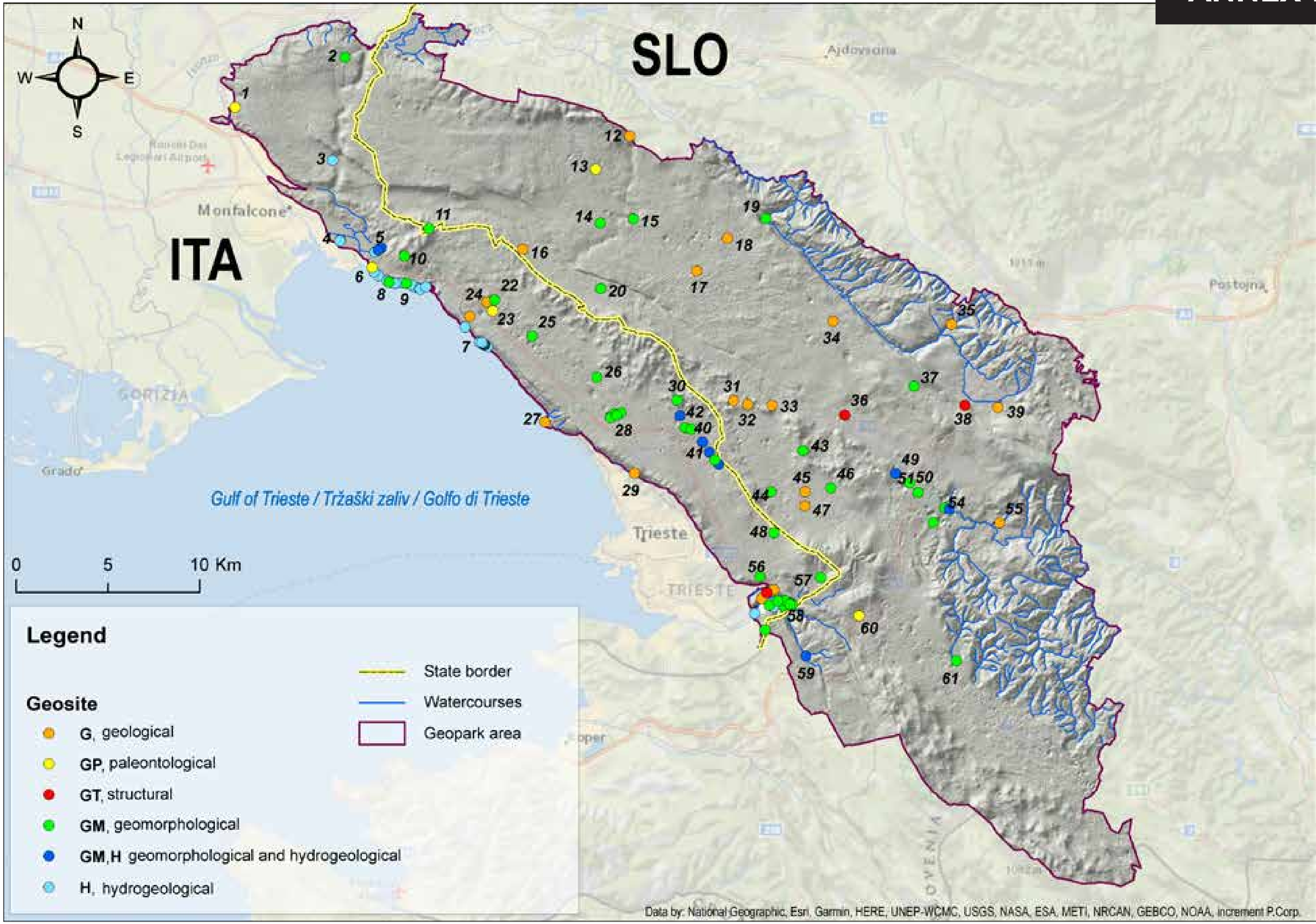
RESPECT THE LOCAL COMMUNITY.

- ***Learn about and respect local customs.*** During your visit, learn about local customs. Observe, enjoy and respect them and support the local community by buying local products and using local services. In this way, contribute to the preservation of the cultural landscape and nature.

In short, you should follow two simple rules: Do not take anything from the geopark except your impressions and your photos, and do not leave any traces of your visit.

SELECTED GEOSITES IN THE CLASSICAL KARST GEOPARK

ANNEX 1



ID del GEOSITO	GEOSITE	NATION	TYPE	DESCRIPTION
1	Paleontological excavation near Polazzo	ITA	GP	Greenish-grey platy limestones characterised by the presence of abundant reef fish fossils and, to a lesser extent, terrestrial plant and reptile fossils.
2	Regina del Carso-Kraljica Krasa Cave (2328/4760VG)	ITA	GM	This is the largest cave in the north-western sector of the Karst. Rich in concretions, it develops in a S-N direction with an almost constant inclination.
3	Doberdò-Doberdob Lake	ITA	H	Doberdò-Doberdob Lake is one of the few karstic lakes in Italy. It occupies the bottom of a polje and is set in an exceptional karstic environment, characterised by the presence of a series of estavelles. Together with the nearby Pietrarossa Lake, it represents a landscape that changes with the height of the water table.
4	Thermal spring of Monfalcone: SPA	ITA	H	Hot water (today around 40° C) from limestone reservoir rocks found at a considerable depth comes to the surface through faults and karst conduits. Already used by the Romans, who adapted them as thermal baths, after alternating periods of abandonment and reutilization, they have been back in use since 2014.
	Thermal spring of Monfalcone: Pozzo del Lisert Cave (4808/5608VG)	ITA	H	Non-accessible cave beside the spa at the bottom of which hot water is found.
5	Timavo - Timavo Springs	ITA	H	The Timavo Springs are part of the extensive spring area of the Classical Karst. After an underground journey of 30-40 km beginning at the Škocjan Caves swallow hole, the waters come to light with four springs, just over 2 km from the Adriatic Sea, creating a fascinating environment that has been eulogised since ancient times.
	Timavo - Grotta del Timavo Cave (1844/4583VG)	ITA	GM, H	This is part of the so-called 'Timavo Springs Complex', the system of largely flooded caves explored by cave divers from the largest of the spring mouths.
	Timavo - Pozzo dei colombi di Duino Cave (215/VG227)	ITA	GM, H	A window on the Timavo Springs Complex that provides access to flooded conduits down to a depth of 82 m below sea level.
	Timavo - Grotta meravigliosa di Lazzaro Jerko Cave (2305/4737VG (LAJ))	ITA	GM, H	Evidence of a direct connection with the groundwater table became a 'window' onto the underground Timavo.
	Timavo - Abisso di Trebiciano - Labodnica Cave (3/17VG)	ITA	GM, H	Evidence of a direct connection with the groundwater table became a 'window' onto the underground Timavo.
6	Dinosaurs of the Villaggio del Pescatore-Ribiško naselje	ITA	GP	Exceptional complete hadrosaur skeletons have been found in a former quarry. These are some of the very few complete dinosaur skeletons found in Italy and are unique worldwide for the exceptional nature of their preservation and the fact that they were found in anatomical connection.
7	Coastal karst springs	ITA	H	Small freshwater outflows at sea level near Villaggio del Pescatore-Ribiško Naselje and Aurisina-Nabrežina coast. The latter used in the past as freshwater resource for the Trieste water supply.
8	Underwater karst springs	ITA	H	Freshwater outflows below sea level in the stretch between Villaggio del Pescatore and Sistiana-Sesljan and others close to Aurisina-Nabrežina.
9	Duino-Devin Cliff	ITA	GM	The cliffs reach a height of 90 m and stretch from the Bay of Sistiana-Sesljan to the small harbour of Duino-Devin, for a length of about 1,500 metres. Differential erosion and corrosion have shaped pinnacles and towers, creating a fascinating landscape.
	Notch near Duino-Devin cliff	ITA	GM	Between Duino-Devin and Sistiana-Sesljan, the submerged notch lies at a depth of between 2.5 m and 1.3 m.
10	Dolina del principe - Dol Doline	ITA	GM	Large sub-circular doline opening on the side of a relief (Mt. Cocco - Mt. Ermada Ridge).
11	Grofova Jama Cave-Brezno na Grmadi Abyss	SLO	GM	Grofova Jama Cave is scientifically one of the most important caves of the Karst. The montmorillonite clay (weathered volcanic ash) found in it is the oldest dated cave sediment in southwestern Slovenia, deposited in the cave about 10 million years ago.
12	Paleokarst features and paleosoils of Trsteljska Brda Hills	SLO	G	Although the paleokarst and paleosoil phenomena of the Trsteljska Brda Hills are relatively indistinct, they are important for understanding the geotectonic processes and the evolution of the Adriatic Carbonate Platform at the end of the Cretaceous.
13	Komen-Škrbina - Komen Limestone with fossil vertebrates	SLO	GP	An important and internationally known locality of numerous fossil vertebrates in the Komen platy limestone.
14	Doline at Debela Griža - Volčji Grad prehistoric settlement	SLO	GM	Besides its geomorphological significance, the doline beneath the ramparts of the prehistoric settlement of Debela Griža with its dry stone walls and terraces shows traces of repeated modifications since prehistoric times.
15	Mali Dol dry valley	SLO	GM	Mali Dol is a dry valley that represents a relict form of fluvial relief on the karst surface, formed in the geological past by a small river that crossed the gradually uplifting area of the Karst.
16	Abandoned quarry of flowstone Rusa jama at Gorjansko	SLO	G	The abandoned flowstone quarry Rusa jama. Part of the interior of the Slovenian Parliament building is also decorated with this rare natural stone.
17	Outcrop of Komen Limestone at Skopo	SLO	G	Outcrop with the clearly visible structural features of the Komen platy limestone, also known for the finds of fossil fish and plants.

ID del GEOSITO	GEOSITE	NATION	TYPE	DESCRIPTION
18	Kopriva Quarry of rudist limestone	SLO	G	A quarry of the prized natural stone of the Kopriva type, important for understanding the global sea-level rise at the beginning of the Upper Cretaceous.
19	Raša Valley with its tributaries	SLO	GM	The mostly dry valley of the Raša with its tributaries, which represents one of the most prominent landforms in the Karst or its surroundings, could be defined as a fracture or crush zone of the Raša fault emptied by erosion.
20	Veliki (Brestoviški) Dol	SLO	GM	Veliki (Brestoviški) Dol represents a tectonic depression formed in the Divača Fault zone.
21	Slivia-Slivno's breccia quarry	ITA	G	No longer active quarry in which a polychromic limestone breccia is found.
22	Karrenfeld at San Pelagio-Šempolaj and Lindner Cave (829/3988VG)	ITA	GM	Alternating bands of karst stony ground (grize) and limestone banks on which are visible all the small surface corrosion features, favoured by the purity of the limestones and the slightly inclined stratification.
23	Palaeontological site of the Caverna Pocala-Pečina Pod kalom Cave (173/91VG)	ITA	GP	Protected cave in which abundant Pleistocene animal remains have been found, including many bones of Ursus speleus, alongside a few artefacts.
24	Aurisina-Nabrežina's Cava Romana	ITA	G	Pit and tunnel quarries for the extraction of particularly compact and aesthetically valuable horizons, commercially referred to as 'marble', were already active in Roman times.
25	Sinkhole of the Noè-Pečina v Rubijah Cave (23/90VG)	ITA	GM	Large sub-circular opening in the ceiling of a prevailing sub-horizontal cave.
26	Baratro dei cavalli Doline	ITA	GM	A collapse doline, asymmetrical, with steep edges and vertical rocky walls.
27	Olistoliths of Miramare Castle	ITA	G	An olistostroma consisting of limestone blocks (olistolites) chaotically embedded in the arenites and pelites of the flysch.
28	Karst at Borgo Grotta Gigante-Briščiki	ITA	GM	An emblematic area for the surface and underground geomorphology of the Italian Karst sector, this is a cave of well above average size, several large and deep dolines, vast karrenfelds, roofless caves and caves used by humans during prehistory.
	Karst at Borgo Grotta Gigante-Briščiki - Grotta Gigante-Briška jama Cave (2/2VG)	ITA	GM	This is the largest show-cave in the world: with a volumetric capacity of 600,000 m3, it is 130 m long, 110 m high and 65 m wide.
	Karst at Borgo Grotta Gigante-Briščiki - Karrenfeld	ITA	GM	Extensive limestone outcrop along the eastern and northern edges of the Školudnjek doline where small karst features such as kamenitze, Karren of all types, karst crevasses, and dissolution holes abound.
	Karst at Borgo Grotta Gigante-Briščiki - Grotta della Tartaruga Cave (1688/4530VG)	ITA	GM	Cave in which remains attributable to the Upper Paleolithic have been found.
	Karst at Borgo Grotta Gigante-Briščiki - Roofless cave	ITA	GM	A serpentine section of a very ancient cave with a predominantly sub-horizontal development (conduit) that came to light through progressive dissolution and lowering of the surface.
29	Drowning of the Cenozoic Carbonate Platform: the conglomerates	ITA	G	Multiple beds of carbonate conglomerate mark the top of the Nummulitid and Alveolinid Limestone carbonate platform. They are followed by marls and clayey limestone that testify a sharp deepening of the depositional environment and the drowning of the carbonate platform.
30	Monrupino-Repentabor residual blocks (hum)	ITA	GM	Unusual isolated features, mute witnesses to the ancient karst surface.
31	Repen limestones at Dolina quarry	SLO	G	A very beautiful profile through the productive zone of the Repen limestone, one of the most prized natural stones from the Karst, rich in rudist shells.
32	Upper Cretaceous stratigraphic section along the Sežana-Vrhovlje road	SLO	G	A long stratigraphic section, important for understanding the evolution of the Adriatic-Dinaric carbonate platform in the Upper Cretaceous.
33	Phantom Karst' (i.e., dedolomite) in the Povir Formation near Sežana	SLO	G	In the surroundings of Sežana, typical brownish coloured calcite bands from metres to tens of metres in size occur in the Lower to Upper Cretaceous limestones, dolostones and breccias, as the result of dedolomitization phenomena.
34	Kazlje Quarry of Tomaj Platy Limestone	SLO	G	An abandoned quarry of the Tomaj platy limestone, one of the most important sites for fossil vertebrates, invertebrates and plants of the northern part of the Adriatic-Dinaric carbonate platform.

ID del GEOSITO	GEOSITE	NATION	TYPE	DESCRIPTION
35	Cretaceous/Paleogene Boundary section Dolenja vas at Senožeče	SLO	G	A well-studied and internationally known stratigraphic section that crosses the Cretaceous-Paleogene boundary, marked by one of the most severe mass extinction events in geological history.
36	Fault zone of Divača Fault	SLO	GT	A zone of tectonized rocks a few tens of metres wide along the Divača regional fault.
37	Uvala Senadolski Dol	SLO	GM	The Senadol Valley represents an elongated karst depression (uvala) running along the fault zone of the Raša Fault, the formation of which is due to accelerated dissolution in the area of the fracture zone of the Raša Fault. It may also be a remnant of an ancient blind valley.
38	Fault zone of Raša Fault	SLO	GT	A cross-section, almost 100 metres wide, of the fault zone of the Raša fault, exposing the typical zoning of rock deformation within the inner and outer fault zones.
39	Rudist patch-reef at Senožeče-Gabrče	SLO	G	Fossil marine reef, built of rudist shells in a road section.
40	Timavo - Blow-holes: Pozzo presso il Casello ferroviario di Fernetti Cave (104/87VG (CFF))	ITA	GM, H	Evidence for a direct connection with the karst groundwater table.
	Timavo - Blow-holes: Luftloch (7477/6442VG (LUF)) Cave	ITA	GM, H	Evidence for a direct connection with the karst groundwater table.
	Timavo - Blow-holes: Dolina dei sette nani (DSN) Doline	ITA	H	Evidence for a direct connection with the karst groundwater table.
41	Karrenfeld and Karren at Percedol-Prčendol	ITA	GM	To the east of the Percedol Basin, kamenitze, karren and karst crevasses develop in quantity and in a variety of shapes on sub-horizontal strata.
42	Abisso della volpe Abyss (100/155VG)	ITA	GM	Single shaft, about 10 metres wide and 181 metres deep.
43	Bestažovca Cave	SLO	GM	This relatively small cave in the Tabor Hills houses, among other geological and geomorphological attractions, numerous prehistoric archeological remains, including drawings that are at least 7,000 years old and unique in Slovenia.
44	Small-size relief rocky features along the "Living Karst Museum" path	SLO	GM	Along the thematic "Living Karst Museum" path, the whole range of both surface and subsurface small-scale karst features can be observed.
45	Lipica 1 Quarry of rudist limestone	SLO	G	A quarry of Lipica limestone, widely used in architecture, both in Slovenia and abroad. Known in literature for its rich rudist bivalve fauna.
46	Vilenica Cave	SLO	GM	Vilenica is a typical example of a relict cave. It is considered the oldest tourist cave in Europe and probably in the world, since entrance fees were charged as early as 1633. Since 1986, the cave has hosted the Vilenica International Literary Festival, which honours outstanding achievements of Central European authors in the field of literature and essayism.
47	Mines of black coal at Lipica	SLO	G	Abandoned black-coal mines and fossil deposits.
48	Claudio Skilan Cave (5070/5720VG)	ITA	GM	One of the largest and deepest and complex cave systems in the Trieste Karst.
49	Kačna jama Cave	SLO	GM, H	With a length of more than 20 km and a depth of 280 m, Kačna Jama Cave is the longest cave in the Karst and the third longest cave in Slovenia. It is also of great importance from a scientific point of view, because together with the other caves that reach the Reka, it offers the possibility to see and study the karst aquifer "in situ".
50	Risnik Collapse Doline	SLO	GM	Risnik is a beautiful example of a depression with a series of forms indicating the stages of its development and thus that of the entire Divača Karst.
51	Denuded (roofless) cave at the Lipove Doline	SLO	GM	The denuded cave at the Lipove Doline is one of the most educative and beautifully designed denuded caves and thus also a special phenomenon for understanding the geomorphological and geological development of karst areas.
52	Reka blind valley and collapse dolines at Škocjan Caves	SLO	GM	The Reka blind valley and the collapse dolines of Škocjan are part of the Regional Park and Natura 2000. They have been inscribed on the UNESCO World Heritage List, declared a Karst Biosphere Reserve (MAB) by UNESCO and included on the Ramsar List as an underground wetland.
53	Škocjan Caves	SLO	GM, H	The Škocjan Caves, together with the surrounding karst phenomena, represent a geomorphological unicum, suitable for studying the geomorphological and geological/geotectonic evolution of a larger area, as well as other geologically similar areas around the world. They have been a UNESCO World Heritage Site since 1986.
54	Jama na Prevali 2 Cave (Mušja Jama Cave)	SLO	GM	Numerous objects from the Bronze and Iron Ages, which were ritually thrown into the Mušja jama, indicate the extraordinary importance that the cave, as well as the surroundings of the Škocjan Caves, had as a sacred place during the European and Mediterranean cultures in the Late Bronze Age around 1000 BCE.
55	Stratigraphic section at Vremski Britof	SLO	G	An internationally known stratigraphic section of the youngest part of the Cretaceous foraminiferal limestones of the Liburnian Formation.

ID del GEOSITO	GEOSITE	NATION	TYPE	DESCRIPTION
56	Črbenjak doline near San Lorenzo-Jezero	ITA	GM	Large solution doline with gentle slopes located near the karstic ridge.
57	Blind Valley of Grozzana-Gročana	ITA	GM	Between the villages of Grozzana-Gročana and Pesek there is a blind valley with a cultivated floor
58	Rosandra-Glinščica Valley	ITA	GM	The Rosandra-Glinščica Valley is a complex geosite due to the variability of the geological and geomorphological phenomena recognisable within it, including a karst fluvial valley with a deep gorge the slope morphology of which is strongly influenced by tectonics and lithological variations, containing an complex and active cave system on several levels. It represents a unique example of surface hydrography in karst territory.
	Rosandra-Glinščica Valley - Drowning of the Cenozoic carbonate platform: the marls	ITA	G	Widespread outcrops of limestone marls and marly limestones, also known as 'Fucoid Marls', which lie between the flysch and the Alveoline and Nummulite limestones.
	Rosandra-Glinščica Valley - Mt. Stena Cave system - Fessura del Vento Cave (930/4139VG)	ITA	GM	A cave of about 2.6 km in length within the Mt. Stena relief.
	Rosandra-Glinščica Valley - Mt. Stena Cave system - Grotta delle Gallerie Cave (290/420VG)	ITA	GM	A cave which develops within the limestone relief of Mt. Stena, on the orographic right of the Rosandra Torrent. It is an important archeological site.
	Rosandra-Glinščica Valley - Mt. Stena Cave system - Grotta Gualtiero Savi Cave (5080/5730VG)	ITA	GM	A cave of about 4 km in length within the Mt. Stena relief.
	Rosandra-Glinščica Valley - Mt. Stena Cave system - Grotta dei Pipistrelli Cave (527/2686VG)	ITA	GM	A small cave which develops within the limestone relief of Mt. Stena.
	Rosandra-Glinščica Valley - Mt. Stena Cave system - Grotta Martina Cucchi Cave (4910/5640VG)	ITA	GM	A cave of about 1 km in length within the Mt. Stena relief.
	Rosandra-Glinščica Valley - Mt. Stena Cave system - Grotta Ferroviaria Cave (1435/4352VG)	ITA	GM	A small cave which develops within the limestone relief of Mt. Stena.
	Rosandra-Glinščica Valley - Rosandra-Glinščica torrent waterfall	ITA	GM	Waterfall set on a sub-vertical fault about 30 metres high immediately downstream of the contact between the turbiditic rocks and the limestones.
	Rosandra-Glinščica Valley - Paleolandslide	ITA	GM	Landslide involving a limestone block about 40 metres thick, about 200 metres wide and 250 metres high.
	Rosandra-Glinščica Valley - Rosandra-Glinščica Torrent Gorge	ITA	GM	A deep valley stretchingfor some 1,300 metres where the stream flows through deep meanders and potholes.
	Rosandra-Glinščica Valley - Bukovec Spring	ITA	H	A small spring originating from condensation phenomena within the overlying debris.
	Rosandra-Glinščica Valley - Crinale Fault	ITA	GT	Fault conditioning the morphology of the northern side of Mt. Carso.
	Rosandra-Glinščica Valley - Alluvial and debris deposits	ITA	G	Alluvial deposits interdigitated with slope debris, evidence of the complex evolution of the valley, linked to climate change.
	Rosandra-Glinščica Valley - Bagnoli-Boljunec Springs - Antro di Bagnoli-Jama (76/105VG)	ITA	H	Karst spring, in sub-vertical layers of Alveoline and Numulitide limestones at the contact with flysch.
	Rosandra-Glinščica Valley - Caverna degli Orsi-Medvedja jama Cave (5075/5725VG)	ITA	GM	Modest protected cave in which bone remains of the Ursus spelaus have been found.
59	Beka-Ocizla cave System	SLO	GM, H	This system of sinkholes, natural bridges and caves represents a special example of contact karst, which is completely different from the contact karst of the Matarsko Podolje, because the streams do not sink at the end of blind valleys, but laterally in the valley of the Rosandra/Glinščica stream, which forms here at the contact between flysch and limestone.
60	Paleokarst pit with fossil remains of vertebrates (dinosaurs and crocodiles) near Kozina	SLO	GP	This is the first and so far one of only two known dinosaur sites in Slovenia and also one of the two sites in the Karst, which is also rich in remains of crocodile teeth. The site is of international importance for understanding the evolution in particular of hadrosaurs and of regional importance for reconstructing the paleogeographic and paleobiogeographic evolution of the area between the Adriatic and Eurasian geotectonic plates.
61	Matarsko podolje (Brezovica, Odolina) blind valleys	SLO	GM	Brezovica and Odolina are typical blind valleys of Matarsko Podolje and represent a "textbook" example of blind valleys as the most expressive phenomenon of contact karst.

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SHORT PRESENTATION:

Geoparks that adhere to the UNESCO Global Geoparks Network (GGN) traditionally present themselves to the community with a publication that illustrates their distinguishing features, which have enabled them to become a UNESCO Geopark.

This informative publication on the Classical Karst geopark is the business card with which this territory and its community present themselves to UNESCO GGN, visitors and citizens in general.

This is not the first work to illustrate the unique geology and geodiversity of this area, the natural environment and the rich cultural heritage of this border area between Italy and Slovenia. For several centuries the geology of the Classical Karst has been the subject of scientific studies and speleological explorations, which have enriched our knowledge of Karst and the specific environment of the area. This is, however, the first publication to consider the geological and territorial resources present across the entire area of the Classical Karst, from the point of view of geoparks, as an element encapsulating identity for the local community and as a tool for sustainable development.

It is an editorial work created within the framework of the Italy-Slovenia Interreg cross-border cooperation project "GeoKarst" and as part of the policy for the enhancement of geodiversity and geoparks promoted by the Autonomous Region of Friuli Venezia Giulia.

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