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Roof of ROCK

Comune di San Dorligo della Valle
Občina Dolina

Riserva Naturale Val Rosandra
Naravni rezervat Dolina Glinščice

Let's grow up together
Adriatic IPA
Cross Border Cooperation 2007-2013

Programme co-funded by the
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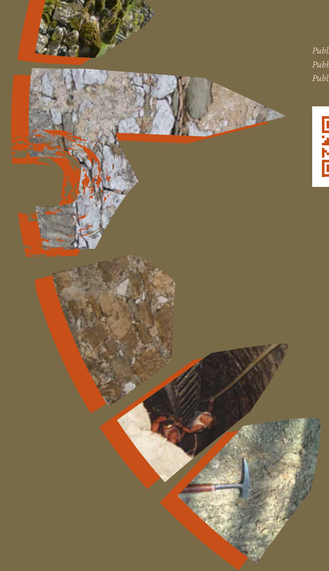
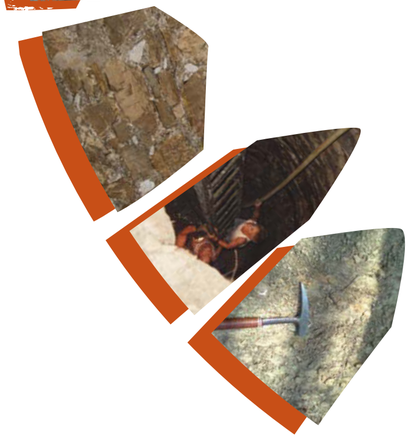


In Transition

Understanding the Junction of Flysch and Carbonate Rocks and its Influence on the use of Stone as a Building Material

A case study of the Comune di San Dorligo della Valle/Občina Dolina Municipality



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Comune di San Dorligo della Valle
Občina Dolina

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DMG dipartimento di matematica e geoscienze

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Comune di San Dorligo della Valle
Občina Dolina

RISERVA NATURALE VAL ROSANDRA
NARAVNI REZERVAT DOLINA GLINŠČICE

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CONTENTS

Trieste and the Golfo di Trieste through the Rosandra/Glinščica Valley: a region of transition from carbonate karst rocks to the flysch world closer to the sea. Transitions in a number of other respects mark the area

Foreword by the Mayor

Sandy Klun, Mayor of the Comune di San Dorligo della Valle/ Občina Dolina Municipality

The publication discusses transition. This is a concept that denotes change. Nature and human history teach us that everything is transient and vulnerable. We can even say that our entire existence is constantly changing without exception.

Nowadays, it is especially important that we are able to tackle change. It is important that we adapt to new challenges we face under new circumstances, even though they might appear very negative at first glance. Here, I am mainly referring to the Regional Law on Reorganising Public Administrations. We must see that each change also brings an opportunity. Alongside this, it is also important we know who we are, who we were and what defines us: to know our cultural heritage, the tradition and natural resources of our land, and to preserve them.

In this publication, the concept of transition also refers to the most distinctive and defining characteristics of the Municipality: transition from the upper, karst region, defined by limestone base, to the lower flysch part. We can observe in the publication how rich our small world is and how our people adapted to large intrusions into the environment and consequently to transition from the historically predominant farming to intensive urbanisation and industrialisation. When we move from the karst plateau towards the Istrian part of the Municipality, we immediately notice the difference in the natural building material of rock between different houses, while construction modes do not differ because our villages were predominantly poor. The majority of households did not have yards. Houses were built directly next to each other to save on walls. Renovations did not start until the Nineteen Sixties or Seventies, when two flat areas of our Municipality were purchased to build the two larger industrial facilities of SIOT and Wärtsilä. This gave local people much needed finance to refurbish their housing stock.

What our ancestors derived from nature through hard work and courage is visible from the architectural heritage subject to the research study depicted in this publication, and from the immense success of local farmers who today market their produce across the world.

I trust that every reader would recognise and appreciate the natural and architectural heritage of our Municipality and that local people would continue to have a say in managing, protecting and preserving all natural resources our precious soil has to offer.

Foreword by the Project Manager

Mitja Lovriha, Head of the Comune di San Dorligo della Valle/ Občina Dolina Municipality European Projects Department

In Transition was planned when the Comune di San Dorligo della Valle/ Občina Dolina Municipality European Projects Department decided to participate as partner in the international project *RoofOfRock – Limestone as the Common Denominator of Natural and Cultural Heritage along the Karstified Portion of the Adriatic Coast*. At the time, I could not anticipate the kind of result we could expect from our participation.
Dr Sara Bensi, familiar with RoofOfRock through contacts with her former university colleague Dr Miloš Bavc from the Geological Survey of Slovenia, encouraged the Comune di San Dorligo della Valle/Občina Dolina Municipality to participate. Her enthusiastic and comprehensive explanation of the project and her readiness to prepare contextual activities for the Comune di San Dorligo della Valle/Občina Dolina Municipality left me in no doubt that the project would be a success.
After initial uncertainty regarding our precise role in the project, we set off when Sara and art historian Neža Čebron Lipovec MA from the University of Primorska furnished us with the detailed content of the study and publication on the Comune di San Dorligo della Valle/Občina Dolina Municipality. This formed the basis for submitting a project to public tender. Alen Sardoč joined us during the project, his precision and experience in European projects ensuring efficient management of procedures. Our hard working colleague Claudia Ferluga took care of all matters regarding the Rosandra/Glinščica Valley. Prof DDr Mitja Guštin offered us professional help in selecting the project group with most expert knowledge from among shortlisted bids. It included architect Aleksandra Torbica, conservation architect Katja Kosič and geologist Dr Igor Rižnar. Nataša Kolenc, another conservation architect, joined later.
The project group researched the geological characteristics and traditional architecture of the Comune di San Dorligo della Valle/Občina Dolina Municipality, summing their findings in this monograph. Over the project's first months, I observed with great curiosity their fieldwork in all our villages. One could hardly resist the exciting contagion of their scientific zeal as they recorded our entire area.
They discovered that the Comune di San Dorligo della Valle/Občina Dolina Municipality is very interesting and unique, especially in terms of geology. Dr Igor Rižnar coined a term when he called the Breg region a real museum of geodiversity. I will also not forget the words of Dr Miloš Bavc who emphasised that geology has always exercised an important influence on all areas of human history and mainly in building heritage. Geological diversity is reflected in buildings' special architectural features. The project group came to new conclusions precisely through analysing buildings.
The Comune di San Dorligo della Valle/Občina Dolina Municipality has always been economically developed, especially thanks to its fertile land and strategic position along all important trade routes. We should also mention the vicinity of Trieste, once the most important port of the Habsburg monarchy, the Austrian Empire and later Austria-Hungary.
The interplay of the above factors made our ancestors very enterprising. Under such conditions special organisational structures and comprehensive and indeed corporative systems of shared values, standards, viewpoints, beliefs, and characteristics develop. We would expect all these characteristics to be present in our culture today. Though slightly concealed, we can dust them off, thus encouraging further development of the Comune di San Dorligo della Valle/Občina Dolina Municipality. The joint pursuit of common goals by all involved is the key, alongside political support.

On the Karst Edge over the Rosandra/ Glinščica Valley Hillsides

Prof DDr Mitja Guštin, RoofOfRock Project Manager at the University of Primorska Science and Research Centre

Much has been said and many exemplary texts written about the Rosandra/Glinščica Valley. The book *Glinščica in njena slikovita krajina* stands out with its length and exquisite quality. In it, writers describe the rich historical memory of life in the valley and the hillsides. They put much emphasis on the rich historic memory of the valley and hillsides above Trieste and the exquisite natural value of the hinterland of the highly urbanised Gulf of Triste that prompted the local authority to designate the area the Nature reserve of the Rosandra Valley (*Riserva Naturale della Val Rosandra/Naravni rezervat doline Glinščice*).
It was in this valley, in Bottazzo/Botač, amid boundaries and ideological division, that they opened the border enabling locals from both sides to socialise. A memorial plaque reminds us of that day: "For peace, civil coexistence, cooperation and mutual understanding since 1981."
In Transition provides an overview of how the geological base influenced the development of traditional architecture. It also warns that the potential to revitalise, improve the quality of life and enrich the tourist economy requires good understanding of the environment and identity.
A few steps up the Rosandra/Glinščica Valley take us to the elevated hinterland of the karst edge that stands proudly over Trieste. Under the Socerb castle, the eagle's nest on the way between Bottazzo/Botač, Petrinje and Klanec pri Kozini, stand a number of natural and historical landmarks deserving special attention.
The wider area of Beka on the karst edge was acknowledged as having great natural and historic significance. A municipal ordinance designated it the Beka Landscape Park as far back as 1992. At the time, it was part of the Municipality of Sežana; today it is in the Herplje-Kozina Municipality. Yet, it never came alive as a place of common identity and memory; on the contrary, it was left to the ravages of time and inventiveness of individual owners.
As on the hillsides below the karst edge, we also find different natural features and cultural/historic buildings and memories along the trade route once known as the Salt Trail. These still await proper evaluation and inclusion into spatial development.
Archaeological remains are also visible on the karst terrain. We have identified the Stone Age Acij rock shelter at Petrinje, the Jazbina cave and the Trpce area near Petrinje. There are numerous remains of forts – fortified prehistoric settlements – such as those at Sela – Monte Carso/Mali Kras, Brgodec or Hrib nad Frnažo, Gradišče Brgod and the Solnograd pri Petrinjah hill fort.
Today, the remains and moats of the Lorencon medieval tower castle (*castrum de la Becha*) and the Punjert (Pungart) and Tabor nad Drago hill forts are covered with grass and forest. As early as the 13th Century, a toll house was built in Klanec pri Kozini ("Klanaz", "Clanez"), later transformed into a mansion house that stands to this day.
The traditional Mediterranean rural building heritage is still reflected in the mills and simple tile roofed one story houses (when the Bora blows, one stays close to the ground) of Beka and its partially preserved village centre. Here, along the Salt Trail, stood hostelries for cart drivers and many houses had special ice storage pits that represented an important source of income and enabled survival not too long ago.
The Church of Sv Peter in Klanec, a mighty Baroque building with a distaff on its façade, faces a centennial linden tree of great symbolic importance. Not far from there still stand relatively well preserved buildings from the times when steam locomotives took water from a railway pump fed by large water supply tanks. More recent developments include a partisan hospital and the modern building of the border watchtower used by the Yugoslav People's Army.

RoofOfRock Project

The RoofOfRock Project is being implemented under the second call for ordinary projects by the Adriatic IPA CBC Programme 2007, by ten partners from four countries: Slovenia, Italy, Croatia and Bosnia and Herzegovina. It started in October 2012 and will continue until the end of September 2015. Two Italian Regions, Friuli Venezia Giulia and Veneto, participate as stakeholder and associate partner.
The intention of RoofOfRock is to establish a joint platform for the sustainable use, preservation and promotion of platy limestone, create relevant guidelines and upgrade individual and joint capacities for preserving common natural and cultural heritage.
Specific project objectives are:

- To analyse the use of building stone in the Adriatic karst region through time and identify examples of best and bad practice;
- To define the general natural characteristics of limestone as building material and to specify the natural characteristics and spread of natural appearance of the specific platy limestone;
- To identify remaining platy limestone deposits and analyse conditions for their sustainable use;
- To prepare grounds for common legislation in the project area;
- To make the stakeholders (spatial planners, conservationists and local government), crafts people and the public aware of best practice in building with stone and to promote the sustainable use of platy limestone while preserving the cultural and natural heritage.

•
The entire Adriatic Region shares at least 200 million years of common geological history. The limestone formed on this platform was a primary building material throughout the project area and plays one of the most important roles in creating common human history. The use of the specific platy limestone as basic construction material is a defining feature of the Adriatic coastline and its hinterland.
The joint publication of the RoofOfRock Project titled *Platy limestones. 10 case studies in the Classical Karst (Carso Classico/Matični Kras)* describes lithological characteristics and techniques for extraction of platy limestone and use of this material in construction of ten characteristic sacral and secular buildings in the Classical Karst area (five from Italy and five from Slovenia) which with typical architectural elements of such stone.
The joint publication features no buildings from the area of the Comune di San Dorligo della Valle/Občina Dolina Municipality as use of platy limestone in construction is not typical for this area but rather the use of rocks from the area surrounding the junction of carbonate and flysch rocks. The publication *In Transition* is intended for precisely this – a better understanding of the junction between carbonate rocks and flysch and the use or rocks located in the above-mentioned area in construction.

Motives for Publishing In Transition

In Transition is part of the *RoofOfRock* project co-funded by the Adriatic IPA CBC Programme 2007-2013. The project seeks to establish a joint basis for the sustainable use, preservation and promotion of platy limestone and create guidelines for the sustainable management of platy limestone as part of the shared natural and cultural heritage of the Adriatic karst coast.
The Comune di San Dorligo della Valle/Občina Dolina Municipality, located on the transition from the karst to the flysch worlds, takes part in the *RoofOfRock* project mainly to gain awareness of how the geological basis is reflected in the architectural heritage. The study gave the Municipality deeper and more detailed understanding of the local geology and a basis for further work in protecting the natural and cultural heritage. Therefore, despite following the same goals as the *RoofOfRock* project, the methodology of the study differs from the joint methodology of the project.
The preparatory phase of the fieldwork confirmed the hypothesis that there are no platy limestone sites in the area and that consequently its use is extremely limited. In the Comune di San Dorligo della Valle/Občina Dolina Municipality, we only find platy limestone used as roofing for a church in San Lorenzo/Jezero. Moreover, roof was renewed using stone specially imported to match the original roofing.
The study on the junction of flysch and carbonate rocks and its influence on the use of stone as a building material relied on two core expert texts written as integral parts of the task. One was *A Geological Report on Conducting a Study on the Junction of Flysch and Carbonate Rocks in the Comune di San Dorligo della Valle/Občina Dolina Municipality and the Influence of the Junction on Architecture* by geologist Dr Igor Rižnar. The other was *An Inventory of Structures by Community* by architect conservationist Katja Kosič, based on the entire project group's extensive interdisciplinary fieldwork.
The selection of communities in *An Inventory of Structures* by Community is based on historically recognised communities listed in Comune di San Dorligo della Valle/Občina Dolina Municipality spatial planning instruments (P.R.G.C. in Italian). They listed Bagnoli della Rosandra/Boljunec, Sant' Antonio in Bosco/Boršt, Dolina, Draga, Grozzana/Gročana, Hervati/Hrvati, San Lorenzo/Jezero, Crogole/Kroglje, Log, Caresana/Mačkolje, Prebenico/Prebeneg, Pesek, San Giuseppe della Chiusa/Ricmanje and Moccò/Zabrežec as having special historical importance. Evidence we collected in these communities confirmed them as witnesses to a rich natural (geological), human and architectural heritage. The study lists architectural and other structures in all of them except Log.
While compiling the inventory, we kept being surprised at how much the appearance of architectural and other structures differs despite the use of similar rocks. We observed that, at the junction, rocks often mere metres apart differ in basic characteristics to a degree reflected in their structural use. It soon became clear that knowledge of local sites and manners of using local rock in construction was insufficient for a wider understanding of the impact of geological diversity on traditional construction; a wider overview was needed.
To understand the numerous transitions at play, we had to gain detailed understanding not only of the geological and geomorphological diversity of the entire area and individual community micro locations, but also of the detailed economic conditions and exceptional cultural diversity which obtained there through time. This is how this study, in effect only a framework to help us prepare guidelines for the sustainable use of rocks and the restoration of architectural heritage, came to life. It confirmed that only detailed understanding of all aspects, including economic and cultural ones, can highlight the factors leading to a particular architectural element and consequently grade its evidentiary value as elaborate or modest.

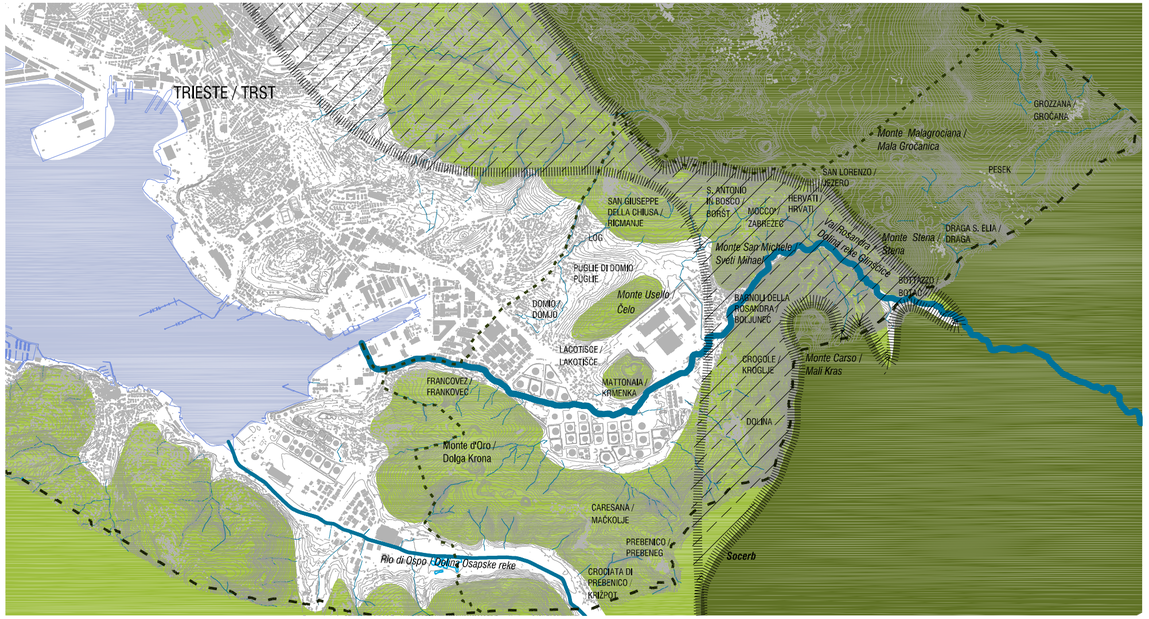
In accordance with the initial bases of the Comune di San Dorligo della Valle/Občina Dolina Municipality, we recorded those items of architectural heritage which had not received special attention before and which moreover represented untapped development potential for the area. Protecting the built heritage over the long term depends on two fundamental factors: identification and use. Involving the built heritage in economic development is today, as in the past, the best guarantee for its preservation.

Acknowledgements

The Authors wish to extend sincere thanks to all residents of the Comune di San Dorligo della Valle/Občina Dolina Municipality who accepted us and offered us help in understanding this diverse area.
We extend especial thanks to the Tul family and so many other residents of the Municipality who opened their homes to us and shared their memories with us.
We extend recognition to the administration of the Comune di San Dorligo della Valle/Občina Dolina Municipality for their active cooperation, especially to Mitja Lovriha, who was as enthusiastic as we were and shared his knowledge and understanding of the Dolina area, as well as Claudija Ferluga and Alen Sardoč for their patience and consistency.
We acknowledge the generous help of a group of RoofOfRock project planners who allowed us to progress our study and to all experts who shared their knowledge, especially Neža Čebron Lipovec, Sara Bensi, David Stolli, Ladislav Placer, Mitja Guštin, Eda Belingar, and the staff of the Research Centre of the Slovenian Academy of Sciences and Arts Nova Gorica Research Station (ZRC SAZU – Raziskovalna postaja Nova Gorica).







margine del ciglione carsico - Breg (termine paesaggistico, adottato da L.Pillacorr, "Krščki rob (landscape term).Geologic section along the motorway Kozina - Kopar (Capodistria)."
rob Krasškega roba - Breg (pokrajinsko poimenovanje, povzeto po L.Pillacorr, "Krščki rob, Geološki prerez vzdolž AC Kozina – Koper"
edge of the Karst edge - Breg (landscape terminology, adopted from L.Pillacorr, "Krščki rob (landscape term).Geologic section along the motorway Kozina - Koper (Capodistria)."

margine del Altopiano Carsico
rob Kraškie planote
edge of the Karst plateau

Altopiano Carsico - Carso
Kraška planota - Kras
Kars plateau - Karst

area del Ciglione carsico - Breg in termini paesaggistici
območje Krasškega roba - Breg kot pokrajina
area of the Karst Edge - Breg as landscape

zona di transizione tra Altopiano e la pianura
prehodno območje med planoto in ravnjo
transition zone between the plateau and the plane

pianura
ravan
plane

Mare Adriatico
Jadransko morje
The Adriatic Sea

Torrente Rosandra
Reka Glinščica
Torrent Rosandra / River Glinščica

Rio di Ospo
Osapska reka
Osp river

Altri corsi d'acqua
Ostali vodotoki
Other watercourses

Confine amministrativo del comune di San Dorligo della Valle
Administrativna meja občine Dolina
Administrative boundary of the municipality of Dolina

Confine di stato Italia / Slovenia
Državna meja Italija / Slovenija
State border Italy / Slovenia

Introduction

On Multifarious Transitions

The Comune di San Dorligo della Valle/Občina Dolina Municipality is on the far north of the Adriatic Sea where the Mediterranean Sea reaches deepest into Continental Europe. The municipality covers the far southeast of the Province of Trieste (Provincia di Trieste/Pokrajina Trst), some 10 km southeast of Trieste, along the Italian-Slovenian border. To the northeast, the municipality scales the karst plateau above a steep Karst edge. The remaining parts include a fertile rolling plain and the flood plains of the Rosandra/Glinščica creek and the Rio del Ospo/Ospapska reka River flowing into the Adriatic.
The land under the karst edge is called **Breg** in the hinterland of the Gulf of Trieste or the **Karst edge** and occasionally the **Bržanija** southeast of Socerb.Today the area is largely a suburb of Trieste in the hinterland of a vast industrial zone (Wärtsilä and other facilities). It is served by motorways joining Trieste with Venice and Koper/Capodistria. These modern structures depict the main feature shaping the region through the centuries: transition. Transition is reflected in occurrences related to the presence of people as well as natural phenomena and structures.

Source: http://www.freeworldmaps.net/europe/italy/map.html

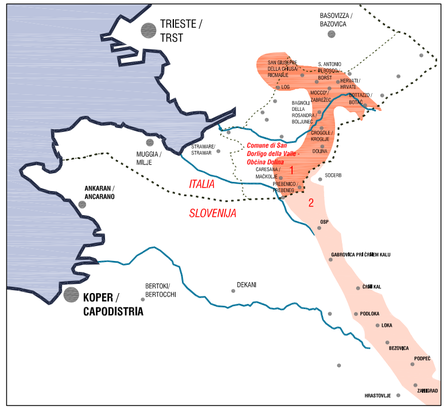
Breg and Bržanija: two names, one area

Dr Borut Klabjan

The area which slowly descends towards Istria/Istra from the Karst (Carso/Kras) is unified in the geographical, historical and sociocultural senses. It extends from hillside villages in the Comune di San Dorligo della Valle/Občina Dolina Municipality, through Osp and Črni Kal, all the way to Brezovica and Podpeč. The name Breg is used in the Italian portion of it and Bržanija in the Slovenian portion.
In the past Breg and Bržanija led a shared life. The area offered relatively advantageous conditions. There was enough water, a fertile soil and clement weather. The vicinity of coastal towns offered additional opportunities for economic development. The area witnessed frequent switches of possession, testifying to an extraordinary location marked by transition. The locality is strewn with evidence of its frontier role and the consequent need to defend it. From antiquity, through the Middle Ages, and all the way to the present, this is where different cultures and sovereigns met, overlapped and clashed. Roman and Byzantine rulers fought here, followed by Lombards, Avars, Slavs, Franks, the Patriarchate of Aquileia, the warlord dukes of old, Venetians and Habsburgs – all the way to the emergence of national entities in Italy in the 19th Century, the dissolution of the Austro-Hungarian Monarchy after the First World War in 1918 and the emergence of the Kingdom of Serbs, Croats and Slovenes named Yugoslavia in 1929. After the First World War, the entire area left the Austrian two-headed eagle for the Kingdom of Italy, retaining its administrative integrity when the German Reich annexed it after Italy capitulated on 8 September 1943. Demarcation after the Second World War significantly influenced the area. On 10 February 1947, the Paris Peace Treaty established the Free Territory of Trieste comprising Zones A and B. British and American forces administered the former, and the Yugoslav National Army the latter. The London Memorandum of 1954 awarded Zone A to the Republic of Italy and Zone B to the People's Federal Republic of Yugoslavia.

The border between Zone A and Zone B, also known as the Iron Curtain, left a significant mark on a once culturally very connected, albeit complex, area. The Italian territory was referred to as Breg, while the Yugoslav territory was referred to as Bržanija. Though the dividing line was, in comparison to other European borders, quite porous and permeable, it undoubtedly changed the local social fibre much. Breg and Bržanija found themselves on the margins of their countries, and not only in the geographical sense. They were at the remote edges of countries with centralised administrations which felt fear and distrust towards their neighbours.

Studies of Istria show differences between neighbouring villages once divided by the Austrian-Venetian border (until the dissolution of the Serenissima in 1797). We still have no similar studies to help us understand how the Italian-Yugoslav and later Italian-Slovenian border (borders not only national but also ideological) influenced the area. However, the differences which emerged in the mid 20th Century did not manage to erase the common history connecting the Breg communities. This joint history rests on shared centennial pursuits like vine and oil tree husbandry, shared religious practices like using the Glagolitic script, the political interaction of the Slovenian and Croatian national movements in the 19th and 20th Centuries with their reading-rooms and social organisations, and last but not least a common cultural heritage exemplified by the characteristic Breg costume (in Slovene called *brška noša*).



An attempt to delineate the Breg and Bržanija.
1 – Breg, 2 – Bržanija (Aleksandra Torbica)

1.1 Blame it on the Geology

The border between the Karst (Carso/Kras) and Breg coincides with a very distinct geological boundary between the karstic limestone and the littoral (Istrian) flysch. The boundary is marked by another characteristic of Breg: the transition from modest, arid land to an aqueous area under the karst edge. The overthrust geological boundary between solid limestone and much softer flysch forms a steep morphological degree up to three hundred metres long, which produces a sharp boundary between the mild Mediterranean climate and the effects of the harsh continental climate. The climatic boundary and the relief create a boundary between the Mediterranean and Continental vegetation which may be additionally divided into arid and aqueous Mediterranean and Continental flora. Specific conditions, especially in the Rosandra/ Glinščica Valley, cause immense diversity in those plant species saved from extinction by a shift in local spatial and commercial development. The local fauna endured, while being completely eradicated by industrialisation and other human intervention in many other nearby areas.There is, therefore, a distinct boundary in the Comune di San Dorligo della Valle/ Občina Dolina Municipality between the natural and developed areas, while the boundary between countryside and city, rural and urban, is also present but somewhat blurred. Water which sinks into the terrain through porous karstic soil comes back to the surface at the junction with flysch. In the Rosandra/Glinščica Valley, it has carved a gorge into the limestone over extended geological periods, the gorge representing both a natural phenomenon and the cradle of local human settlement.

The presence of karstic caves offering protection in high locations, the abundance of drinking water, a mild climate, a fertile soil, and the vicinity of the sea attracted people of different origins to this area over the millennia. In the Early Middle Ages, a link, was laid here between the Latin, Germanic and Slavic worlds. in the cultural and political sense. Today, the two nations of Italy and Slovenia remain intertwined here.

Indigenous construction traditions originated from the natural resources and developed over the centuries through contact with the construction traditions of arriving outsiders. This combination fused Karstic and Istrian architecture in this area. Some parts preserve typical forms, while elsewhere forms fuse into unique shapes and combinations that cannot be seen anywhere else. The basic building material of the local architecture was grey limestone and brown flysch sandstone, used in a manner seen nowhere else.

1.2 When Geology has no Influence

The geopolitical and spatial interventions of recent decades stripped the natural transience of the area. This transience was partially restored by the opening of the border between Italy and Slovenia: not in the strictly transitional sense, but as opening a possibility of common development and sustainable use of an area shared by the two countries. The phenomena of the Rosandra/Glinščica Valley, in particular, represent unexploited development potential for both sides.

Characteristic geological formations and the Supet waterfall nearby Bottazzo/Botač: water and rock determine almost all aspects of life in this region

A view of Trieste through the Rosandra/Glinščica Valley; the Church of St. Mary on the Rock (Santa Maria in Siaris/Sv. Marija v Pečah) is visible bottom left

The plaque marking the opening of the border at Bottazzo/Botač

Spatial Transitions over Time

The role of architectural heritage in understanding the development of an area

The architectural heritage and other traces of human settlement in an area are both a kind of fingerprint of the time when they were created and occasionally also a locked treasure chest of knowledge about those that created the heritage. Just as the presence and form of rocks testify to the geological history of a particular area, architectural heritage also bears visible and invisible traces of its builders or peoples that transformed the space they lived in over the centuries. Local architectural knowledge that developed from long and necessary adaptation to the natural characteristics of the terrain was continually improved by the knowledge and customs of newcomers and new technical advances. This also applies to the heritage of Breg.

Here, like elsewhere, the key motivation for selecting a place to settle was primarily connected with survival or a better life for individuals or groups: people required adequate food, water, and safety for a favorable economic and political environment. Due to its special transitional location between the sea and the land, as well as the presence of a river in an area that otherwise has no surface watercourses, the spatial development of Breg was marked by a distinct connectedness of towns and paths that led this area in different directions through history as the political and economic circumstances changed.The favorable climate, karst caves, plentiful water, and access to the sea attracted people to settle this area as early as prehistoric times. The continuous settlement of Breg dates very far back in history. The first known human traces in Breg are associated with Neanderthals (*Homo neanderthalensis*), who sought shelter in the caves below the Breg during the last glacial period. The remains of characteristic stone tools,fireplaces, and evidence of food consumption found in Bear Cave (*Caverna degli Orsi/Medvedja jama*) below Mount Karst (Monte Carso/Mali Kras) attest to their presence, in addition to skeletons of cave bears and other Ice Age animals.

Drawing of the entrance to Bear Cave (Caverna gegli Orsi/Medvedja jama) below Mount Karst (Monte Carso/Mali Kras).
Source: Photo Archive of the Trieste History and Art Civic Museum

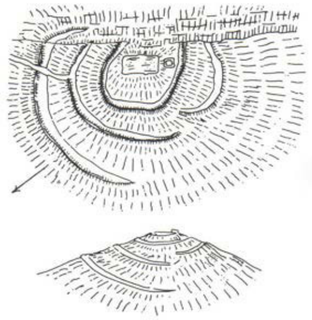
The presence of ancient humans is attested by archaeological finds, including these Neolithic fired clay stamps known as pintaderas found in Gallery Cave (Grotta delle Gallerie/jama Pečina pod Steno) above the valley.
Source: Photo Archive of the Trieste History and Art Civic Museum

The course of Rosandra/Glinščica creek as a natural millennia-old transition between land (the Karst Plateau) and Gulf of Trieste

Later traces of Stone Age man, already Homo sapiens, in this area are significantly more recent. They originate from the last great glaciation, when the climate was becoming warmer and the level of the Adriatic Sea rose again almost to today's level. Remains of settlement from this area have been discovered in Trench Cave (*Caverna della Trincea*/jama *Spodmol v Podpečini*).
People also settled Breg in the Neolithic at the end of the Stone Age. Traces of Neolithic culture can be found in a number of locations, the most important one being Gallery Cave (*Grotta delle Gallerie*/ jama *Pečina pod Steno*) above the Rosandra/Glinščica Valley. The Neolithic is marked by the emergence of agriculture and livestock farming, ceramic items, and permanent settlement. Archaeological studies thus far indicate that, in the period when settlements with simple open-air residences started to emerge, karst caves in Breg remained in use as shelters, stables for livestock, and temporary residences for Neolithic people.From the perspective of architectural heritage, the Neolithic is of interest as the era to which one can date the first use of local stone for building homes. This was when people carried out activities that affected the natural environment for the first time, adapting it to their needs.
The first recognized settlements that still partially mark Breg today started developing there in the second century BC, parallel to the emergence of metal use in the Bronze Age. These prehistoric inhabitants established a number of fortified settlements in Breg, the most prominent of which are the Mount Karst (Monte Carso/Mali Kras) Hillfort and the St. Michael (San Michele/Sveti Mihael) Hillfort at Bagnoli della Rosandra/Boljunec. Its triple stone wall is still visible from the flat part of Breg. The key motivation for the shape and location of settlements was security. These hillforts, on two hills at the entrance into the Rosandra/Glinščica Valley, also controlled the important transition between the coastal plain and the plateau in the hinterland (in terms of security, military, and economics). The ancient inhabitants of Breg, believed to be a tribe known as the Histri, also secured the settlements with massive walls. They usually built a double stone wall filled with smaller stones (the core-and-veneer technique without using mortar). Such walls were built from local stone, and in the hinterland of the Gulf of Trieste they were built from limestone or sandstone. The technique of building various types of dry walls—the most reasonable response to the natural conditions of an area with plentiful stone and a lack of other material—has survived until present times. Preserving this type of architectural heritage and the knowledge connected with it signifies living contact with the past and the many peoples that laid stone on stone here from generation to generation.

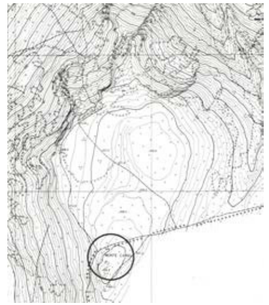
Limestone cliffs above the right bank of Rosandra/Glinščica creek with a cave area settled in prehistoric times

The Mount Karst (Monte Carso/Mali Kras) Hillfort (hilltop at left) and St. Michael (San Michele/Sveti Mihael) Hillfort (hilltop at right) jointly overlooked the transition between the sea and the Karst Plateau through the Rosandra/Glinščica Valley



The St. Michael (San Michele/sveti Mihael) Hillfort at Bagnoli della Rosandra/Boljunec (layout and view from the west) as sketched by Carlo Marchesetti (1850–1926), a natural scientist and paleontologist from Trieste and director of the Trieste Natural History Museum for many years.
Source: Flego & Rupel, Prazgodovinska gradišča tržaške pokrajine

Photo of St. Michael's (San Michele/Sveti Mihael) Hill from the beginning of the twentieth century with the hillfort visible at the top.
Source: Flego & Rupel, Prazgodovinska gradišča tržaške pokrajine



Topographic map of Mount Karst (Monte Carso/Mali Kras) above the Rosandra/Glinščica Valley, with the largest hillfort in the Trieste Karst (Carso triestino/ Tržaški Kras) and the hilltop clearly shaped for a hillfort. According to Marchesetti, Histri troops found shelter here after battles with the Romans in 178 BC.
Source: Flego & Rupel, Prazgodovinska gradišča tržaške pokrajine

Marchesetti's sketches of the Mount Karst (Monte Carso/Mali Kras) Hillfort: layout and view from the east side.
Source: Flego & Rupel, Prazgodovinska gradišča tržaške pokrajine

Remains of the massive, almost 800 m, east wall of the Mount Karst (Monte Carso/Mali Kras) Hillfort.
Source: University of Trieste, I siti costieri dell'alto Adriatico: indagini topografiche a terra e mare

Decorated clay pot from the nearby Montedoro/Dolga krona Hillfort at Trieste (thirteenth to eighth century BC). Source: Photo Archive of the Trieste History and Art Civic Museum

Like any form of human settlement, the emergence of settlements in form of hillforts on the northern Adriatic coast and its hinterland reflected the needs and opportunities of that time. The construction method used for hillforts and other structures is also an indicator of the connectedness of prehistoric communities in the wider European or Mediterranean area, and also points to the influence of eastern Mediterranean civilizations at the time. Connections were established on land (e.g., the prehistoric Amber Road) and on sea. The location of Stramare/Štramar on the coast has been especially important for Breg and its residents, who have been connected with sea routes since prehistoric times.

The strategic location of Breg also influenced its spatial development after the arrival of the Romans in the second century BC. The Romans built a large military fort on Saint Roch's Hill (Monte San Rocco/Koromačnik) hill at the transition between the coastal plain and the entrance to the Rosandra/Glinščica Valley. Its remains are still preserved today. The latest archaeological excavations (in 2015) show that it is actually the oldest Roman structure in the Trieste area found to date. The fortification at Saint Roch's Hill (Monte San Rocco/Koromačnik) was built as a starting point for Roman conquests of the territories of neighboring peoples during the military campaigns against the Histri. They started in 181 BC with the establishment of a Roman colony in Aquileia and ended in 178–177 BC with the final defeat of the Histri and the Roman conquest of Istria and other Histri territories. The military importance of this fort is believed to have been supplemented by two smaller Roman forts at Grociana Hill (Monte Grozzana/Mala Gročanica) and at Gold Hill (Monteoro/Dolga krona), both in today's Comune di San Dorligo Della Valle/ Občina Dolina Municipality.

In Breg, in the same vein as in Istria (Istria/Istra) and in the Karst (Carso/Kras), the supremacy of the Romans brought to an end the two thousand–year period of the hillfort culture and the abandonment of settlement at the hillforts. Local architectural tradition was partially merged with and partially superseded by the Roman manner of construction and settlement formation.

The year 46 BC was an important milestone in the development of Breg and the countryside around Trieste in general. This was when Julius Caesar granted Tergeste (today's Trieste) the status of a Roman colony. With this, the settlement—which presumably existed on St. Justus' Hill (Colle di San Giusto/Grič svetega Justa) prior to the arrival of the Romans—and its surrounding areas began a completely new chapter.In Roman times, the spatial development of Breg was significantly marked by the construction of roads and other structures connected with supplying the growing city of Tergeste with food, water, and other necessities. In the Karst (Carso/Kras) area of today's Comune di San Dorligo Della Valle/Občina Dolina Municipality, the Romans improved the road connecting Aquileia with Tarsatica—now the Trsat/Tersatto) district ofRijeka/Fiume, Croatia.

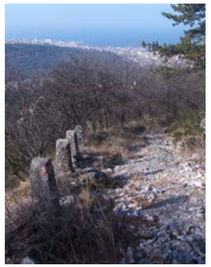
View of Saint Roch's Hill (Monte San Rocco/ Koromačnik) from Dolina with the remains of a Roman military fort from the second century BC (Trieste in the background)

Later on, they built a road to Dalmatia, which was the main connection between Rome and the Adriatic coast. An important connection between Tergeste and this road ran through the western part of the Comune di San Dorligo Della Valle/Občina Dolina Municipality. It also served as a road towards Emona, Noricum, and Pannonia. The Via Flavia ran through the flat part of today's Comune di San Dorligo Della Valle/Občina Dolina Municipality and connected Tergeste with Istria/Istra and its coastal towns.The Roman aqueduct is a structure that has symbolized the Roman presence in Breg until this day. This approximately 15 km aqueduct was built in the first century AD to supply water to the expanding town of Tergeste. The majority of water was gathered from Oppia Spring (Fonte Oppia/*Zvirk*, *Klinščica*, or *Klinšč'ca*) in the Rosandra/Glinščica Valley. From there, the viaduct ran all the way to the center of Tergeste.The aqueduct from the Rosandra/Glinščica Valley, like many other Roman constructions, served its purpose for a long time, apparently continuously until the sixth or seventh century. It is said that in the eighteenth century it was so well preserved that the Trieste city administration considered renovating it to provide better drinking water for Trieste. The plan was abandoned when they started obtaining water from other sources, mainly from the Timavo/Timava River. In the Roman period, life in Breg, like elsewhere, moved from hillforts to more easily accessible and more fertile areas. The form and logic of settlements completely shifted during that period. In the fertile valley below the Karst edge, wealthy Romans built *villeae rusticae*, or rural manor houses, located on larger agricultural estates, and mainly made a living from agriculture, fishing, and intensive grazing. Contrary to the way the word villa is often understood today, a *villa* was a rustic (i.e., simple countryside) estate with a rural house and separate outbuilding located on cultivated land. A basic characteristic of these estates was the use of slave labor and a market orientation. They sent their produce to the world by sea (via nearby ports; e.g., Stramare/Štramar) and land.

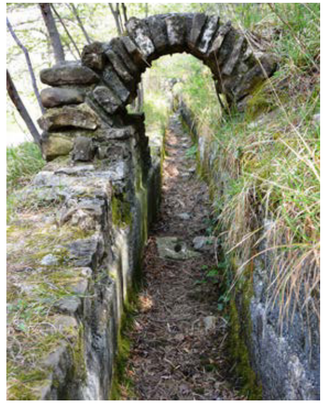
The Zaboljunec cremation cemetery (also known by the Slovenian microtoponym *pri Grubljі*) attests to dense settlement of this territory in the Roman period. A number of other finds also testify to this period: numerous Roman coins, ceramics, and other remnants from the Roman era, especially in Bagnoli della Rosandra/Boljunec and its immediate surroundings (a transient location, plenty of water, and fertile land).

The *Pax Romana*, or the period from first to third centuries AD, was a long period without wars that saw Tergeste and its surroundings develop and flourish. It ended in 476 AD—the year that marked the fall of the Western Roman Empire. It was that year when the German commander Odoacer dethroned the last Roman emperor, Romulus Augustus, and handed over his crown to the Byzantine emperor. With this act, Tergeste and its surroundings formally came under Eastern Roman or Byzantine rule. However, from 476 onwards, this area was de facto ruled mostly by various German rulers. Rome had ruled the northern Adriatic territories for six centuries and left behind a diverse heritage, including a construction tradition, which influenced the area's everyday life long after its fall.After the fall of the Western Roman Empire, there was a tumultuous period of migration of peoples, during which various interests clashed in Breg, especially the interests of the Byzantines, Lombards, and Franks.

Detail from the Tabula Peutingeriana, a medieval copy of a Roman itinerary from the third century AD. In parallel with the colonization of new lands, the Romans systematically built a road network that strategically connected the entire empire. "All roads lead to Rome": within Rome's Regio X Venetia et Histria the majority of roads started in its capital, Aquileia. Source: Strade romane, http://trieste.a.wiki-site.com/images/1/11/Tavola_Peutingeriana_Istria.jpg



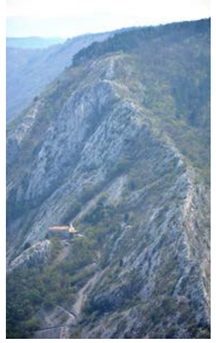
The presumed route of the Roman road on Drašče Hill above Trieste. Source: University of Trieste, I siti costieri dell'alto Adriatico: indagini topografiche a terra e mare



Remains of the ancient Roman aqueduct at Bagnoli Superiore/Gornji konec in Bagnoli della Rosandra/Boljunec

An abundance of clean water in the Rosandra/ Glinščica Valley

After the fall of the Roman Empire, the wars and overall shortage caused a significant decrease in the number of inhabitants of Europe. The Romans, or the Byzantines, who had settled in this part of the Adriatic, started to close themselves into newly fortified coastal cities, such as Trieste and Koper/Capodistria. They also took refuge in various shelters in the Rosandra/ Glinščica Valley: on the rocky Crinale Ridge (Crinale/Počivenca) (where the remains of a soldier from Late Antiquity were discovered), and in the fortified Iron Gates Cave (*Grotta delle Porte di Ferro/Železni prton*) high up and below the Karst edge. Over the following centuries, the abandoned territory was gradually settled by Slavs.The document on the Rižana assembly drawn up in Rižana/Risano near Koper/Capodistria, probably in 804, testifies to the events at the time. It talks of the complaints of the inhabitants of Istrian towns and citadels to the delegates of Charlemagne regarding the aggressive introduction of the Frankish feudal system in the area, which had been under Byzantine administration for centuries. The document is one of the most important documents depicting social, administrative, economic, and political conditions in Istria/Istra during the transition from the Byzantine to Frankish administrative system. It also refers to the settlement of Slavs in the hinterland of Istrian Roman cities. The Slavs mostly came from Carniola. They were settled by their Frankish rulers to make better economic use of unpopulated areas in the countryside near the fortified cities. It is believed that during this time the first Slavic (or Carniolan) settlements emerged in Breg. Archaeological finds indicate that they presumably first settled below St. Michael's Hill (Monte San Michele/Sveti Mihael), above the remains of the Roman aqueduct, in the area of today's Bagnoli della Rosandra/Boljunec. The Slavs brought their own building tradition (using wood for construction), which they gradually merged with the construction knowledge of the native inhabitants and other peoples they were in contact with.



The Crinale Ridge (Crinale/Počivenca) above the Rosandra/ Glinščica Valley with the Church of St. Mary on the Rock (Santa Maria in Siaris/Sv. Marija na Pečah)

The period of settlement of the Slavs in Breg is connected with the legend about the origin of the Romanesque Church of St. Mary on the Rock (Santa Maria in Siaris/Sv. Marija na Pečah). The shrine at this inaccessible rock in the Rosandra/Glinščica Valley was supposedly built by Charlemagne himself with the wish to be buried there. The first historical information dates back to 1267, when an ecclesiastical brotherhood of flagellants (Battuti/ Bičani) was established in Trieste. Their founding act, among other things, prescribed penance for swearing: a sinner had to go on a barefoot pilgrimage to this shrine in the rocky Rosandra/Glinščica Valley, 12 km away. In the fifteenth century, the church was a known pilgrimage destination. In the mid-seventeenth century, the church was renovated and expanded, and later abandoned for a long time.

The year 948 was of great significance for the area now known as the Comune di San Dorligo Della Valle/Občina Dolina Municipality. It was then that Frankish King Lothair II of Italy gave Bishop John of Trieste the town of Trieste/Trieste and its surroundings as his feudal estate. During the same period, the first parish church outside the Trieste town wall was constructed in Breg: St. Ulrich's Church (Sant' Ulderico/Sveti Urh), which became the center of the new episcopal district. The settlement of what is now Dolina, today the seat of the municipality, developed around the initial religious center over the course of the centuries. St. Ulrich's Church long preserved the role of a religious center, but the center of secular power later moved to a new, more dominant location: Moccò Castle (also referred to as *Mokovo*, *Mucho*, or *Mocho*; Sln. *Muhov grad*). The castle was first mentioned in written documents in 1233 under the name *Castro de Muhou*, but it is probably much older.The position of Moccò Castle allowed control of the entire Breg and the profitable trade route from Istria through the Aquilinia/Žavlje salt pans to Carniola and other Austrian provinces. It was built on the foundation of an older building. Modern archaeological research connects its loca-

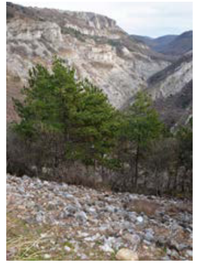
The Church of St. Mary on the Rock (Santa Maria in Siaris/Sv. Marija na Pečah)in the dramatic Rosandra/Glinščica Valley right above the ancient route through the valley

tion with the prehistoric and Roman periods. The Moccò episcopal district was named after the castle. The Moccò district comprised ten villages. In the Middle Ages, they were called Riçmegne (now San Giuseppe della Chiusa/ Ricmanje), Gassi (now Log), Borst (now San Antonio in Bosco/Boršt), Breseç (now Moccò/Zabrežec), Bagnoli (now Bagnoli della Rosandra/ Boljunec), Creguiani (now Crogole/Kroglje), Sancti Odorici (now Dolina), Sancti Martini (now Brce), Brde (nowBrdo), and Preseriani (now Preserje). The last two villages disappeared over the course of time.For centuries, the Moccò district was the border area between Trieste, a distinctive part of the Austrian lands, and the territories of the Venetian Republic. It was therefore an area of a lengthy struggle that significantly influenced the development of Breg. The influence of Moccò Castle ended in 1511, when, after one of the many wars with the Venetians, it was razed to the ground at the behest of Trieste Bishop Pietro Bonomo.

Modern reconstruction of Moccò Castle with three towers. Source: Riavez, Duiz, & Bini: I principali siti di epoca medievale. 3D graphic representation: Fonda, for ArcheoTest srl

Scant remains at the site of Moccò Castle. On the slopes below the former castle, large quantities of stone—the remnants of a former fortification—are still visible

The location of Moccò Castle on the hill above the Rosandra/Glinščica Valley between the Gulf of Trieste and St. Michael's (San Michele/Sveti Mihael) Hill (right) allowed effective control over the territory and trade routes



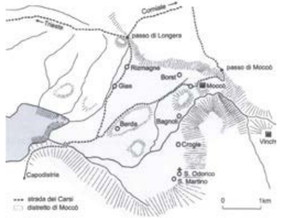
Scant remains at the site of Moccò Castle. On the slopes below the former castle, large quantities of stone—the remnants of a former fortification—are still visible

A well-known but inaccurate depiction of Moccò Castle (Castello di Mocco/Muhov grad) by Alberto Rieger. Somewhat more realistic is the depiction of the Rosandra/Glišcica Valley and Karst edge with visible routes at the time. Source: Darovec, Kratka zgodovina Istre

In the Middle Ages, much of life in Breg was centered around the trade route that connected the Littoral to Carniola and beyond to other Austrian provinces, all the way to Vienna. For centuries, Trieste and Koper/Capodistira, and later the Venetian Republic and the Habsburgs, fought for control over the route and the transport. A trade route, today known as the Salt Road, ran through the territory of today's municipality: from the Chiusa Pass (Chiusa/ Ključ) at Cattinara/Katinara above Trieste, past Breg, on towards the Ospo/ Osp Valley and further towards Istria/Istra. A later variation of the route ran past Moccò Castle so that the owners of the castle would have better control over it.

Sea salt was very important merchandise; it was one of the main sources of wealth at the time and was a good that the Venetian Republic had a monopoly over in this part of the Adriatic. Therefore, the vast Aquilinia/Žavlje salt pans at the mouth of Rosandra/Glinščica creek were of great importance for the economy of Breg. One of the main trade routes towards Carniola and interior Austrian provinces ran past the Aquilinia/Žavlje salt pans. Salt pans were a source of great wealth and were one of the reasons for the many wars between Trieste and the Venetians, causing Trieste to voluntarily surrender to the Habsburgs in the fourteenth century. Thus, Trieste's territory remained relatively independent, and the city itself gained in importance. This decision significantly influenced the further development of Trieste and its expansion, representing a shift toward the spatial and general development of its hinterland, including Breg.

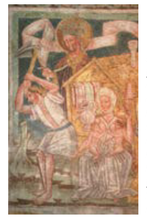
In addition to wars for political and economic supremacy, the fifteenth century was marked by a number of Ottoman invasions. The Ottomans managed to reach Trieste and its environs a number of times. As a response to the Ottoman threat, people living in the countryside started building fortified camps for defense against the Ottomans, where they took refuge during incursions. A monument from this period is the Botač Fort (Tabor di Draga/Tabor nad Botačem), a partially preserved fortification on the rim above the Rosandra/ Glinščica Valley. It is believed to have been built by the inhabitants of Draga and the surrounding villages. In the seventeenth century, the former Moccò district was given a new administrative center. The center of secular power moved to the dominion of Socerb at Socerb Castle, which remains dominant in this area to this day. During that period, two new manors were built in Breg: a mansion near Lacotisce/Lakotišče and a manor near the former Moccò Castle at Moccò/Zabrežec, which served as an administrative center and a tollhouse on the old road between the coast and the Karst Plateau. It was simply referred to as the Robida Manor due to the vicinity of the ruins of Moccò Castle (also known as Robida). Neither manor is preserved today.



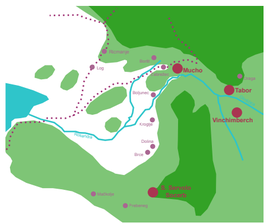
Medieval trade routes in the Dolina area. Source: Colombo, Mocco—castello e distretto. Quattro secoli di medioevo alle porte di Trieste

Packing goods through the Karst region in the bora wind. Source: Valvasor, Die Ehre deß Hertzogthums Crain

The great Aquilinia/Žavlje salt pans on a military map prepared under Joseph II (Josephinische Landesaufnahme, 1763–1797). The map shows a historical reconstruction of routes in the past (dotted black line) and the route that was recently interpreted with the help of software (red line). Source: Gherdevich, L'analisi spaziale come strumento per la ricostruzione della viabilità medievale nel Friuli Venezia Giulia



A section of a fresco from the Hrastovlje church depicting a modest wooden house is one of the rare depictions of a residence between Istria/Istra and the Karst (Carso/Kras) from that time. Source: Parish of Predloka



Castles and forts in the Rosandra/Glinščica Valley and in Breg. Source: Davide Stolli

Similar to the Bottazzo/Botač Fort, the walled Holy Trinity Church (Cerkev Sv. Trojica) near Hrastovlje offered locals protection against Ottoman attacks. The building is much better preserved than the one in Breg and is a monument to its time thanks to the paintings preserved inside the church (created by John of Kastav in 1490)

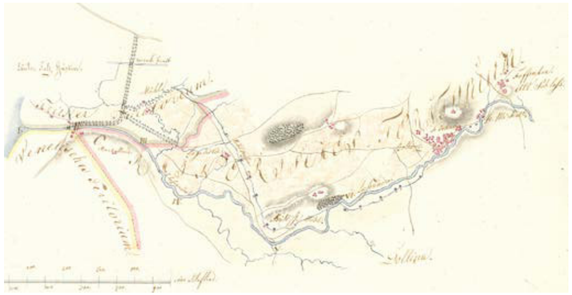
The year 1719 is another turning point in the development of the wider Trieste area and the city itself. It was then when Holy Roman Emperor Charles VI pronounced Trieste a free port. Two years later, freedom to sail on the Adriatic was granted. Trieste became the main port and the commercial capital of the Austrian Empire. This measure caused an economic revolution, turning Trieste, formerly an insignificant small town, into a blossoming economic and cultural center. The city grew as new districts were built, and the number of residents and newcomers increased. The development of the Port of Trieste under Habsburg rule in the eighteenth century, and especially in the nineteenth century, once again moved thecenter of development from the countryside to the sea, fostering an emerging metropolis. The economy of the dominion of Socerb, which had previously been mainly based on supplying itself, became centered around the city's market.

The geology and geomorphology of Breg with the presence of running water offered the residents of the Rosandra/Glinščica Valley another economic activity: milling. The existence of mills was documented for the first time in the thirteenth century. The market for millers in Breg comprised the wider Karst area, where there were no surface streams that could power mills. The economic significance of milling increased parallel to the increase in the economic power of Trieste and its port. In the nineteenth century, there are believed to have been as many as thirty-two mills along Rosandra/Glinščica creek, which required significant development along the stream. They predominantly milled grain for flour or basic foods. However, with the increase in maritime trade through Trieste, the Breg mills also processed more exotic products, such as oriental spices. There are few traces left of the many Breg mills. Some were abandoned and disappeared over the course of time, and parts of the mill structures were preserved when they were converted to other purposes. Only one mill has preserved its milling mechanisms and equipment, and it is perhaps the last that can carry the milling story of Breg into the future.

With the abolition of serfdom in 1848 and 1853, large estates were finally abolished. Farmers could finally purchase land, which changed spatial management patterns. The abolishment of serfdom ended the existence of the dominion of Socerb. The nobles' land was reorganized and split, creating two municipalities: Materija and Dolina, which in today's form represents the historic continuity of the initial bishop's district, the later Moccò district, and the dominion of Socerb.

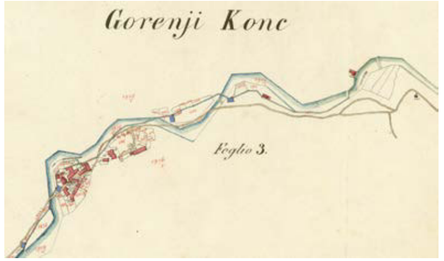
Socerb Castle above the Gulf of Trieste.
Source: Darovec, Kratka zgodovina Istre

Water management of Rosandra/Glinščica creek above Bagnoli della Rosandra/Boljunec and the mouth of the river on the map showing mills in 1830. The mills are marked as blue squares.
Source: Trieste National Archives, IR Direzione delle Fabbriche del Litorale, II-opere idrauliche, Rosandra, da Moccò alla foce ("Situations Plan Der Wildbach Lussandro von Marine bis nach Füssenberg" [sic]), call number: 0136 c.



Detail from the cadastral survey produced under Emperor Francis I, circa 1830. The overview map of the coast of the Austrian Empire (Uibersichts Karte des Küstenlandes) clearly marks salt pans at the mouth of Rosandra/Glinščica creek.
Source: National Archives in Trieste, Carta Corografica del Litorale (Übersichts Karte des Küstenlandes [sic]), call number: Foglio 23

The cadastral map of Bagnoli Superiore/Gorenji Konc in Bagnoli della Rosandra/Boljunec from 1872, with a visible system of sequentially built mills (marked as blue squares) and millraces.
Source: Trieste National Archives, Comune di Bagnoli della Rosandra Foglio VII, Allegati ai fogli 3 e 3 (mappa accessoria in doppia scala del Comune di Bagnoli della Rosandra), call number: 651 a07



This was also when the Austrian Monarchy started building the Austrian Southern Railroad, connecting the southern parts of the monarchy, including Venice, Trieste, and Istria/Istra, with the capital city of Vienna via Ljubljana. The section between Trieste and Hrpelje was built in 1887. The railroad was another factor that significantly changed the conditions for the use of this area. Instead of the intensive freight transport for which it was intended, the railroad through the Rosandra/Glinščica Valley additionally encouraged the exchange of goods between Trieste and its agricultural hinterland, which contributed to the economic growth of this area. Additional proceeds and exposure to new more urban trends marked Breg's architectural heritage of that time.The construction of a short but technically difficult railroad along the precipitous cliffs in Breg symbolizes the end of an era, when people mainly adapted their lifestyle to nature or natural resources. The ensuing technical and social development enabled the establishment of completely different criteria for spatial development, in both good and bad senses.After the Second World War, which made Breg a new border area between Italy and Slovenia (as part of Yugoslavia), trains passed from Trieste through the Rosandra/Glinščica Valley to Draga for a while, right up to the state border. In 1958, the line was discontinued, and the tracks were

The Austrian railroad network in Istria in the nineteenth century. The line from Trieste to Kozina runs through the Rosandra/Glinščica Valley and is marked in gray.
Source: Parenzana Museum, Izola; Gombač, drawing

The former railroad route through the Rosandra/Glinščica Valley has been transformed into a hiking and cycling trail

removed in 1966. After decades of abandonment, the old railroad bed was transformed into a well laid out, popular cycling and hiking trail between Trieste in Italy and Kozina on the Slovenian side of the border, which points to development opportunities in this shared area.

The First and Second World Wars and the social changes that accompanied them also radically changed Breg during the twentieth century. The first war resulted in the dissolution of the Austrian-Hungarian Empire and annexation of this territory to Italy. As a monument to that time, there are remains of defense systems inBreg that were built for the Austrian-Hungarian defense of Trieste. Fascism also resulted in different treatment of Italians living in the Trieste area and other ethnic groups, mostly Slovenians. After the Second World War, the new state border sharply cut into this area and disrupted traditional connections and ancient routes. The old center of the former Dolina Municipality with Breg and part of the Karst Plateau remained on the Italian side, and the plateau at Socerb and the valley below the Brkini Hills was on the Slovenian side. The area was also changed by intensive industrialization and urbanization, especially in the valley area of today's municipality. With the in-migration of Italian citizens from elsewhere, the number of residents increased and the demographic situation also changed. Gradually, the Comune di San Dorligo Della Valle/Občina Dolina Municipality started losing its predominantly homogeneous Slovenian ethnic structure. Currently, ethnic Italian residents account for less than 30% of the population. Today, in the same way as in the past, mutual understanding and cooperation are a key challenge and opportunity for the future of this area.

Breg between the Karst (Carso/Kras) and Istria, between sea and land, between city and countryside, between Slovenia and Italy

Hiking and cycling trails, and trans-border trails in the Rosandra/Glinščica Valley and its surroundings, are attracting increasingly more people and are part of the necessary infrastructure that can offer this area new directions for economic and spatial development

The Comune di San Dorligo Della Valle/ Občina Dolina Municipality through Time

Mitja Lovriha

The settlement of Dolina has been the seat of municipal administration for almost two centuries. The municipal organization was established by the French in 1811. The Dolina Municipality emerged near Socerb Castle. It consisted of as many communities as there were tax municipalities. In the past, the municipality was considerably larger, because in addition to today's area it also included the area right up to Jelovice and Vodice in the Croatian part of the Čičarija Plateau, measuring 133 km² altogether.
After the dissolution of the Illyrian provinces, the Austrians preserved the municipal organization, but they introduced provinces. Today's Dolina belonged to the province of Istria (the Margraviate of Istria, to be more precise), which was divided into the districts of Dolina, Capodistria, and Pinguente. The districts had electoral and judicial authority. The seat of the electoral district of the Municipality of Dolina was not in the settlement of Dolina but at Fünfenberg Fort above Boršt. The district court conducted its business here in Slovenian, until it moved to Capodistria. In 1828, Istrian irredentists achieved the annexation of the Dolina district to the Capodistira district, significantly weakening the voting power of Slovenians in the Istrian provincial diet. The voting system was based on payment of taxes, but the privileged classes could vote regardless of taxes. In Istria, Italians were always a minority compared to Slovenians and Croats, but the appropriation of the voting system ensured that Slovenians and Croats, despite the ethnic awareness that allied them at the end of the nineteenth century, never managed to obtain a majority in the diet. Two representatives of the Dolina Municipality were elected to the diet: Josip Pangerc and Josip Valentič in 1908. Valentič was reelected in 1914.
On March 17th, 1849, a municipal law was passed regulating the area of municipalities. The municipal legislation was drafted by Interior Minister Franz Stadion, Count von Warthausen, who introduced new administrative changes. The temporary municipal law (the *Provisorisches Gemeindegesetz*) bore the epithet "temporary" because it was based on the idea that it was a sudden transition to a new political regime for the entire Austrian Monarchy, parts of which were quite different and also had different conditions for development. The principles of the law remained in force until the dissolution of Austria-Hungary. The law has a frequently-cited principle in its preamble: "The foundation of a free country is a free municipality."
There were twenty-two municipalities within the district board of Capodistria, in the Margraviate of Istria, among which were Boljunc, Boršt, and the Dolina municipality (including Dolina itself, Prebeneg, Socerb and Črnotiče, as well as Ricmanje. Caresana d'Istria/Mačkolje was part of the Municipality of Osp and Gročana and Draga were part of the Municipality of Ocizla–Klanec . Changes occurred in 1853, when the Municipality of Podgorje was annexed to the Municipality of Dolina.
In 1850, the Municipality of Dolina was broken down into a larger number of smaller municipalities: Ricmanje, Boršt, Boljunc, Gročana, and so on. Almost every community became a separate municipality. On March 5th, 1862, a new "framework law" was passed that outlined the principle provisions for the organization of municipalities. The law was the basis for municipal regulations (*Gemeindeordnung*) and municipal voting regulations (*Gemeindewahlordnung*), which were passed in the form of laws for individual provinces. The law for Istria was passed on July 10th, 1863. In accordance with the 1862 law, the key municipal authority was the municipal council (*Gemeindevertretung*), which comprised the municipal board (*Gemeindeausschuss*) and the municipal executive board (*Gemeindevorstand*). The municipal board adopted decisions on municipal affairs and monitored the municipal executive board, which implemented the decisions. The mayor chaired the municipal board, and the executive board consisted of the mayor and two councilors.
Pursuant to laws and orders of the ministry of internal affairs, Istria acquired a new organizational structure in 1868, which it maintained until the dissolution of the monarchy. In the judicial district of Capodistria, the number of municipalities was reduced from twenty-two to seven. Consequently, the Dolina Municipality comprised Ricmanje, Boršt, Dolina, Boljunc, Caresana d'Istria/Mačkolje, Prebeneg, Osp, Gabrovica, and Socerb. Until 1889, it also included the Municipality of Ocizla–Klanec with Gročana, Draga, Ocizla, Klanec, Črnotiči, Prešnica, and Podgorje. Unlike a number of municipalities in Istria that were annexed to Italian centers, the Dolina Municipality acquired a fairly large portion of land and remained independent.
The Italian borders changed again after the arrival of the Italian administration. In 1923, Osp, Gabrovica, Socerb, and Kastelec were taken away from the Municipality of Dolina, and Draga, Vrhpolje, Nasirec, Krvavi Potok, and Mihele were annexed to the municipality. After 112 years of existence, royal decree no. 800 of March 29th, 1923 changed the name of the municipality to "*San Dorligo della Valle*".
In the second half of the nineteenth century, open-air rallies (Sln. tabori) were held, at which large numbers of Slovenians came to discuss their needs and rights. It is known that Mayor Ivan Lovriha was one of the initiators of the rally in the Municipality of Dolina. More information on this aspect of national heritage can be found in the minutes of the municipal council and the municipal board from 1894 onwards. There are no documents in the municipality's archives prior to this year. All of the minutes of sessions until 1923 were in Slovenian. However, much information has been gathered on the operation of the municipal council for promoting ethnic identity from that year onwards. The municipal representatives especially supported the development of the school system because they were aware that only education can raise a people's cultural level. For this purpose, they provided grants to high school students to study in Ljubljana, Vienna, and Prague. They built new schools in almost all of the villages. These have served their purpose well to this day.
In 1923, the municipal council was dissolved, the mayor was removed from the office, and a prefectoral commissioner (Ital. commissario prefettizio) assumed power, later replaced by a Fascist mayor (Ital. podestà).
After the Second World War, the locals regained control of the municipality with a mayor and board appointed by the Allied military government. The first democratic elections took place in 1949, and the democratic process has continued ever since.
Today's scope of the Comune di San Dorligo Della Valle/Občina Dolina Municipality is marked by the border that was established in 1945, when the municipality lost the villages of Vrhpolje, Nasirec, Krvavi Potok, and Mihele, which were awarded to Yugoslavia. To this day, Dolina remains the center of the municipality, with an area of 23.10 km² and comprising twenty-one settlements, some of which were newly established after the Second World War.
In line with its statue, today the Comune di San Dorligo Della Valle/Občina Dolina Municipality is a local administrative body that represents its own community, ensures its wellbeing, and promotes its development, while respecting the social and natural environment. The municipal statute especially emphasizes the values of brotherhood, peace, and harmonious coexistence of the ethnic groups living within its borders. Proceeding from these basic principles, the Comune di San Dorligo Della Valle/Občina Dolina Municipality was the originator and the main backer of the 1981 "Confine aperto – ODPRTA MEJA" (Open Border) event, which has strived to bridge the differences imposed by the borders ever since.

Historic routes

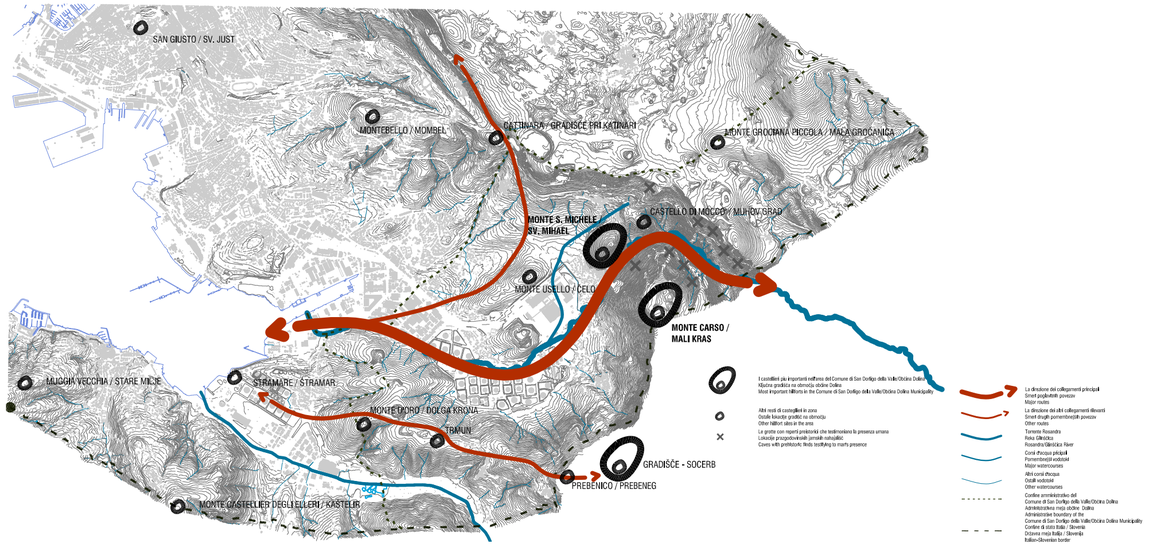
Reconstructing past connections

It is possible to discover the history of the valley below Breg by following the historic routes people have traversed since prehistoric times. As long as they walked from place to place, whether daily or only for special occasions, they made their way where the natural features offered the shortest path and where the slope was gentlest. When they packed goods using animals, it was essential to have enough watering places along the way where the animals and their handlers could rest. Adaptation to the natural terrain features was a constant throughout long periods, until the introduction of motorized transport, and especially construction equipment and construction techniques that made it possible to introduce routes based on completely new criteria.Throughout the centuries, old routes were improved, modernized, abandoned, or rerouted, depending on the political situation and on the needs of the local economy. It is fascinating that to this day we often follow routes taken by our predecessors from the prehistoric times onwards.
Roman roads also often followed the routes of older, prehistoric routes, in the same way as the roads from medieval times and later on are often just an upgrade of the famous Roman roads. However, nowadays due to completely different means of transport and the needs of the global economy the roads are routed on completely different starting points as in the past.

Abandoned watering place at San Antonio in Bosco/Boršt on the road to San Giuseppe della Chiusa/Ricmanje

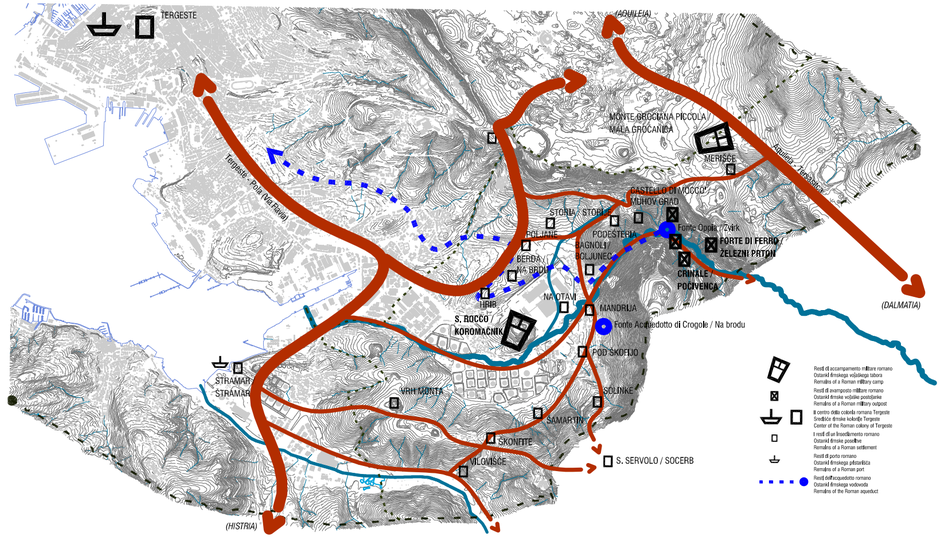
3.1 Prehistoric routes

Due to favorable conditions, the hinterland of the Gulf of Trieste was rather densely populated by prehistoric times. What stands out most is the large number of hillforts from the Bronze Age and Iron Age, and this territory also functioned as route for people passing through much earlier. The majority of prehistoric settlements were found in safe locations at higher elevations. The main routes were established between the sea and the hinterland in this part of Europe by utilizing natural transitions between the coastal plain and the countryside beyond the Karst edge.



3.2 Roman routes

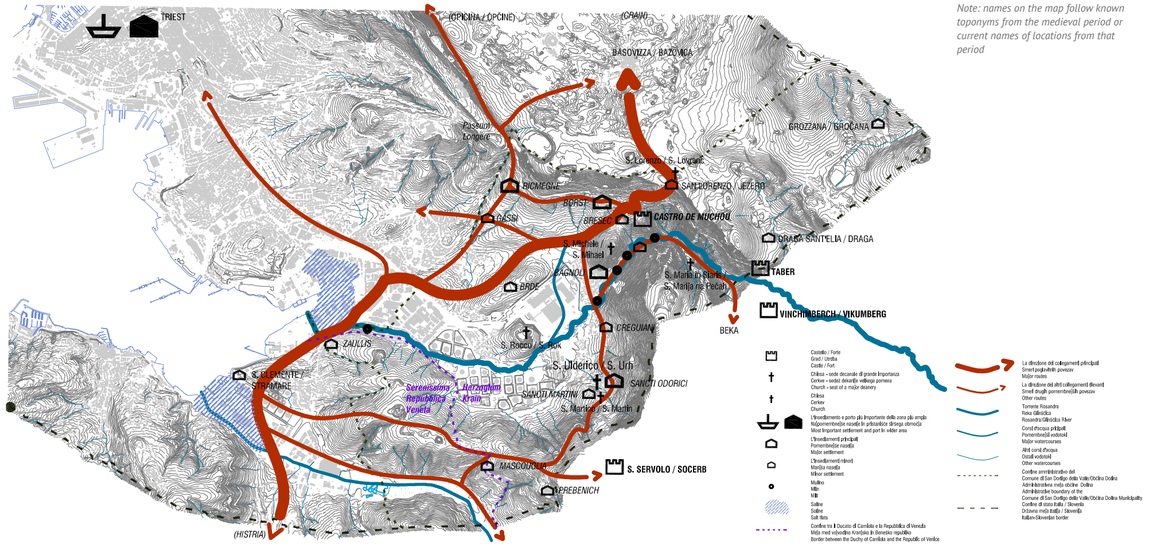
After the Romans arrived, life moved from high-elevation hillforts to the fertile lowlands. The process of Roman settlement is believed to have expanded from the settlement at Saint Roch's Hill (Monte San Rocco/ Koromačnik) near Bagnoli della Rosandra/Boljunec to the lowland part of the municipality. It was also related to water sources or the presence of the important Roman aqueduct that supplied water to Tergeste.
Two important Roman roads intersected this area: the Via Flavia, which connected Tergeste (Trieste) with Istria/Istra, and the road from Aquileia to Tarsatica (Trsat/Tersatto near Rijeka/Fiume), which further connected Aquileia with Dalmatia, or the conquered territories along the eastern Adriatic coast. Today's Comune di San Dorligo della Valle/Občina Dolina Municipality was also an important connection between the two.



Note: names on the map follow known toponyms from the Roman period or current names of archaeological sites from that period.

3.3 Medieval routes

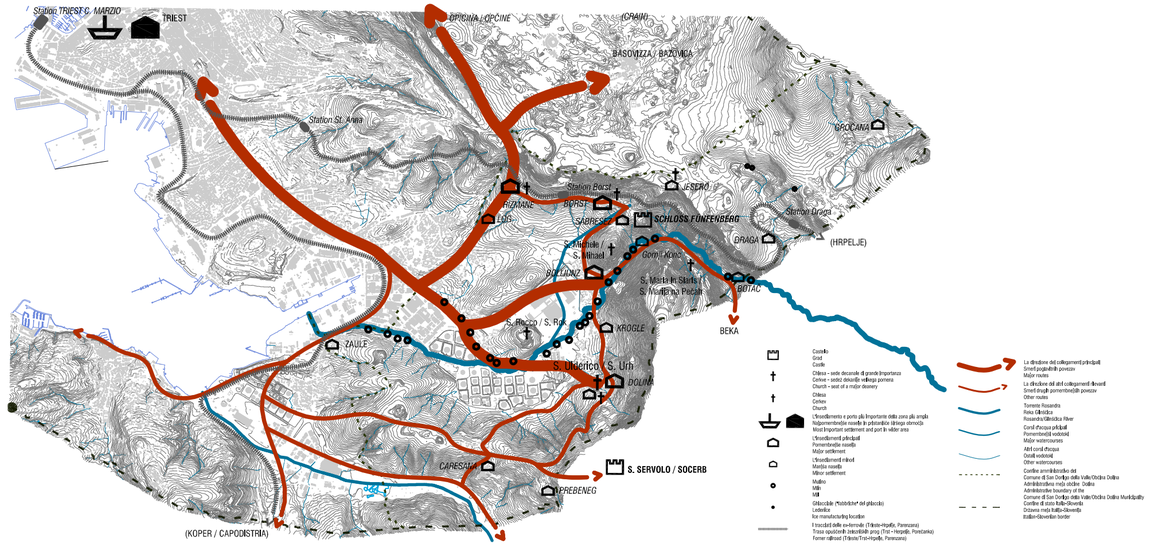
In the Middle Ages, the district of Moccò with its center at Moccò Castle or its successors became part of the Austrian lands and a border area between Austria and the Venetian Republic. Many wars were fought for salt or the Aquilinia/Žavlje salt pans, which were not subject to the Venetian monopoly over the salt trade in this part of the Adriatic. From Aquilinia this valuable commodity was transported to the hinterland of Carniola and other Austrian lands via the Salt Road past Moccò Castle, which controlled the road.



Note: names on the map follow known toponyms from the medieval period or current names of locations from that period

3.4 Routes in the 18th and 19th centuries

With the rapid expansion of Trieste as a free Austrian port from eighteenth century onward, the center of Breg's economic activity mainly shifted toward the expanding city. The main transport route went from Dolina or Boljunc (with watermills) toward Trieste. Connections with the Karst and hinterland of the Austrian Monarchy also remained important. The railroad was a very important factor in economic and spatial development, especially because it effectively connected places below the Karst edge with the city and the wider area with the hinterland of the Austrian Monarchy.



Geology - Geomorphology - Typology

The Interplay between Natural Factors and their Structural Manifestations

This section attempts to establish a framework for understanding the interplay of natural resources resulting from the geological substrate, the geomorphology and related micro-climatic and hydrological factors, how all these factors manifest in the form and appearance of built up areas, and last but not least, in construction modes.
The underlying technical paper is the *A Geological Report on Conducting a Study on the Junction of Flysch and Carbonate Rocks in the Comune di San Dorligo della Valle/Občina Dolina Municipality and the Influence of the Junction on Architecture* and the geological map of the *Comune di San Dorligo della Valle/Občina Dolina Municipality* to 1:5000 scale by Igor Rižnar PhD, almost entirely summarised below. The exception is the chapter on Typology, which aims mainly to invite locals or visitors of the Breg to take a different look at the surrounding stone buildings and to understand how the interplay of different factors highlighted in the study results in the visible environment.

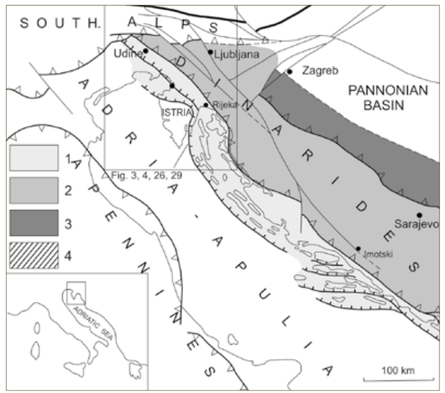
4.1 The geological history of the greater surroundings

The history of the formation of the greater surroundings is roughly summarized from many studies by Slovenian, Croatian and Italian researchers. Most recently, the geological problems were covered intensively by Ladislav Placer, who deals primarily with tectonics and kinematics, and Bogdan Jurkovšek, who deals with stratigraphy and paleontology. The presentation of the area's history is taken mainly from their research.
Geological history of the Karst and above all the Rosandra/Glinščica valley has been for decades an object of research of the Geological and mathematical department of the University in Trieste (Università degli Studi di Trieste, Dipartimento di Matematica e Geoscienze), above all Cucchi and coleagues (1987; 2005; 2012) and Gasparo (2008). The Department in colaboration with the Geological survey of Friuli Venezia Giulia (Servizio Geologico della Regione Friuli Venezia Giulia) also prepared a geological map of the classical Karst in Italy in 1 : 50.000 scale (Cucchi et al., 2013).

Paleogeographical overview and tectonic subdivision

The karst edge area has been formed along the border between the Dinaric and the Adriatic segment of the initially uniform **Adriatic-Dinaric carbonate platform**. The Adriatic-Dinaric carbonate platform is considered a microplate (microcontinent) that separated from the African plate during the Mesozoic era, when the supercontinent Pangea broke up into several continents and the Tethys Ocean started to open between the African and Eurasian plates. At the end of the Mesozoic era this process came to a halt, as the African and European continents began to converge. Today, the Mediterranean Sea represents the last remnant of the Tethys Ocean. Microcontinents separated from the African plate (with the Adriatic-Dinaric carbonate platform among them) and eventually collided with the European plate forming large mountain belts like the Alps, the Pyrenees, the Carpathians and, as subject of this study, the Dinarides. The Adriatic-Dinaric carbonate platform is a microcontinent extending from northern Italy to Greece and from the Apennines to the central Dinarides. The microcontinent is roughly divided into two segments along the eastern Adriatic coast: the Dinaric microplate refers to the northeastern segment, and the Adriatic-Apulian or simply Adria to the southwestern segment. The approaching African and European continents provoked a thrusting of the Dinarides due south-east in the Eocene epoch (approx. 30 million years ago). The **External Dinaric Thrust Belt** along the segment boundary is formed where the Dinaric segment is thrust upon the Adriatic one. The Thrust Belt is characterised by vast overthrusts observed throughout western Slovenia, southwestern Croatia and southwestern Bosnia. The southwestern part of the zone is imbricated and represents a deformed margin of the Adriatic segment (Adria),

and is referred to as the **External Dinaric imbricated belt**.
Due to the continuous approach of the African and European continents the northwestern part of the elongated Adriatic-Dinaric microplate collided with the European plate in the Miocene epoch (approx. 23 million years ago). The northwestern part of the microcontinent (the Padanian segment) broke along the Kvarner fault that runs along the eastern Istrian coast. Because of the oblique position of the microcontinent against the European plate margin the Padanian segment started to rotate in a counterclockwise direction. Consequently, its eastern margin started to underthrust beneath the Dinaric segment of the Adriatic-Dinaric microplate. This underthrusting of the Padanian segment provoked intense a deformation of the External Dinaric Thrust Belt between Trieste and the Velebit mountains. This newly-formed zone is referred to as the Istria–Friuli Underthrust Zone. The underthrusting of the "Istria" (the southeastern part of the Padanian segment) under the Dinaric is still active today, and its influence is notable as far as the Želimlje fault at the eastern margin of the Ljubljana Moor (Placer, 2010).
The area referred to in this study therefore belongs to the External Dinarides – more precisely the External Dinaric Imbricated Belt – that deformed into the **Istria–Friuli Underthrust zone** due to said rotation and underthrusting of the Istria.



Tectonic subdivision of the Adriatic area. Reprinted by permission of the author and the publisher from Placer et al., 2010. Key:
1. External Dinaric imbricated belt;
2. External Dinaric Thrust Belt;
3. Internal Dinaric Thrust Belt;
4. Budva Trough.

4.2 Tectonics

According to scheme of tectonic subdivision, the researched area belongs to the External Dinarides and with further division to the External Dinaric Imbricated Belt. Further subdivision divides the area into Trieste-Komen and Rijeka/Fiume sinclinoriums, which belong to the upper structural level. It covers the karstic area in the northern and eastern parts of the municipality. The lower structural level belongs to the Istria-Friuli subthrusting belt. The boundary between the two structural levels represents the Petrinje Thrust (Placer, 2010).

Petrinje thrust

The NW-SE trending Petrinje Thrust runs above Longera/Lonjer and San Giseppe della Ciusa/Ricmanje where it turns due east to San Lorenzo/Jezero and from there again due southeast above Bottazzo/Botač into the Rosandra/Glinščica canyon towards the village of Petrinje. Geological cross-sections show that the Petrinje thrust divides moderately folded anticlinorium (upper structural level) from the imbricated belt (lower structural level). A shift in the course of the Petrinje Thrust Fault trace between San Giuseppe della Chiusa/Ricmanje and Draga is a direct consequence of the rotation and subsequent subthrusting of the Istria or more correctly, the eastern part of the Padanian segment under the Dinaric one (Placer, verbal communication, 2014). The shift of the Petrinje Thrust Fault, or rather its subsequent deformation, is accompanied by a continuous change in the strike of the Alveolinid-numulitid limestone bedding that follows the strike of the Petrinje Thrust Fault trace.
A transition from Alveolinid-numulitid limestone to the lower part of the Transitional Beds is exposed between the Italcementi quary and San Giuseppe della Chiusa/Ricmanje. Here the Transitional Beds are developed without any basal conglomerate. Just below the Thrust the flysch beds are intensely folded into tight and occasionally weakly-overturned folds with a wavelength of 10–20 m. A zone of intensely folded flysch beds approximately 300 m wide lies below the Petrinje Thrust.

Škrivenca syncline

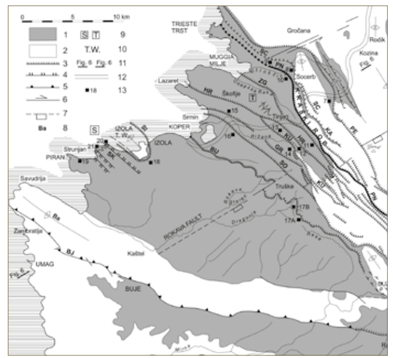
The Škrivenca Syncline is exposed in Škrivenca area between Pesek and Draga. Intensely folded flysch beds form the core of the syncline. Completely developed Transitional Beds can be followed along the northern limb of the syncline and east of Draga, with minor reverse faults present in the limbs of the syncline.

Jezero syncline and jezero fault

A small SE trending syncline is exposed at San Lorenzo/Jezero. The syncline plunges gently to the SE and is cut by the Jezero Fault. It starts in the large oval depression just NW of the village and continues due south-east. The village (jezero = lake) is likely named after the depression with an impermeable core that retains water for some time after heavy rainfall. Though the depression resembles a kartic doline its marly core leaves no doubt as to its real genesis.
The Jezero fault trace runs along the northern margin of the village and due south-west along the electric power line beneath the road to Sant' Antonio in Bosco/Boršt. The fault divides tectonized Basal Marl and flysch in the northern block from the imbricated structure in the southern block. The obvious left-strike character of the fault is not the only deformation along its trace; complex vertical displacements likely exist along the Jezero Fault as well.

Imbricated structure and the associated thrust faults

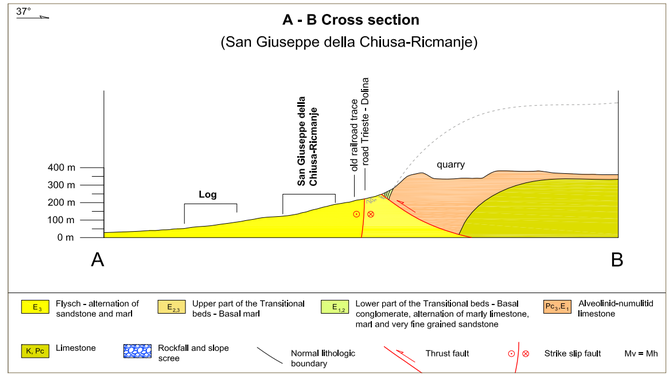
The imbricated structure southwest of the Petrinje Thrust is a set of overturned folds, torn and thrust upon each other to form a series of duplexes bounded by thrust faults, the duplexes having been formed at the end of the Eocene epoch. The easternmost duplex lies south-east of Fonte Oppia/Izvirk Klinščica, along the "Na opoki" gorge, so-named after the local term for the marl (opoka = marl) exposed in the gorge. A thrust contact exposed at several locations runs along the eastern flank of the gorge. Placer (verbal communication, 2014) named the structure the Opoka Thrust, while Italian geologists refer to it as Faglia del Crinale (Cucchi, 1987; Cucchi et al., 2005).
The Boljunec Anticline is the next duplex, its anticline axis running from Monte San Michele/Sveti Mihael due south-east between Monte Castelliere/Veliki vrh (436.8 m) and Monte Carso/Mali Kras. The anticline (forming a duplex) is thrust upon flysch along the Socerb Thrust (Placer, 2007), known in Italian literature as Sovrascorimento del Monte Carso (Cucchi et al., 2005). The thrust trace runs 150 m south of the Antro delle Sorgenti/Na jami spring to the south-east. Above Crogole/Kroglje the thrust is covered by colluvial deposits and continues beneath the Griža cliff above the Socerb Castle. North of the Antro delle Sorgenti/Na jami spring the thrust is covered by alluvial deposits, but knowing its age and geometry we can infer that its behaviour to the north resembles that of the Petrinje thrust, as they both share the same kinematic history. The same is true also for the Kastelec thrust, stretching parallel to the Socerb thrust.



stria-Friuli Underthrust Zone. Reprinted by permission of the author and the publisher from Placer et al., 2010. Key:
1. Upper ductile horizon: flysch;
2. Platform carbonates;
3. Thrust faults: PE – Petrinje Thrust Fault, KA – Kastelec Thrust Fault, SC – Socerb Thrust Fault, PN – Palmanova Thrust Fault (local Črni Kal Thrust Fault), ZG – Zanigrad Thrust Fault, HR – Hrastovlje Thrust Fault, KU – Kubed Thrust Fault, GR – Gračišče Thrust Fault, SO – Sočerga Thrust Fault, BU – Buzet Thrust Fault, SI – Simon Thrust Fault;
4. Secondary thrust faults of the Strunjan Structure: SK – Sv. Križ Thrust Fault;
5. Thrust Front of External Dinarides: BI – Buje Fault;
6. Strike-slip fault;
7. Normal fault;
8. Ba – Buje Anticline;
9. S – Strunjan Structure, T – Tinjan Structure;
10. Izola Tectonic Window;
12. Motorway.

4.3 Basic geomorphological characteristics of the area

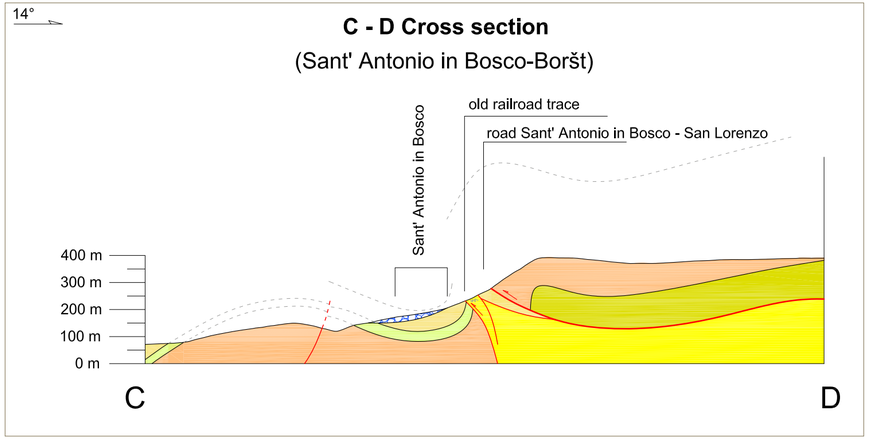
The essence of the area is already contained in the term "karst edge", as thoroughly elaborated by Placer (2007), and hence cited here: "A part of this geomorphologic step became known in the last decade of the 20th century as the *Kraški rob* (Karst edge). With respect to geological and geomorphologic considerations the term *Kraški rob* as a landscape term for cliffs above the valleys of the Rio Ospo/Osapska reka River and upper Rižana/Risano rivers should be distinguished from the term karst edge (*kraški rob*) as a general term which is a synonym for the geomorphologic step consisting of precipitous cliffs and steep carbonate slopes situated between the mouth of the Timavo/Timava River and Mt. Učka that form a border zone between the karstic plateaus of the Karst (Carso/Kras) and Čičarija on the one side, and the flysch Istria with the Trieste flysch coastal zone on the other side."
Two types of transition from the karstic environment defined by a limestone geologic basement into the Istrian characterised by flysch are observed in the broader area. The transition is very sharp between Barcola/Barkovlje and San Giuseppe della Chiusa/Ricmanje, as the limestone–flysch boundary there runs in very straight NW–SE line and is represented by the Petrinje Thrust, along which limestone is thrust upon flysch. This is also the reason for the simple relief there: a steep limestone cliff (thrust front) called Breg that descends gradually into a flysch slope beneath the boundary all the way down to the shoreline. Minor springs feeding the creeks below are situated at the lithological boundary, as the limestone mass above the impermeable flysch represents a karstic aquifer. Deep gorges are incised into the steeper slopes in soft flysch formation leading the water down towards the sea. These creeks are systematically oriented orthogonally to the slope; consequently all of the ridges between the creeks are oriented in the same direction as well. A simple transition between limestone and flysch is illustrated by the geological cross-section across San Giuseppe della Chiusa/Ricmanje. Here a steep limestone cliff is covered by a slope-scree. The Transitional Beds dip at an angle of 50–70°, but as their resistance to erosion is far lower than the limestone's the slope is not as steep here. The slope above San Giuseppe della Chiusa/Ricmanje is not as steep as the dip of the Transitional Beds, which is why there are no significant landslides. The ancient as well as recent traffic routes are built in the narrow belt of the Transitional Beds precisely for this reason. The flysch below the thrust is predominantly built of soft marl and thin sandstone layers resulting in relatively high erodibility and consequently an even gentler slope making it suitable for settlement. The flysch bedding dips toward the northeast, except along the thrust structures, where deformation features follow the thrust planes. The ridge San Giuseppe della Chiusa/Ricmanje is built upon is delimited by two creeks running orthogonally to the limestone–flysch boundary. Above the village there is a high impassable limestone cliff protecting it from the northeast. The village is therefore protected or bounded on three sides and open towards the sea.
A similar type of transition from limestone to flysch is also present at Crogole/Kroglje, Dolina and Prebenico/Prebeneg. Common to all of these cases is the fact that the village is never situated at the boundary itself, as mass movements here are far more common and active than elsewhere in the region.Another type of transition from a karst- to flysch-dominated area is associated with the recently active subthrusting of the Istria. The tectonic boundary between limestone and flysch has been formed in a fairly straight line and remains so today, north of San Giuseppe della Chiusa/Ricmanje all the way to Sistiana/Sesljan. Due to the rotation and subsequent subthrusting of the Istria the thrust boundary eventuallydeformed in such a way that today it is skewed between the villages of San Giuseppe della



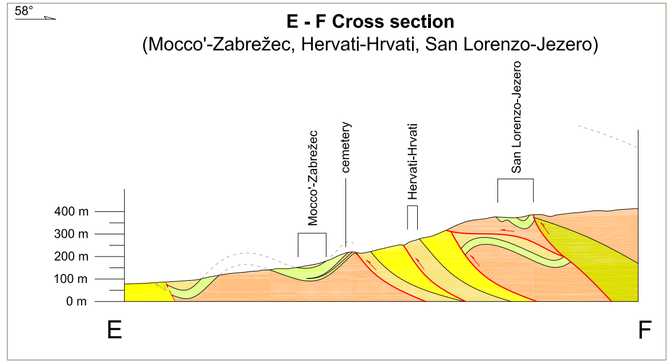
Geological cross-section across San Giuseppe della Chiusa/Ricmanje

Geodiverziteto razumemo kot raznolikost izdanjajočih kamnin skupaj s strukturno kompleksnostjo (narivi, gube, prelomi), od tega pa je odvisen razvoj reliefa, mnogoterost reliefnih oblik in v končni posledici tudi drugih, iz geoloških danosti izhajajoči, posledic. Tako so z geodiverziteto pogojeni kompleksnost reliefa, posledično mikroklimatski pojavi, hidrogeološka zgradba, biodiverziteta in še vrsta iz teh izhajajočih družbenih dejavnikov (npr. potek cest in političnih mej), ki na koncu vplivajo tudi na odločitve ljudi o tem, kje zasnovati naselje.

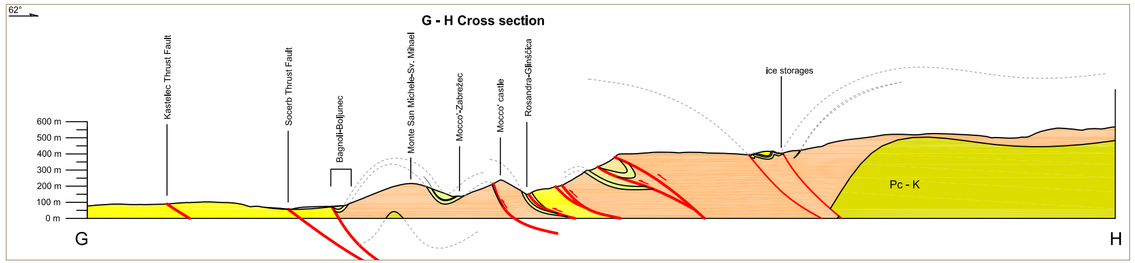
Chiusa/Ricmanje and San Lorenzo/Jezero and from there on it re-adopts its original course. In a process of skewing – or rather shifting of the tectonic boundary (between limestone and flysch) – a set of folds and steep reverse faults have, due to subthrusting, formed between San Lorenzo/Jezero and Bagnoli della Rosandra/Boljunec.
Thrusting of the limestone mass upon the flysch, initially during the subsequent folding and tearing of the primal structures and finally, the erosion of geologic formations with very diverse erodibility, led to a large variety of relief forms described as **geodiversity**. High geodiversity is demonstrated by geological cross-sections C–D, E–F and G–H. Along the 2300 m-long E–F cross-section trace there are 17 geologic boundaries on the surface. Comparing this with the A–B cross-section across San Giuseppe della Chiusa/Ricmanje, where only two geologic boundaries can be found along its trace, it becomes clear why the the cross-section E–F across San Lorenzo/Jezero and Bagnoli della Rosandra/Boljunec appears far more complex. Each lithological boundary and fault represents a potential erosion line into which, given enough precipitation, a valley can be incised. The larger concentration of lithological boundaries the more dispersed the erosion, which leads to gentler amplitudes in relief undulation and consequently very diverse relief without extremes.
Three different areas comprising three geological situations can be distinguished from the geomorphologic point of view in the area concerned: karstic relief, flysch area, and the transitional zone where geodiversity is unusually high. Areas with elevated geodiversity are marked on the graphic representation of the general geological characteristics.



Geological cross section C–D



Geological cross-section E-F



Geological cross-section G-H

4.4 Lithostratigraphic units

1 See map No 1 - the graphic representation of the general lithological characteristics.

The alveolinid-numulitid limestone

The oldest geological formation in the area in question is Alveolinid-numulitid limestone. According to the revised classification (Košir, 2003; Jurkovšek et al., 2008), the formation represents the youngest formation of the Karst Group (*Kraška grupa*) that comprises shallow water and paralic carbonates of Liburnian, Trstelj, and Alveolinid-numulitid limestone formations. The lower section is composed of light grey micrite limestone with large benthic foraminifera visible to the naked eye. Stratification here is poorly expressed. In the upper part of the formation the limestone becomes darker, with grey varieties followed by dark brown varieties, biointracalcarenite and microbreccia, and dark grey kerogenic limestone at the top of the formation. According to Jurkovšek (2013) Planktonic foraminifera content is also higher in the upper part of the formation. Along with the darker colour and increased organic matter in the limestone we find a gradual subsidence of the sedimentary basin. Facial varieties were not distinguished in the process of mapping, as there is not enough physical diversity amongst them to introduce lithological boundaries expressed as a relief.

The Alveolinid-numulitid limestone crops out in two structural levels described in more detail in the chapter referring to tectonics. The Alveolinid-numulitid limestone in the northeastern part of the Municipality forms a part of the Čičarija and the Trieste-Komen anticlinorium (Placer et al., 2010). The other area built of Alveolinid-numulitid limestone is Monte Carso/Mali Kras, San Michelle/Sveti Mihael, and the Rosandra/Glinščica Canyon northwest of Bottazzo/Botač. Exposed limestone above the village of Dolina also forms part of this structural level.

From the stratigraphic point of view, the Alveolinid-numulitid limestone has been deposited upon the Trstelj Formation, which does not crop out in the area concerned. The basement of the Alveolinid-numulitid limestone is only seen in geological cross-sections without internal division. The overburden of the Alveolinid-numulitid limestone is the Transitional Bed Formation marking the transition from shallow water

Fractures parallel to the Petrinje Thrust in the Alveolinid-numulitid limestone along the route of the old Hrpelje – Trieste railroad

Alveolinid-numulitid limestone in the Scoria quarry above San Giuseppe della Chiusa/ Ricmanje unsuitable for stonemasonry due to intense fracturing, despite the bedding in the quarry exhibiting no large displacements

carbonates to flysch sedimentation. Based on the geological cross-sections the thickness of the Alveolinid-numulitid limestone is estimated to be 450 m in the upper structural level (in the NE part), and approx. 250 m in the lower level (the SW part of the area). The most significant change in thickness appears to be at the Petrinje Thrust, indicating that the thrust itself may have been initiated along the previously existent structural boundary responsible for the thinning out of the Alveolinid-numulitid limestone.
The age of the Alveolinid-numulitid limestone is determined as the lower part of the Eocene epoch (Jurkovšek et al., 1996) in the Karst (Carso/Kras) on the basis of benthic foraminifer stratigraphy.

Transitional Beds

Transitional Beds is a formation that marks the transition from shallow water carbonate sedimentation, where the sediment is formed almost exclusively of shallow water organisms, to deep-water gravity-driven predominantly clastic sedimentation. Subsidence of the sedimentary basin is obvious in the upper part of the Alveolinid-numulitid limestone due to its dark colour (from its high kerogen content that when broken makes the rock smell of petroleum) and pelagic foraminifera.
From the lithological point of view, the Transitional Beds are represented by two members: a basal conglomerate with alteration of the marly limestone or marl, and a very fine-grained sandstone with a carbonate matrix make up the lower part of the Transitional Beds; and the upper part composed of Basal Marl.

The lower part of the Transitional Beds: a basal conglomerate and alternating marl, marly limestone and a very fine-grained sandstone or limestone with a significant proportion of quartz grains.

Basal conglomerate appears in the researched area already in the upper part of the Alveolinid-numulitid limestone. A layer several metres thick, with all the attributes typical of Transitional Beds, is exposed at the top of the steep slope some 200 m SW of the village of /Pesek. As the layer pinches out to the northwest it does in fact constitute a large thin lens. A conglomerate layer less than a metre thick with relatively large limestone pebbles comprised exclusively of Alveolinid-numulitid limestone is deposited upon the Alveolinid-numulitid limestone. The pebbles are medium- to well-rounded, approximately 10 cm across on average, with a marly limestone matrix. A bed of marl several metres thick lies atop the conglomerate layer, followed by another mass of Alveolinid-numulitid limestone 50 m thick, on top of which a similar sequence is observed, consisting of alternating layers of dark grey marly limestone and a very fine-grained sandstone or limestone with a significant proportion of quartz grains. A continuous horizon of the Transitional Beds lies exposed from the cut of the old Hrpelje–Trieste railroad line 350 m SW of the abandoned Krvavi Potok border checkpoint to the NE and around the Škrivenca hill all the way to the village of Draga. The same horizon also surrounds the syncline at San Lorenzo/Jezero. Two horizons of the Transitional Beds are also exposed on the slope above the village of Bottazzo/Botač and along the road between the villages of Hervati/Hrvati and Bottazzo/Botač. The lower part of the Transitional Beds are most exposed SE of Mocco'/Zabrežec at the southern slope of a nameless hill on

The basal conglomerate as a part of the lower part of the Transitional Beds SW of Pesek

Alteration of the marly limestone and very fine-grained sandstone near Mocco'/Zabrežec, SE of the Cemetery

which stands a cemetery. The compact finetgrained sandstone of the Transitional Beds was quarried there for local use. The Transitional Beds formation runs south of Mocco'/Zabrežec, around the northern side of Monte San MicheleSveti Mihael, along national road No. 11. To the SE they are covered by the alluvial deposits of the Rosandra/Glinščica creek and emerge at the Antro Di Bagnoli/Na Jami karstic spring. To the SE the Transitional Beds are covered by colluvial deposits and emerge again at the belvedere above the forest trail between the villages of Crogole/Kroglje and Prebenico/Prebeneg above Dolina. The Transitional Beds appear in two horizons separated by a package of Alveolinid-numulitid limestone also south of the village of Mocco'/Zabrežec and above the village of Bottazzo/Botač as well.

The upper part of the Transitional Beds: Basal Marl

Greenish massive marl is present on top of the lower part of the Transitional Beds everywhere in the researched area, of which Basal Marl is an important component. On Italian geological maps it has frequently been merged with flysch due to the time-consuming determination process defining the boundary between them in the field. The thickness of the Basal Marl in the upper structural level (Trieste-Komen anticlinorium) between Pesek and Draga is approx. 15 metres, while in the lower structural level it grows to a full 75 m in the vicinity of Crogole/Kroglje. In its lower part, the Basal Marl is massive and quite compact, while higher up towards the flysch it becomes increasingly silty. Poorly expressed stratification without sharp boundaries dominates in the upper part of the Basal Marl. Pseudobeds here are up to 3 cm thick and are difficult to recognise in small outcrops of weathered bedrock. Basal marl is soft and hence highly deformable sedimentary rock. In the zones of intense deformation we find calcite slickensides up to 2 cm thick. As these are coated by limonite, they give the marl an appearance similar to flysch. However, the limonite-coated calcite slickensides must not be confused with the thin sandstone layers typical for flysch. Slickensides are formed along numerous fault planes in the fault zone. Occasionally, Alveolinid-numulitid limestone pebbles up to 10 cm are present in the Basal Marl. They have been observed in the Škrivenca area SW of Pesek and above Dolina.
Large exposures of Basal Marl are present along the forest trail between San Lorenzo/Jezero and the road between the villages of Hervati/Hrvati and Bottazzo/Botač. Large, sub-vertical cuts are observed also behind several buildings in the northeastern part of Sant' Antonio in Bosco/Boršt.
Deposisition of the Basal Marl is triggered by several events. Such deposits represent a relatively sudden onset of a deep-water environment only occasionally reached by shallow water deposits (occasional limestone peb-

Calcite slickensides in the Basal Marl (Scoria quarry above San Giuseppe della Chiusa/Ricmanje)

Occasional pebbles in the Basal Marl SW of the village of Pesek

bles). A sudden deepening is caused by the cumulative effect of progressive subsidence observed already in the upper part of the Alveolinid-numulitid limestone, combined with the eustatic rise in sea level at the Paleocene–Eocene boundary. Due to the subsiding shallow water environment and the sudden eustatic rise in sea level the coastal line moved significantly inland and consequently drastically reduced grain size and the amount of sediment reaching the sedimentary basin.
The onset of the Transitional Beds in the Trieste Karst (Carso triestino/Tržaški Kras) area is classified as Middle Eocene by Cucchi and Piano (2013).

Flysch

Flysch lies on top of the Basal Marl in all of the researched area. The Flysch Formation is composed of alternating layers of sandstone and marl. Marl and relatively thin layers of fine-grained sandstone dominate in the lower part of the Flysch Formation, and is present in the entire southwestern part of the Comune di San Dorligo della Valle/Občina Dolina Municipality. To the northwest it reaches the thrust front above the San Giuseppe della Chiusa/Ricmanje and Sant' Antonio in Bosco/Boršt, and in the east up to Bagnoli della Rosandra/Boljunec and the thrust plane above Dolina and Crogole/Kroglje. Flysch is exposed also in two small-scale thrusts above Hervati/Hrvati, east of Mocco'/Zabrežec, at the confluence of the Griža and Rosandra/Glinščica creeks west of Bottazzo/Botač, and in a very thin duplex along the thrust plane in a gorge between Fonte Oppia/Počivenca and Monte Carso/Mali Kras hill.
A Flysch area between Pesek and Draga is in fact an eastward plunging anticline (the Škrivenca Anticline). As the Basal Marl does not differ from thick marly beds within the Flysch formation, the boundary between formations was identified as the first sandstone layer.

Overturned fold in flysch sandstone in the road cut at Hervati/Hrvati

In the process of geological mapping an attempt was made to distinguish between those areas distinguished by predominantly marly sedimentation and those predominantly of sandstone, but in such a tectonically disturbed area it is a difficult task rife with potential for incorrect conclusions, especially when lines are drawn based on poor data. Flysch with sandstone layers thicker than 20 cm (20–40 cm) is exposed at the Hervati/Hrvati village, in the cut of the old railroad line at the abandoned Krvavi potok checkpoint, and just above the village of Dolina. Otherwise, further to the west at Muggia/Milje, among the several quarries once active at least one is still in operation

Quaternary deposits

Slope scree and breccia

A large part of the steep slopes is covered with Pleistocene gravel forming scree slopes. Extensive scree slopes were formed due to crioclastic weathering in the Pleistocene (Ice Age) when the temperature hovered around 0 °C. Extensive scree slopes are found in the Rosandra/Glinščica canyon below Mt. Veliki Vrh, on the southern slope of the Mocco' Castle hill/Grad and Monte San Michelle/Sv. Mihael.
The gravel is entirely carbonate where the slopes are composed of limestone, but is somewhat different where the limestone is thrust upon the flysch. There, the limestone gravel was poured on the weathered flysch or marly slope. In the lower part of the talus (below the thrust), the gravel is mixed with weathered flysch – more precisely with brown sandy silt. Such scree slopes are nevertheless quite fertile and were systematically transformed into cultivated terraces where mainly grapes were cultivated. Unfortunately (for our purposes), today all of these slopes are entirely overgrown with forest. The majority of scree slopes that have been converted into cultivated terraces lie above Crogole/Kroglje and Dolina, and on the southern slopes of Mt. Stena above Bottazzo/Botač. Scree slopes weren't systematically bounded as they are already represented, to a degree, on the topographic map. What is more important, however, is they lack a distinctive morphology, as they were altered to become terraces. Only large scree slopes forming talus bodies obscuring insight

Thick talus at Bagnoli della Rosandra/Boljunec
The reddish beds at the base are eolian sand (Finocchiaro et al., 2015)

into the geology beneath are presented on the graphic representation.
Cementation of the gravel takes place when water saturated with CO_2 flows through the gravel. Changes in temperature and partial pressure of CO_2 enable precipitation of the carbonate between the gravel clasts binding them into breccia. Such breccia is observed in the Dolina area; however, the breccia there does not lie where it was originally cemented. In fact the boulders of breccia have landed at the base of the slope as the result of a large rockfall. Breccia boulders can be traced from the base of the slope at the western limit of the village along the Potok stream all the way up to the cliff above.
The old part of the village of Dolina is actually built on the rockfall talus composed of breccia and gravel. Similar breccia boulders were observed at the base of the Sant' Antonio in Bosco/Boršt ridge.

Slope gravel and weakly lithificated slope breccia

Slope limestone gravel with sandy silt and sandstone clasts from weathered flysch (Dolina)

Several large boulders of well-cemented breccia in the roadcut (No. 23 provincial road) at the W part of Dolina

Proluvium and Alluvium

Proluvial and alluvial deposits were not thoroughly studied. They are represented as deposits by the Rosandra/Glinščica and its tributary that carry silt, sand, flysch sandstone pebbles and limestone pebbles from the re-sedimented colluvial deposits. A large part of the alluvial plain is now urbanised, obscuring the original morphology. Most of the sediment is derived from the flysch upstream of Bottazzo/Botač, with the limestone pebbles originating from the talus between Bottazzo/Botač and Bagnoli della Rosandra/Boljunec.

Travertine

Limestone is also excreted from the stream water on the surface in the form of travertine. Such is the case in the Potok creek above the village of Dolina and the Rio del Gias/Slavčev potok creek NE of San Giuseppe della Ciusa/Ricmanje.

Creek above Dolina (Moganjevec)

4.5 The use of local stone in buildings

A quick glance at the visible stone in structures clearly shows that flysch sandstone construction is characteristic of the San Dorligo della Valle/Občina Dolina Municipality. This is because flysch is available nearby even in villages which are not directly built over flysch sandstone layers or fractured local limestone which is generally unsuitable for construction. Even though flysch sandstone is a building material of lesser quality, it has proved suitable for the area. It was much easier to quarry flysch sandstone and form large blocks. One of the reasons for the prevalence of flysch sandstone could be that, in the past, agricultural land was prevalent in flysch areas. When clearing this land or forming terraces, the better quality excavated material offeredd itself for building construction, among other uses.

The next phenomenon is a combination of rocks in village structures. Exclusive use of flysch sandstone or limestone is rare. The two are often combined, ratios depending on specific location. Thus, flysch sandstone has its place in the characteristic limestone buildings of Grozzana/Gročana. It is generally used to horizontally level the walls or in window or door reveals. Draga is very specific because the village lies directly on limestone, yet construction with flysch sandstone with blocks of surface limestone in walls is a local feature. Sant'Antonio in Bosco/Boršt tells its own story. There, we observe use of the lower part of Transitional Beds in building blocks. Usually, outside walls are of flysch sandstone blocks, occasionally interspersed with limestone scree slope gravel. Similar outside walls are found in Moccò/Zabrežec, San Giuseppe della Chiusa/Ricmanje, Dolina and Prebenico/Prebeneg. In Bagnoli della Rosandra/Boljunec, where flysch sandstone is also prevalent, limestone scree slope gravel and flysch sandstone pebbles can be found in outside walls. Caresana/Mačkolje is the only Breg village with only flysch sandstone visible in outside walls.

2

See map No 2 - graphic representation of the use of local stone in construction.

The Alveolinid-numulitid limestone

Fracturation of the rock that inhibited yields of large blocks of Alveolinid-numulitid limestone is the main reason it has never been seriously exploited for stone masonry in the researched area. Alveolinid-numulitid limestone is heavily folded along the thrust fronts, as seen from the geological cross-sections. Due to poorly expressed stratification, the rock mass is being deformed by fracturation and faulting rather than by flexural folding. The areas of largest stress in the folding and thrusting rock mass (this is the case of the Alveolinid-numulitid limestone along the Petrinje thrust) are located along the thrust itself and in the hinge of the fold. The researched area is being further deformed due to the described recent subthrusting of the Istria, and this additional stress is affecting the Alveolinid-numulitid limestone most, as it represents the most recent deformation still ongoing. The fracturation of the Alveolinid-numulitid limestone is increasingly less pronounced as distance from the area of most intense deformation increases towards the village of Grozzana/Gročana, where the first poorly-shaped building blocks of Alveolinid-numulitid limestone appear to have been used for window frames. In fact the ice sheds ("jazere") in the Škrivenca area are also built of roughly-shaped Alveolinid-numulitid limestone blocks. The only sophisticated stonemason's product made from the Alveolinid-numulitid limestone has been identified in the Sant' Antonio in Bosco/Boršt, where the bollards and inscription plate of the public fountain in the village centre are fashioned from Alveolinid-numulitid limestone. Why the usual cretaceous limestone from quarries established as far back as the antiquity wasn't used remains unknown. Perhaps it was simply a case of local patriotism.

The Alveolinid-numulitid limestone crops out between the villages of Sant' Antonio in Bosco/Boršt and Socerb as well, but there it is a part of the lower structural level – in the External Dinaric imbricated belt – where the Alveolinid-numulitid limestone has been deformed into overturned folds thrust one upon another. Needless to say the limestone there is even more fractured and thus unsuitable for stonemasonry. The fact that Alveolinid-numulitid limestone there is not used for building blocks is even more understandable in view of the fact that there is exposed flysch in the vicinity. Namely, extracting and shaping flysch sandstone into equally thick blocks is far easier and less time consuming than is hard, massive limestone. Yet an interesting exception has been observed here, in the form of the Roman aqueduct built in the 1st century AD, from Fonte Oppia/Izvirk Klinščice to the coast. What is interesting

The use of roughly-shaped stone blocks for construction of ice storage sheds between Pesek and Draga villages

A public well in the village of Sant' Antonio in Bosco/Boršt. The bollards and inscription plate are fashioned from Alveolinid-numulitid limestone

is the fact that the aqueduct is built of Alveolinid-numulitid limestone. Here the building blocks have not been shaped but just dimensioned. Flysch sandstone blocks have only been used in some places in the construction of the vault. We can only speculate as to why, but the fact is that limestone reacts chemically with hardening mortar better than flysch, which is porous and less resistant to freezing and thawing.

A poor quality stone frame made from local Alveolinid-numulitid limestone (Grozzana/ Gročana)

A vault of the Roman aqueduct made from Alveolinid-numulitid limestone and flysch sandstone (left), and of Alveolinid-numulitid limestone exclusively (right)

Aqueduct channel made of local Alveolinid-numulitid limestone

Transitional Beds

The Transitional Beds, precisely their lower part in which the marly limestone alternates with very fine-grained sandstone or limestone (depending on the proportion of quartz grains in the rock) were certainly recognised as a source of good construction material by the locals. These rocks are most widely exposed at the southern slope of the cemetery hillock southeast of the village of Mocco'/Zabrežec. Due to alternating layers of the soft marly and the much harder sandstone the lower part of the Formation exhibits properties similar to flysch. Like the flysch sandstone, the weathered sandstone from Transitional Beds takes on a brownish colour due to its iron content of terrestric origin. One architrave, one washing basin and individual building blocks made of the sandstone from the Transitional Beds can be found in Sant' Antonio in Bosco/Boršt and Mocco'/Zabrežec. The sandstone from the Transitional Beds serves as a particularly good construction material, but the fact is that not all sandstone layers prove suitable. Namely, the quality depends on the proportion of silt and clay in the rock. The higher the silt and clay content in the matrix, the poorer the material strength and its resistance to weathering. Since the silt and clay content of the rock varies significantly in both the vertical and horizontal direction, the Transitional Beds do not represent a serious material source for stonemasonry. Additionally, the relatively poor thickness of the Formation is another factor in the truly limited use of the material in architecture.

Architrave made of sandstone from the Transitional Beds of Sant' Antonio in Bosco/Boršt

A detail of the rear side of the Architrave reveals it was originally built-in, and appears here in secondary use

A washing basin made of sandstone from the Transitional Beds exposed in the background (village of Mocco/ Zabrežec)

Flysch

Flysch is a rock formation in which two types of rock are interchanged, usually sandstone and marl or shale. The alternating of soft marly layers with much harder sandstone layers allows for the easy extraction of sandstone blocks of constant thickness. The individual layers are already separated, so there is no need to cut the horizontal planes, but only the vertical ones to achieve a block shape. The latter is true for the material from the quarry. However, we observe large variations in the quality of flysch sandstone building blocks. Certainly the Flysch sandstone building blocks in Sant' Antonio in Bosco/Boršt and Bagnoli della Rosandra/Boljunec and very likely in other villages as well were initially collected from the surface layers in the near vicinity. This because the building blocks are irregular in their thickness, are frequently laminated and are completely oxidized, also in the core of the block. Fresh flysch sandstone extracted from the quarry is greenish-grey in colour; once it comes into contact with air and humidity it gradually changes to brown as the iron minerals in the sandstone oxidize. Blocks of laminated sandstone of poor quality (due to its tendency to exfoliate) are frequently observed in older buildings. Freezing water trapped in laminated sandstone, with laminae containing enough clay minerals or open micropores that can host water, causes exfoliation and hence degradation of the blocks' integrity. The use of building blocks with large calcite veins and blocks of irregular shape also demonstrate that the material was collected in the vicinity of the thrust zones near the villages of Hervati/Hrvati, Sant' Antonio in Bosco/Boršt or Bagnoli della Rosandra/Boljunec, where the oldest flysch beds are exposed. These beds are also intensely folded and tectonized, hence the large calcite veins and the absence of regular straight layers that would enable the easy production of regular blocks.

An old wall of entirely different appearance can be seen at Caresana/Mačkolje, where even the oldest buildings are built with far better blocks, regardless of their size. Considering the built objects crafted from small blocks of flysch sandstone very likely not acquired from the quarry, one can claim that the material at Caresana/Mačkolje and Prebenico/Prebeneg is in general of a higher quality. Taking the geological map as reference we can suggest the reason for this lies in the younger part of the flysch formation, which exhibits a higher sandstone/marl ratio and the fact that the flysch is less tectonized there.

Only two recognizable extraction sites (not real quarries due to their size) are recognized in the Comune di San Dorligo della Valle/Občina Dolina Municipality: one at the eastern margin of Dolina and the other at Hervati/Hrvati. Both are quite small, with sandstone beds up to 30 cm thick. Presumably, such extraction sites were once more common, but today have been built up due to the obvious shortage of suitable land for building development.

Sandstone blocks with calcite veins are irregular in shape. Occasional blocks of Alveolinid-numulitid limestone are also present (Sant' Antonio in Bosco/Boršt)

Laminated flysch sandstone and a block of Alveolinid-numulitid limestone with large benthic foraminferae (white spots)

Building blocks of higher quality are used south and east of Bagnoli della Rosandra/Boljunec

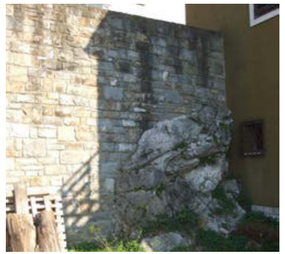
A partly-weathered block of flysch sandstone with lamination in the upper part (Prebenico/Prebeneg)

Fresh (not weathered) greyish-green sandstone blocks are a reliable indicator that flysch blocks originate from a quarry, dug out from deeper layers (Prebenico/Prebeneg)

Quaternary deposits

Rockfall blocks

Generally, rockfall blocks were not used in construction. However, they often became part of the main floor due to their size as they were not removed before construction, but were used to support buildings directly. Many examples are seen in Dolina as well as Sant' Antonio in Bosco/Boršt and San Giuseppe della Chiusa/Ricmanje.



Dolina is built on large limestone (and breccia) boulders

Pebbles

Large flysch sandstone pebbles from the Rosandra/Glinščica creek beds are used to form building blocks.

A wall with sandstone pebbles in Bagnoli della Rosandra/Boljunec

Large flysch sandstone pebbles in a building in Bagnoli della Rosandra/Boljunec

Slope breccia

Slope breccia can be heavily cemented and as such can be used for building blocks in masonry. However, shaping the breccia into blocks is time-consuming, as it is usually massive rather than organised into layers of uniform thickness like the flysch sandstone. Breccia building blocks are only sporadically found in walls, indicating the preciousness of each building block. Probably more interesting, however, is the fact that millstones are carved from slope breccia. The only two perfectly preserved specimens found have been built into the stone wall at Mocco'/Zabrežec.

Blocks of slope breccia and flysch sandstone pebbles in a wall in Bagnoli della Rosandra/Boljunec

Millstones carved in slope breccia built into a wall in Mocco'/Zabrežec

Travertine

Travertine is also a very useful building material owing to its soft texture, which makes it very easy to shape. Only one vaulted window frame made of travertine was observed, in the church at the Dolina cemetery.

Vaulted window frame made of the local travertine, in the church at Dolina

The vaulted window frame was completely covered in plaster and painted

4.6 The geomorphology of some of the researched communities

Grozzana/Gročana

Grozzana/Gročana is situated at the edge of the Krasno Polje, a typical karst polje (karst field) approximately roughly 1500 m long and 300 m wide at its mouth. Krasno Polje is formed along a hinge of a moderately expressed anticline, along which axis runs the **Gročana Fault**. A simple valley was formed out of fractured limestone along the anticline axis that also hosts a fault, as weathering (dissolution) of the limestone developed far faster here than elsewhere in the surroundings. The valley was eventually filled with fine-grained alluvium. Sinkholes are situated at the southwestern margin of the field, though only one of them is apparent in the morphology; the others are active beneath the surface at the limestone/alluvium interface. The underground water flow is directed from the sinkholes along the Gročana Fault zone in a south-easterly direction, emerging in a spring some 400 m due south-east.

Apart from the main creek running along the valley axis, several N–S oriented fault zones are apparent in the morphology of the northwestern side, acting as tributaries in the geologic history of the Krasno Polje. Shallow gorges have formed along these fault zones, though today the water only runs along the fault zones below the surface. The valley slopes are covered in colluvial rubble. The village of Grozzana/Gročana is conceived at the mouth of two such small valleys, where the limestone bedrock usually appears more fractured than elsewhere, making the slopes more gradual. Limestone rubble of various size stones served as a convenient source of building material.

An architectural survey of Grozzana/Gročana revealed that the greatest part of building materials employed consists of Alveolinid-numulitid limestone. As building blocks of the Alveolinid-numulitid limestone are not particularly well elaborated the question whether they originate from a large cut opened expressly for this purpose arises. Closer geological examination of the building material revealed that the lithotype of the limestone building blocks matches that of the local bedrock. Another argument favouring the local source theory is the weathered surface of many limestone building blocks, which is typical for a weathering process at the surface. This would indicate that the rock material was largely collected from the surface rather than quarried. As was observed during the architectural survey, the usual limestone building blocks are only roughly shaped, whereas larger blocks used for cornerstones and portholes (primitive windows) reveal better finishing. Examples of window frames with rough surface finishes are very rare and cannot compete with the far more elaborated stonemason's finish of the frames acquired from the workshops at the cretaceous limestone quarries in the Krast (Carso/Kras).

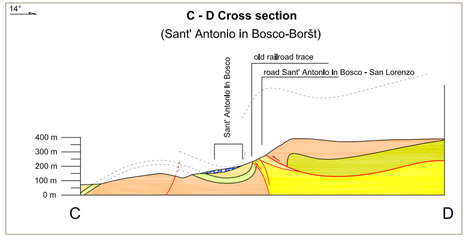
Flysch sandstone was used as a secondary building material. Small building blocks 5 to 15 cm thick are used to form vaults above doors and windows as well as to compensate for the irregular thicknesses of the limestone blocks. Individual examples of architraves made of the flysch sandstone are also to be found. Flysch sandstone was also used for window- and door frames, but was most frequently used for eaves, and for which 40 x 40 cm slabs 5 cm thick were used.

Grozzana/Gročana lies only a mile from the nearest flysch exposure, the closest source of which is Mt. Veliko Gradišče (Slovenia) connected by a road-route passing the village of Sv. Tomaž. However, a few pieces of flysch sandstone were found on a route along the southeastern margin of the Krasno Polje during geological mapping. A few pieces of flysch sandstone found on the path are interesting because the route is too narrow for motorized vehicles, suggesting that the sandstone has been carried along the route by a simple drawn carriage. As the route leads from Grozzana/Gročana to Krvavi Potok and Draga, the assumption that the sandstone blocks for the buildings there might come from the immediate area, perhaps exclusively, is particularly relevant.

San Antonio in Bosco/Boršt

The village of San Antonio in Bosco/Boršt lies on the west side of a 1.2 km-long slope east of San Giuseppe della Chiusa/Ricmanje. The shape of the village as it is shown on historic maps reveals two principal axes: the more pronounced east–west axis, parallel to the flysch/limestone boundary and orthogonal to the slope, is seated a few hundred metres below the boundary (See geological map). The lithological boundary between the flysch and the limestone is tectonic, with the limestone thrust onto flysch. Due to the large differences in erodibility of the flysch and the limestone the area below the boundary is less favourable for a settlement as it is exposed to mass wasting. The road between San Giuseppe della Chiusa/Ricmanje and San Antonio in Bosco/Boršt is also placed at some distance from the lithologic boundary for the same reason. The other axis runs in the NNW–SSE direction, almost orthogonally to the E–W axis and coincides with a weakly pronounced ridge upon which the central square and church are built.

The ridge was formed by a succession of various factors. To the south the ridge is covered by large (up to 1 m3) boulders of slope breccia. The latter was formed by cementation of the Pleistocene gravel of the scree slope. A stiff crust of breccia slid downhill due to heavy precipitation and the spring wetting the impermeable Basal Marl at the lithological boundary. During the collapse the cemented gravel crust (breccia) disintegrated into large blocks now exposed at the southern base of the ridge. In fact, the whole ridge is actually covered by rockfall debris. Due to the high permeability of the talus it acts as a secondary open aquifer with the Basal marl serving as an impermeable base. The described geologic

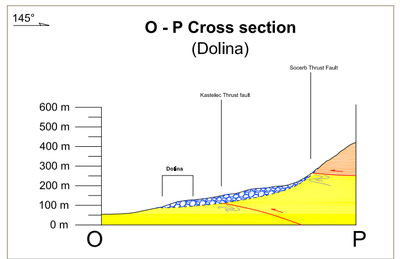


The C–D geological cross-section with exaggerated vertical scale across San Antonio in Bosco/Boršt (aquifer sediments (rockfall) are marked in blue)

conditions refer to the spring at Sant' Antonio in Bosco/Boršt, situated approx. 60 m E of the church, as marked on the historical maps. Judging by the position of the spring and the morphology of the area the rocky talus is up to 10 m thick.
The C–D geologic cross-section running along the ridge shows that the settlement is built upon the least steep part of the slope. The primary aquifer, the position of the talus (rockfall debris) representing the secondary aquifer, and the position of the outlet (the spring) are shown in the geologic cross-section using an exaggerated vertical scale. It is obvious that the water table is very close to the surface on the ridge, as can be seen in one of the original wells incorporated into one of the well-preserved existing houses here. Only a thin layer of rock debris had to be removed to reach the water level in order to fashion a simple well, which only required digging a shallow pit into the marly basement.The geologic basement at San Antonio in Bosco/Boršt is represented by flysch in the western part, and breccia, gravel talus and the Basal Marl in the central and eastern parts. Flysch sandstone constitutes the predominant building material in San Antonio in Bosco/Boršt. The sporadic presence of unshaped limestone blocks demonstrates the value of each building block that did not have to be brought from elsewhere. A more detailed survey revealed that the flysch sandstone blocks represent a relatively poor quality rock material. In fact two kinds of flysch sandstone are present in building walls in San Antonio in Bosco/Boršt: the higher quality material has definitely been quarried, while the poor quality blocks were likely collected or dug out from the surface layer of nearby fields, or from small cuts like the one preserved at Hervati/Hrvati.

Dolina

The village of Dolina is built upon the toe of a large debris slide. Huge boulders of slope breccia can be found in the foundations of many buildings, among them in the foundations of a church tower. Toes of large rock debris slides usually prove a stable foundation substrate. The ridge of a debris slide toe is a dominant feature in the morphology of Dolina – just as in the case of San Antonio in Bosco/Boršt. Roughly 1.5 million cubic metres of debris have accumulated at the toe alone, but vast scree slopes are present both east and south of the settlement. The scree slopes in particular, with their large portions of weathered flysch, represent reasonably fertile ground. Terraces are still preserved around the abandoned settlement above Dolina, and lush gardens and orchards are still in use south of the village. The village's water supply comes from the thrust boundary above the impermeable flysch below Mt. Mali Kras, and runs through the gravel slope, so ground water is present also in the colluvial deposits that act as secondary aquifers.
The village grew towards Crogole/Kroglje along the N–S axis along the lower limit of the slope gravel towards the Antro delle Sorgenti/Na jami karstic spring.



Geological cross-section across Dolina

Prebenico/Prebeneg and Caresana/Mačkolje

Both villages are situated in an area characterised by low geodiversity and are, from this point of view, quite alike. Both are situated at the start of a 5 km flysch ridge that represents the divide between the Glinščica and Rio Ospo/Osapska reka River watersheds running from the village of Socerb (Slovenia) down to the sea. Growth of Prebenico/Prebeneg is severely hampered due to the unstable southern and northern slopes of the ridge, where numerous fossil and active landslides are obvious. To the east, a very steep slope also acts as a natural barrier. The nearest source of limestone lies 1 km due west at Socerb, making flysch sandstone the dominant building material here. Only the occasional door- and window frame have been purchased from the quarries above Trieste. The differences between objects made from locally-sourced materials and those quarried from one of the nearby flysch quarries (probably the Jelarji/Elleriquarry) are obvious; the same is true also for Caresana/Mačkolje.
Similar to Prebenico/Prebeneg is Caresana/Mačkolje, which is built along the Črni Kal thrust fault trace. It would be difficult to claim that the morphology of the settlement is a direct consequence of enhanced erosion processes along the fault zone in the flysch, as the area is covered in vegetation. Yet in both villages ground water is captured in the weathered surface layer and drawn from relatively shallow wells (only a few metres deep), but water is not particularly abundant owing to the small size of the catchment area.

The view from Socerb to the ridge where Caresana/Mačkolje and Prebenico/Prebeneg are

Caresana/ Mačkolje

San Giuseppe della Chiusa/Ricmanje

San Giuseppe della Chiusa/Ricmanje is built on a flysch ridge just like Prebenico/Prebeneg and Caresana/Mačkolje. In this case the relief is interesting because it has been formed in a subthrusting process of the Istria-Friuli segment. The Karst edge runs in a very straight line from Aurisina/Nabrežina to San Giuseppe della Chiusa/Ricmanje with the principal slope facing southeast. The subthrusting of the Istria-Friuli segment provoked the initially straight Petrinje Thrust Fault trace to bend as it was pushed towards the NE as much as 1500 m. This is the reason the slope between San Giuseppe della Chiusa/Ricmanje and San Lorenzo/Jezero today faces south. The San Giuseppe della Chiusa/Ricmanje ridge therefore represents a corner in the relief, which makes the village much like Prebenico/Prebeneg. Both villages are situated on a corner offering a 145 degree view to the area below. Two creeks emanating from the limestone massif above cut small gorges into relatively soft flysch beds on either side of the ridge that divides it from the surrounding area; more importantly, however, the ridge is protected from erosion as all the water is channelled through the creeks. Colluvial deposits some metres thick in the upper part of the village also act as a secondary aquifer.

4.7 Construction Typology

3

See map No 3 - the graphic representation of the general geomorphological characteristics and predominant types of the settlement system

The detailed overview of Breg communities and buildings in the geological and geomorphological context offers a unique image. The construction typology could be termed **traditional Breg rural architecture**, characterised by transitions **at the junction of traditional karst rural architecture** with limestone as typical building material, and **traditional Istrian rural architecture** with **flysch sandstone** as basic building material. Istrian architecture here means the architecture of the Slovenian Istra. Together with the presence and the interplay of both construction typologies, the transition between both generally known typologies is also influenced by unique buildings that cannot be found anywhere else.

When separately observing the typical elements of construction in each village (such as location, roof, exterior, fireplaces, balconies), one establishes the surprising fact every village in this geologically and geomorphologically very diverse area features diversified construction and an individual style. Construction is conditioned by village micro-location and consequently a microclimate calling for humans adaptation. In addition to natural factors, we cannot ignore the cultural influence evidenced mainly in the enclosed courtyard of the Karst borjač and Istrian korte with their memories of various cultures that have left their mark. Water influences construction significantly. The area is quite rich in water which was also one of the key factors in the development of individual industries (milling, laundering) and associated buildings. The natural transitions in the area, the consequences of the prevailing features of individual settlements on the history of Trieste and rapid urbanisation in the 19th and 20th Centuries are not to be forgotten. The latter can be seen in the **transition of rural into urban construction** in some larger villages.

Tipološke značilnosti gradnje uporabljamo kot orodje za razumevanje neposredne povezave med razpoložljivimi viri za gradnjo ter iznajdljivostjo človeka pri njihovi uporabi. Z drugimi besedami nam iskanje ponavljajočih se vzorcev v gradnji omogoča, da prepoznamo odstopanja in s tem značilno pojavnost grajenega v posameznem prostoru. Ne moremo mimo dejstva, da se na ta način posplošuje in je zato na mestu opozorilo, da je potrebno vedno in vsakič znova pogledati vsako gradnjo posebej v vseh njenih delih. To je pomembno predvsem, ko želimo pristopiti k prenovi, saj nas tipološka prenova (to pomeni, da želimo narediti nekaj tipičnega, po nekih splošno prepoznanih vzorcih) pogosto vodi k temu, da izgubimo dragocene elemente avtentičnosti posamezne gradnje, naj si bo to mlin, perišče ali stanovanjski objekt.

To better understand the particular elements which make Karst and Istrian buildings unique and observe the transition between the two in the Comune di San Dorligo Della Valle/Občina Dolina Municipality, here we provide a comparative description of their basic typological characteristics. This is inevitably a generalisation which cannot encompass all existing forms.

	Karst architecture	Istrian architecture
Foundation	Lime stone	Flysch sandstone
Characteristic morphology of the terrain and settlement pattern	Relatively flat relief with occasional hills. Communities are normally in leeward locations and the foot of smaller hills. Settlements are nucleated and follow mainly the principle of appropriate sheltering with façades facing the south and west.	Normally varied terrain with steep slopes. Communities are normally located on peaks and develop in strings, in accordance with terrain contours. When terrain inclination enables this, communities develop in a nucleated fashion. Where the inclination is great, buildings are normally partially sunk into the ground and have more than one entrance from terraces on different levels. Community orientation and façades face south and west as in the Karst (Carso/Kras) area.
Cultivated areas	Cultivated areas developed when the stone was cleaned mainly in the predominantly flat part of the Karst plateau. Excess rocks were used for peripheral drystone walls which, among other purposes, serve as protection from erosion. Higher quality stones could serve as building blocks for buildings.	Cultivated areas were obtained by terracing. Excess rocks were used for terrace retaining walls, while higher quality rocks were used in buildings.
Positioning and relationship with the outside space	The basic cell was in the shape of an oblong rectangle. The façade composes the longer side facing the sun. Normally buildings develop additively along the margins of their plots which usually have boundary walls. These walls protect the private area or borjač from the Bora wind, enabling its winter use.	The basic cell is an oblong rectangle, even longer than the karst one. Façades are along the longer side facing the sun. As a rule, buildings develop in rows additively along terrain contours. Individual rows may be connected transversely by building over the passages which close the inner yards (courts or korts) from the streets.
Surface water drainage and water supply	Water sources are rare in the Karst plateau due to basic ground characteristics. Water supply involves channelling rainwater from roofs into tanks called "štirna".	The ground conditions offer more water in the Slovenian Istria. Sources were accessed using wells (Sln. pač). These supplied water to communities with residents walking to nearby watercourses lower towards the valley. Proper surface water drainage was important to communities due to poor local ground permeability.
Roofs	Double-ridged roofs covered with clay roof tiles, normally over timber frame structure. The ridge is parallel to the longer side. Beams lean perpendicularly to the ridge. Above the beams are timber boards or *žagance* which carry the clay roof tiles or *korci*. *Korci* are bedded in lime mortar. Some roofs have, instead of boards, timber battens or *remelni*, perpendicular to the beams on which clay tiles are placed. Eave overhangs are short to protect the timber from weather and the roofs from the Bora. Longer overhangs normally cover the outside roofed area next to the building or *gank*. As a rule, there are no overhangs over side walls, or they are formed by rows of stone flags.	Double-ridged roofs covered with clay roof tiles, normally on timber structures. The ridge is parallel to the longer side. Parallel to the ridge are beams fitted atop the side walls. When the distances are great, they are supported by triangular timber racks. Timber boards are placed perpendicular to the beams, above which are the clay roofing tiles or *korci* embedded in lime mortar. Eave overhangs are short, being longer only if connected with the covered outdoor areas or *baladurs*, or with wooden cantilever balconies. There are generally no overhangs on side walls. When they are present, they are rows of stone flags.
Fireplaces	In the past fireplaces were convex or completely separate structures with stone roofing and characteristic large chimneys. Later, depending on individual building development, fireplaces moved into the interior.	Similar to karst typology: the convex fireplace is common, with chimney flues in the interiors or along outside walls.
Lean-tos and sheds	Normally, a covered cantilever balcony or gank is featured. This has a number of functions like improving living conditions in buildings, protecting them from direct exposure to rain, appropriate shading in summer and enabling low winter light interior illumination. The gank is the central passageway on the floor. It was used to dry laundry and farm produce. The load bearing structure of ganks comprises timber and/or stone cantilever beams bearing timber boards. Ganks are accessed by external stone stairs.	Normally a roofed outside area or baladur, from the Italian ballatoio, with a similar function to the gank. The lower part of baladurs are normally stone walls of flysch sandstone with larger arched openings. The roofing is supported by timber and stone pylons. Baladurs are accessed by external stone stairs. We also find outside roofed areas with timber roofs.

4

See map No 4 - the representation of the local construction

If we embark on a walk through Breg settlements starting at the edge of the Karst Plateau, we find **Draga**, a typical nucleated community. Despite being located on limestone, the buildings are mainly of flysch sandstone. The settlement is nucleated, with inner courtyards for protection from the Bora. There are cantilevered timber balconies on some façades. Windows and doors are often framed in flysch sandstone shaped so that the sandstone plate has vertical layers. Fireplaces are convex and have large chimney breasts.

Window reveals with flysch frame

Drywall

A row of buildings with a distressed cantilever balcony

In **Sant'Antonio di Bosco/Boršt** we find typical positioning by terrain relief. The organisation of buildings also shows the influence of the karst area. They are organised around enclosed courtyards which offers shelter from the Bora wind to which the village is quite exposed. There are many portals of Cretaceous limestone but the basic building element is flysch sandstone. The widespread use of imported stone testifies of the community's traditional wealth, with a strategic transit location and rich water sources and large wells in the centre and outskirts. Construction of the Castello di Moccò/Moccò Castle and later the railway – consequences of natural features – promoted local economic development. The influence of the city and tourist development in the early 20th Century brought new building typologies with long and distinctly ornamented overhangs. The influence of the railway is clearly visible from marginal structures of later origin featuring rather larger flysch building blocks in their outer walls, very unlikely to be of local origin.

This extended and ornamented overhang is not characteristic of the countryside

An ornamented extended overhang and shutters with movable elements show a bourgeois influence in this construction

A traditional arched portal

A portal with a pointed architrave through which the inner fenced courtyard is accessible

The size of these building blocks is not characteristic of traditional construction

Later extensions almost completely cover the traditional arched portal

An outside area and the structure of a wall

A row of buildings

A walk to nearby **Moccò/Zabrežec** offers interesting opportunities to note the distinctive manner of locating buildings on terraces. There are no enclosed courtyards here because of the village's leeward and sunny location. We can also observe the extended use of local flysch sandstone in door and window reveals, often combined with from cretaceous limestone frames. Here we see the pragmatic building approach of borrowing existing elements for reuse from disused buildings. Rows of buildings emerged by adding units, as shown by an external fireplace not located inside a cell which was built later (we find similar ones in the Slovenian Istria).

A window frame which reuses side pylons of cretaceous limestone taken from another building

An outward projecting fireplace

When we descend into **Bagnoli della Rosandra/Boljunec** the picture becomes even more blurred because the community is located where the Rosandra/Glinščica creek abruptly cuts its way between Monte Carso/Mali Kras and Monte San Michele/Sveti Mihael (Hribenca). The central historical part of the settlement is at the foot of Monte San Michele/Sveti Mihael, with classical terrace construction that follows the relief. We again note that the basic material is flysch sandstone despite the fact that the settlement is built over limestone. In terms of typology, construction is completely unique, with external roofed areas. At the same time, we can see a typical oblong cell whose roof has a rather clear construction with beds parallel to the axis of the ridge. Part of the settlement in an alluvial plain right at the foot of Monte San Michele/Sveti Mihael. This area offers less shelter than the centre. Here we first notice a fenced outside area or kort. Communities built in less favourable locations testify to the economic abilities of the past. Magnificent buildings at the central square with overhangs over side walls, which give countryside buildings a bourgeois appearance, testify to the community's important economic role and abundant contact with the city.

Timber console balconies

A stone hook used to fasten the door spindle

A view of the construction of the arched element

A traditionally ornamented supporting console with a profiled arch

Timber lintel over a gate. Above it is a load bearing stone arch of flysch sandstone building blocks

From **Bagnoli della Rosandra/Boljunec**, we gradually ascend in **Crogole/Kroglje** where we can again observe the terrace construction with rather expanded wooden balconies. In the settlement we can also find a rainwater channel which is constructed entirely from flysch building blocks or plates. The settlement is located on flysch and in the vicinity of previous layers therefore the amount of water directed from the hinterland to the valley must be quite significant.

A timber balcony

Rows of houses

A gate reveal of flysch sandstone which was entirely rendered

A drain of flysch sandstone

Magnificent buildings in the centre indicate the community's important past role

An arched underpass offers access to the shared area behind a row buildings

A window reveal of Cretaceous limestone. Above it is a load bearing arch of flysch sandstone, with a timber load bearing element beneath it

We continue our way to **Dolina**, where the commmunity's special function is at once apparent. The large Church of St Ulrich (Sant' Ulderico/ Sveti Urh) and other magnificent bourgeois buildings, abundant portals from Cretaceous limestone and a large well (Kaluža) in the centre (through which the main local watercourse runs) testify to this. Peculiarities include high quality load bearing stone arches of flysch sandstone blocks and plentiful portals, window and door frames from karst quarries. Between the load bearing arch and the frame of Cretaceous limestone there is often an additional load bearing element.

A window reveal with a frame and arch of flysch sandstone

A lavish arched portal of Cretaceous limestone

At **Caresana/Mačkolje** we see what we refer to as Istrian architecture prevalent in the nearby Slovenian Istria. Caresana/Mačkolje is a typical terraced community featuring mainly flysch sandstone buildings and terraced farming areas along the margins. There are baladurs and real Istrian korts. The flysch sandstone blocks are considerably larger than elsewhere in the Breg. Surface treatment of window and door reveals, such as traditional pointing, bespeaks the local stone's higher quality. Typical construction has buildings accruing around korts and leaning against terraces with the natural relief. This is similar to the approach in **Prebenico/Prebeneg**.

A traditional vine trellis

A terrace

Entrance to a building from an upper terrace. The difference between elevations of nearby terraces is such that the building is entirely dug into the ground

A row of buildings with traditional trellises

Characteristic construction of peripheral walls from flysch sandstone

A view of the lower rendered part of a baladur

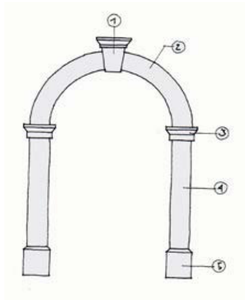
A window frame of flysch sandstone with a load bearing arch also of flysch sandstone. Note the traditional full shutters

A view of a flysch sandstone portal offering access to a kort

Portals with pointed architraves as pointers to the cultural influence of the karst area

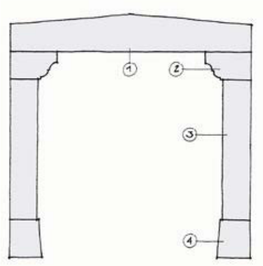
Most Breg communities feature portals with pointed architraves. This element is unmistakably an example of typical karst building typology. It spread to the area under review when the railway (Trieste – Vienna, 1857) arrived and when quarrying in karst flourished as the economy enjoyed an upswing. Such portals' significant presence in the area was mainly the consequence of economic development and the fact that it is also present in Breg communities. Fitting stone portals was most expensive and therefore bestowed status on owners. Initially, portals were built of local stone, in areas where the basic building material was limestone or flysch sandstone. Occasional arched portals (mostly of Cretaceous limestone) were rarer before the railway arrived and were especially present in rare richer buildings or ones with special functions, like churches.

A traditional arched portal



1. keystone (with or without a garland)
2. arched segment (monolithic or not)
3. impost
4. jamb

A portal with a pointed architrave



1. pointed architrave
2. supporting console with a profiled arch
3. jamb
4. base

Recording

To preserve memory and knowledge

This chapter provides a more detailed insight into Breg and Dolina buildings. The initial objective of the study was to inventorise three residential buildings in recognition of the variety of buildings reflecting the specific natural and cultural resources of this transitional area. This gradually resulted in the realisation that the inventory should represent preserved construction typologies bearing witness to the direct connection of the Dolina people with their environment.
One of the selection criteria was the evidentiary value of the selected buildings and the degree of their vulnerability (the danger of loss of visible evidentiary elements). The criteria for selection included the presence or absence of attention to buildings in existing expert literature, the accessibility of locations and the potential for using the record to promote tourism in the municipality.
Also included were collections of photographs, descriptions, measurements and tracings that enable preservation and further study of preserved architectural heritage elements, at least on paper if circumstances do not permit preservation insitu.

The following buildings were recorded:

- **1. House “Mačkolje No 1”,**
- **2. A watermill in Bottazzo/Botač ,**
- **3. An Ice Pit near Pesek and Draga.**

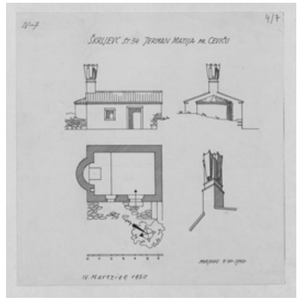
5.1 House “Mačkolje No 1”

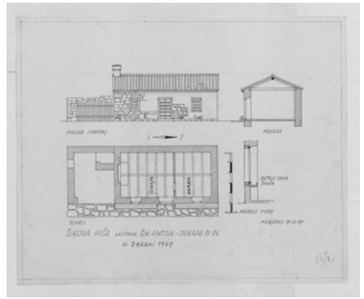
The house is in the northeast of Caresana/Mačkolje. It has the same outlines as other local buildings. The house “Mačkolje No 1” was named after the “old” house numbering system. Abandoned in 1922, it now serves as an agricultural building (a stable). The Tinjanč family resided here until 1922.

Boundary marker of the Caresana dell'Istria/ Mačkolje, Prebeneg, Dolina Municipalities and a photograph of the house: SEM, Teren 23 - Mačkolje, 1967. Source: Slovene Ethnographic Museum, Teren 23 – Mačkolje, 1967, F0000023/167, author Borut Kodrič; F0000023/29

The house was selected for detailed inspection because it is typologically an old Istrian house. It is a rare example of a preserved single room house with a fireplace niche and a pitched roof. Such residences were once present throughout Istria/Istra.
A perpendicular single room house has a niche for the fireplace. Outer supporting walls rendered on the inside and outside were probably constructed on two sides with the intermediate space filled with gravel and soil. The average thickness of the supporting walls is 70 cm. The original render has perished.
The house is roofed with pitched grooved roof tiles. The roof structure is visible from the inside. The beams are perpendicular to four triangular quasi spreaders. Ceiling joists are used as beams and are not placed on the location of the eaves. Above the roof is a timber panel on which grooved roof tiles are bedded in cement. We can conclude that the roof was initially thatched, before a separate fireplace with a chimney posed a fire hazard. The diverse dimensions of flysch sandstone blocks show that the stone was local. Being relatively poor, it would have been collected from the ground nearby or from a small local quarry. It was most probably excavated during terracing for farming purposes. Suitable pieces were used in construction and rest was discarded or used for terrace supports. The Tul family state that redundant stone was deposited in a barrow from which they constructed a niche to serve as shelter from cold, wet and hot weather.
Spoken sources state that local people bought flysch sandstone for window and door columns and lintels at Jelarji/Elleri (Elerje as locals refer to it) – a quarry operating to this day. This stone is renowned for its thickness and has supplied the wider Trieste area.

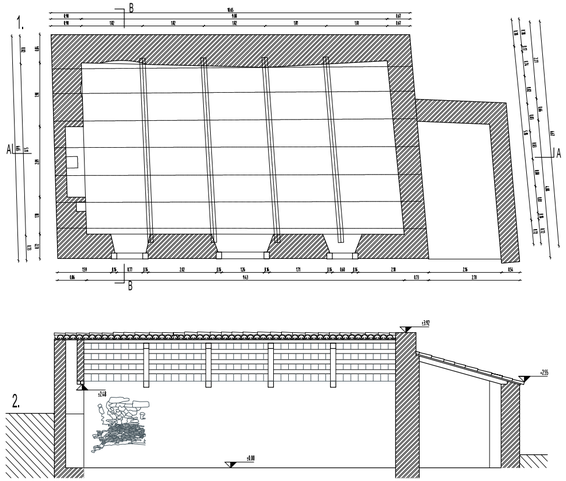
The first cadastral entry of the house was in 1873. (left the Franciscan cadastre of 1818, right the Franciscan cadastre of 1873).
Source: National Archives in Trieste, Mappa catastale del Comune di Caresana foglio IV, mappa accessoria in doppia scala al Comune di Caresana, Segnatura: 655 a 04; Dettaglio della Mappa catastale del Comune di Caresana foglio I, sezione I, Segnatura: 655 a 01



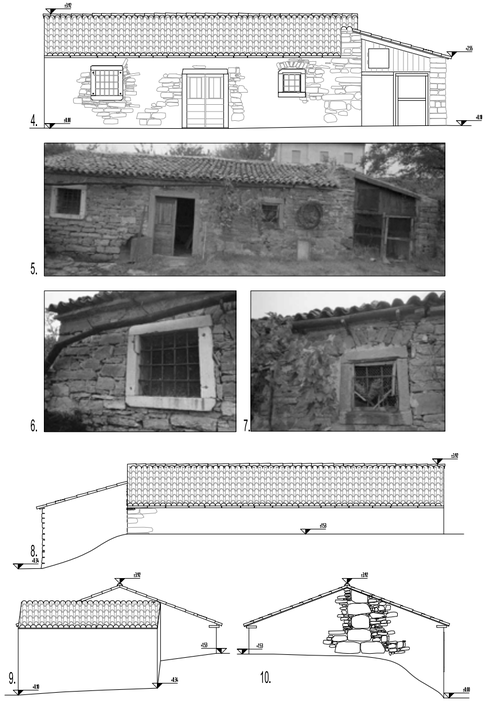


Old unicellular houses: single roomed house with a separated fireplace in Škriljevec, Source: Continuity of Istrian architecture; and Šik's house, Dekani 76. Source: Slovene Ethnographic Museum, Teren 4: Marezige, 1950, R0000004/7b, authors Gizela Šuklje in Teren 3: Dekani, 1949, R0000003/3b

Location, source: Google maps, October 2014



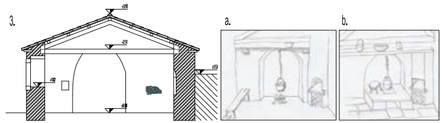
Depiction of the building by conservation architect Katja Kosič: 1. Ground floor; 2. Longitudinal section A-A;



Drawings by conservation architect Katja Kosič: 4. Façade; 5, 6., 7. Photographs of the house, Terrain 23; Caresana/Mačkolje, 1967. Source Slovene Ethnographic Museum , Teren 23 – Mačkolje, 1967, F0000023/24, F0000023/25, F0000023/52; 8. Northern wall; 9. Eastern wall; 10. Western wall

The fireplace is the basic functional element of the house. Unfortunately, the architectural heritage – the chimney and the farmhouse stove – are not preserved.

Cross-section B-B; a,,b. An attempt to reconstruct the fireplace and the brick farmhouse stove by conservation architect Katja Kosič



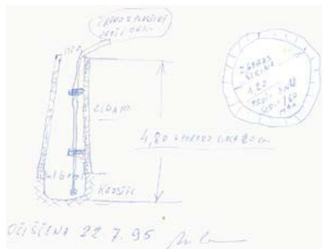
Traces of an unpreserved farmhouse stove in the southern wall

There were many farmhouse stoves in every village because many housewives supplied bread to Trieste for a living. Bread women lived in Servola/Škedenj near Trieste and the Slovenian Istria. Each village had a number of farmhouse stoves for baking risen dough. When more bread women baked at once, each marked hers with a special notch. In one night they would bake two to three batches, and on holidays up to five. In the early hours of the morning they would put the cooled bread into wicker baskets and deliver it to regular customers in town. At the end of the 19th Century caravans of bread women headed to Trieste from local villages. Bread baking came to a complete stop by the Second World War. Water, which in Caresana/Mačkolje is in a weathered lid, may be reached by digging relatively shallow wells. Next to the "Mačkolje No 1" house there is a well with a diameter of 1.2 m and a depth of approximately 4.8 m.

A sketch of a bread woman

Photo. A baker in typical attire dispenses flour from bags. Fonte: Angel Kosmač, Angel Kosmač, Ricmanje včeraj in danes

An old well at the Tinač old house. Source Tul Milan, 1995; and Slovene Ethnographic Museum, Teren 23 – Mačkolje, 1967, F0000023/28



A sketch of the well next to the Caresana/Mačkolje 1 house. Source Tul Milan, 1995

Shelter in a stone barrow – "Kuča", Source photography: Slovene Ethnographic Museum, Teren 23 – Mačkolje, 1967, F0000023/165, author Borut Kodrič; and Milan Tul, 1995

Entrance into the building

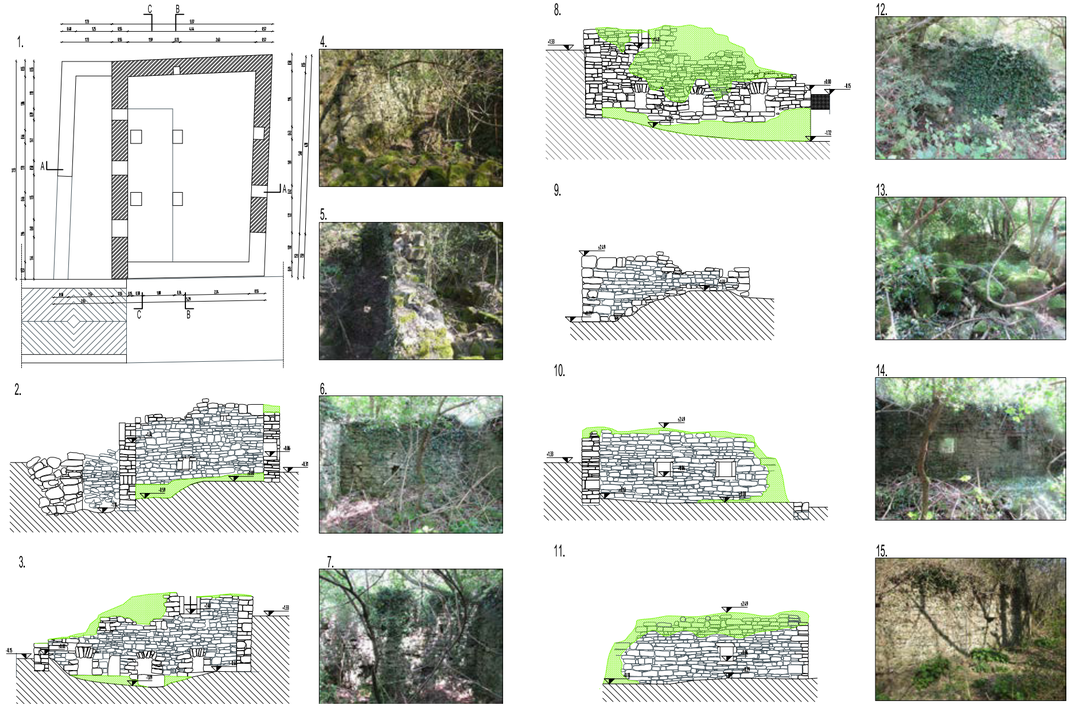
Roughly treated flysch sandstone door frame

5.2 A mill at Bottazzo/Botač

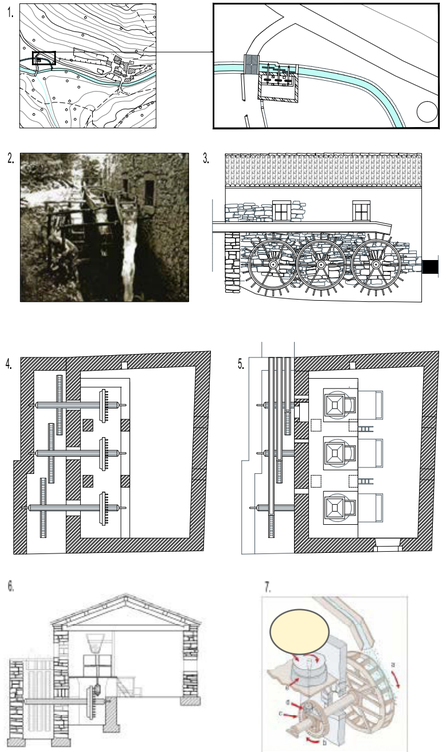
The sheer number of mills is one of the most distinctive features of Breg or the Rosandra/Glinščica Valley. Milling and mills also represent a special feature of local architectural, technical and general heritage. A historical overview of milling spanning over seven centuries was presented at the historical/ethnological exhibition called *Mlini reke Glinščice* (*The Mills of the Glinščica/Rosandra creek*) in 1990 through archive documents, old photographs, newspaper articles and milling implements.The Sancin mill was selected because there are sufficient original elements are preserved (the building was not adapted to a different function) and also because of its relatively accessible location frequented by many people near Bottazzo/Botač and along existing hiking trails through the Rosandra/Glinščica Valley. The mill is a simple perpendicular building on the right bank of the Rosandra/Glinščica. The mill shown on the 1830 cadastre was probably constructed earlier.

A section of the 1873 Franciscan cadastre. The Sancin mill, located west from the centre, right next to the road from the Hervati/Hrvati village is marked blue. Source: National Archives in Trieste, Comune di Draga S. Elia foglio IV, sezione IV, segnatura: 661 a 04

The Sancin mill drawn by conservation architect Katja Kosič: 1. Ground floor plan; 2. Crass section A-A; 3. Longitudinal section C-C; 4. Photo. Mill remains; 5. Photo.. Remains of the milling channel and the stone bearing wall; 6. Photo. Eastern wall; 7. Photo. Northern wall Depiction of the Sancin mill drawn by conservation architect Katja Kosič; 8. Northern wall; 9. Eastern wall; 10. Longitudinal section B-B; 11. Southern wall; 12. Photo. Northern wall; 13. Photo. Eastern wall; 14. Photo. Eastern peripheral wall; 15. Photo. Southern wall



The facility stopped operating around 1930 and is in poor condition. Of four outside walls only three are partially preserved. The roof, floor and ceiling constructions have perished. There is nothing left of the mill wheels, machinery or other equipment. Only the milling channel by the building is partially preserved. Due to the need for a steady flow the mill is not located directly on the torrential Rosandra/Glinščica but next to a manually dug channel or mlinščica. The channel was routed from the river bed from which the correct amount of water was directed toward the water mill. A floodgate diverted excess water back into the river. When water levels were low, all water was routed into the channel. It is presumed that the mill was driven by three water wheels with paddles of approximately 2.5 metre diameter. From a slot in the wall torque was transferred to the horizontal wheel through spindles. The horizontal wheel had wooden spikes hammered into the rim. From the horizontal spindle of the distaff torque transferred to the round stones. The lower stone was fixed, while the upper, fitted to its spindle, turned. Millstones were enclosed by a round timber rim. Above this was a grain hopper into which the miller poured grain. The grain entered openings in the upper millwheel through a camshaft. Flour poured from the rim into a larger timber area to which a moving sieve was attached. From this the flour fell into purifier; the barn fell into a wooden stream under the purifier through a hole. Other important trades such as smithies and oil mills developed near mills. Bread baking also developed.



An attempt to reconstruct the Sancin mill:
1. Situation with the supposed course of the channel;
2. Photo. Mill on the Rosandra/Glinščica creek. Source: Silvester Metlik archive;
3. Ground floor plan: depiction of water wheels;
4. Ground floor plan: depiction of the mill plant

Depiction of the Sancin mill by conservation architect Katja Kosič:
6. Reconstruction of the mill in cross section. It consisted of millstones, a grain hopper, grain chute and a frame;
7. An operating scheme of an overshot water mill (a mill where water comes from above). Source www.digilander.iol.it/agarda/mulino/mulino.html: a. water mill with paddles; b. spindle; c. horizontal wheel; d. distaff; e. lower stone; f. upper stone; drawing by Katja Kosič, conservation architect

5.3 Ice pits

We find visible remains of at least four ice pits between Pesek and Draga. They are hidden by trees along hiking and cycling trails. It is no accident that they are located on the geological junction between the upper and lower transitional layers as water may be collected and retained on the surface in this area with proper regulation of the pond substrates. Rows of still visible, properly regulated shallows or ponds collect running water which reaches the appropriate depth enabling the formation of a layer of ice in winter (sources state a need for -10 degrees for at least ten consecutive days). The ice had to be of a thickness enabling it to be broken without cracking (approximately 20 cm or a hands breath). The broken ice was stored in round retarding basins or ice pits, excavated in the ground.

We are not familiar with the technology in more detail, but can observe a row which begins with a pond rocks arranged by the edge. This is followed by a larger pile of excavated material which we assume was removed to form the pond and the ice pit. It is interesting to note that the excavated material was not used to line the ice pit; instead, local (alveolina nummulitic) limestone was used, as found in the vicinity. Most probably the ice pits were covered with simple timber lids covered with straw.

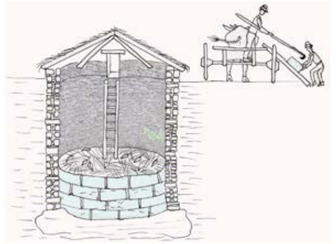
Until the First World War, ice pits were an important source of income during winter for the wider Karst (Carso/Kras) and Breg area and beyond. While once widespread, they have now fallen into disuse, though some operated until the Second World War. Trieste bars needed ice to cool beverages and households needed it to store fish and other food. Transportation also needed it, alongside medical practices. Local ice was exported as far afield as Alexandria in Egypt, showing how important this business was in the past.

An important accompanying activity was ice transport typically using enclosed horse carts driven by *horse and cart drivers* (Sln. furman). There was a renowned ice pit between Divača and Kozina which operated between 1860 and 1906 and could store up to 50 tons of ice. The Trieste National Archives even have a 1797 plan for a public ice pit which intended to store ice in the city.

View of a pond

Excavated material at the pond

A circular ice pit



A diagram of an ice pit drawing by Katja Kosič, conservation architect

The Rosandra/Glinščica Valley with Monte Carso/Mali Kras in the background

Conclusion - For the future

Why preserve the natural/geological and cultural/constructed heritage

The study sheds new light on the region of the Comune di San Dorligo della Valle/Občina Dolina Municipality and reveals diverse variations of indigenous local architecture that is fundamentally characterised by adaptation to multifaceted local conditions. Understanding local architecture in depth offers opportunities to transfer know-how. This, in turn, is a key foundation of sustainable construction and reasonable use of space. The scope of know-how is not set out in any book. Instead, it is written in the stone and other materials wrought by the builders of the past in a way that was complemented and improved from generation to generation, lasting for centuries and indeed even millennia. The stone houses of Breg inscribe the local history and culture of the people who constructed and inhabited them. In the living indigenous building tradition of the area, we mostly find the cultural heritage of local Slovenes whose building tradition was handed down to them from their ancestors. This tradition developed and enriched through contact with other peoples and cultures ever since. The millennial story of these communities rests on geology. The properties of rock on which their world stands and its evolution through the ages shaped the life of these people, from prehistoric hunters to the last millers to set up mills in the 20th Century.

6.1 Kamnite hiše in vasi

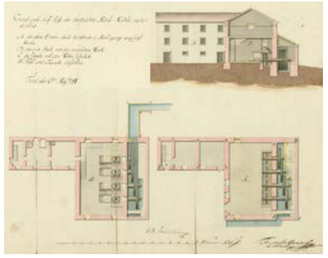
H kakovostni kulturno-turistični ponudbi bistveno pripomore kakovostno obnovljen in vzdrževan stavbni fond, ki poleg pokrivanja vsakodnevnih praktičnih potreb prebivalcev omogoča tudi ohranjanje avtentičnosti stavbne dediščine in privlačnosti kulturne krajine. Terensko delo je potrdilo, da je tudi na tem področju, tako na območju občine Dolina, kot v sosednjih območjih, stanje mogoče še precej izboljšati tako v gradbeno-tehničnem smislu, kot v smislu varovanja kulturnih in naselbinskih prvin stavbne dediščine. Občinska uprava ima lahko pri tem aktivno vlogo z nudenjem strokovne in druge pomoči oziroma usmeritvijo občanov, lastnikov nepremičnin.

Bottazzo/Botač has a pivotal role in tourist image of the Rosandra/ Glinščica Valley. It is therefore appropriate to preserve its settlement heritage very carefully

6.2 The mills of Breg

A part of the present study focused on the mills of Breg, since they are directly tied to geological features. Through long periods, soil consistency shaped local water currents that provided the fundamental resource for milling.The presentation of the milling tradition will enrich the cultural and educational experiences offered by the valley. One can venture even further: the renovation and reactivation of one of the mills in an attractive location can offer both a cultural and a new product which is interesting due to changing eating habits: for example, freshly ground cereals. All under the motto »Cultural Heritage from the Mill to the Plate«, witnessed in real time.

»Piera col buso«, a typical element of Venetian influence on Karst-Istrian houses in Hervati/Hrvati



A mill on the Glinščica in olden days
Source: National Archive in Trieste, Državni arhiv v Trstu, Grund und Auf-Riss der Stattischen Mahl-Mühle nechst Dolina (1788 mag. 2), Fondo Direzione delle Fabbriche del Litorale, Archivio piani; Segnatura 0501 a

The village well in Prebenica/Prebeneg with a three-part flysch sandstone upper lever is a testimony on how much knowledge and labour was needed to provide enough water for everyday life

Restored Mazorin's mill in the Dragonja valley and flour with added value – full-grain milling on stone.
Source: Trobec, T. 2010: Dragonja. DEDI - digital encyclopaedia of natural and cultural heritage in Slovenia, http://www.dedi.si/dediscina/359-dragonja

6.3 The natural and cultural heritage as a business opportunity

Nature and natural resources that acted as the foundations of survival to numerous generations have been stripped of economic significance by intensive urbanisation and industrialisation of the hinterland of the Gulf of Trieste (Golfo di Trieste/Tržaški zaliv) in the 20th Century. And yet they are still here. Decades ago, the Rosandra/Glinščica Valley was hailed as one of the most important pillars of tourist development in the Karst including Breg and Brkini. Providing further management and equipment to the habitat, constructing shorter and longer theme trails, cross-border connections to similar areas, inclusion of related offers into networks across Europe and the complete provision of tourist infrastructure (nature, cultural and recreational tourism) will give tourists a deeper and more fully experienced groundedness in this area and establish new contacts with the inhabitants, while local communities will benefit from renewed economic landscape utilisation.The marketing of natural and cultural heritage of the area should definitely include ice caves: extraordinary geological formations and a unique natural phenomenon in the area.When we research the stories of nature and the history of Breg, we no longer pay attention to industrial halls and highway overpasses because our eyes are caught by other things altogether. The picturesque Breg's villages with oil reservoirs in the background do not offer an idyllic image of the area anymore, but its identity can still be preserved for the future development.

A combination of activities involving nature protection, heritage tourism, recreational programmes and marketing, manufacturing activities, with the Sečovlje salt pans an example
Sources: Sergej Mašera Maritime Museum of Piran, Saltworks Museum in the Sečovlje Salina Nature Park, http://www.pomorskimuzej.si/sl/muzej-solinarstva

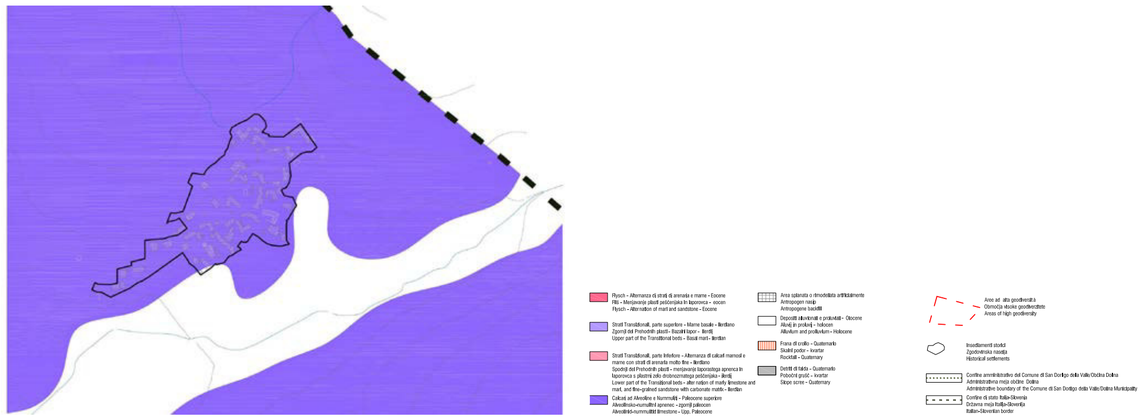
Ice caves under Pesek, hidden in nature's embrace, remote from everyday paths, with immense suggestive powers

The Rosandra/ Glinščica Valley from San Lorenzo/Jezero: inviting us to a journey full of discoveries and wonderful surprises

A Step towards Evaluation and Guidelines for Renovation

Using the example of **Grozzana/Gročana** village, we present a manner in which community heritage may be evaluated on a community-by-community basis. Guidelines for intervention follow, designed to help preserve individual community heritages. This could then be followed by a set of suitable measures on the level of intervening into individual elements such as peripheral walls or external paving while renovating structures or buildings.

1. General information on village geology and geomorphology



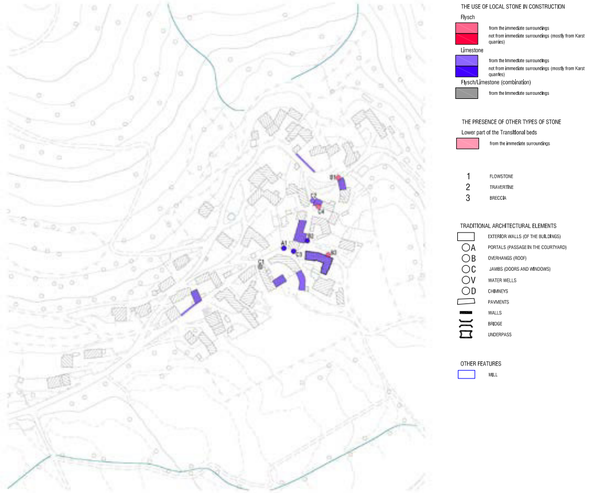
2. Types of local rock and their use in construction

An architectural survey of Grozzana /Gročana revealed that the greatest part of building materials employed consists of Alveolinid-numulitid limestone. As building blocks of the **Alveolinid-numulitid** limestone are not particularly well elaborated the question whether they originate from a large cut opened expressly for this purpose arises. Closer geological examination of the building material revealed that the lithotype of the limestone building blocks matches that of the local bedrock. Another argument favouring the local source theory is the weathered surface of many limestone building blocks, which is typical for a weathering process at the surface. This would indicate that the rock material was largely collected from the surface rather than quarried. As was observed during the architectural survey, the usual limestone building blocks are only roughly shaped, whereas larger blocks used for cornerstones and portholes (primitive windows) reveal better finishing. Examples of window frames with rough surface finishes are very rare and cannot compete with the far more elaborated stonemason's finish of the frames acquired from the workshops at the **cretaceous limestone** quarries in the Kras (Carso/Kras).

Flysch sandstone was used **as a secondary building material**. Small building blocks 5 to 15 cm thick are used to form vaults above doors and windows as well as to compensate for the irregular thicknesses of the limestone blocks. Individual examples of architraves made of the flysch sandstone are also to be found. Flysch sandstone was also used for window- and door frames, but was most frequently used for eaves, and for which 40 x 40 cm slabs 5 cm thick were used.

Grozzana/Gročana lies only a mile from the nearest flysch exposure, the closest source of which is Mt. Veliko Gradišče (Slovenia) connected by a road-route passing the village of Sv. Tomaž. However, a few pieces of flysch sandstone were found on a route along the southeastern margin of the Krasno Polje during geological mapping. A few pieces of flysch sandstone found on the path are interesting because the route is too narrow for motorized vehicles, suggesting that the sandstone has been carried along the route by a simple drawn carriage. As the route leads from Grozzana/Gročana to Krvavi Potok and Draga, the assumption that the sandstone blocks for the buildings there might come from the immediate area, perhaps exclusively, is particularly relevant.

Typologically, Grozzana/Gročana can also be marked as a typical **karst**



settlement comprising strings of buildings developing around courtyards (*borjači*). The buildings have predominantly closed frontages facing the street (*gas*) or the Bora wind. The sunny and leeward side opens out to the yard (*borjač*). As a rule, buildings have two floors serving economic and/or residential functions. Modesty and rationality in the selection and use of materials is a general characteristic of the village. In the past, the village most probably depended on agriculture which did not offer significant earnings due to natural constraints.

However, Grozzana/Gročana had an important religious status. In 1645, immediately after consecration of the Church of St. Thomas the Apostle (now in Slovenia), the Grozzana/Gročana curacy was established with Vrhpolje and Pesek, including the Basovizza/Bazovica presbytery with

the villages of Padriciano/Padriče, Groppada/Gropada and Longera/Lonjer, the Lokev presbytery with Prelože and the Draga presbytery with villages Bottazzo/Botač, Mihele, Nasirec, Krvavi Potok. In 1863, it became a parish. The border established after the Second World War curtailed these relations as a very restrictive regime was imposed in the border area.

The ruins of the once-important Church of St. Thomas the ApostleQbe-speak these turbulent times. The period left ineradicable traces in the fibre of the village's historic buildings because the majority of preserved ones are in a poor condition. Previous renovations mainly reflected the sheer need for modernisation without much consideration for heritage. There are also many new buildings which brought completely foreign building typologies.

The Grozzana/Gročana village in today's crossborder area

*The Church of Saint Thomas the Apostle is recorded in the Cultural Heritage Register of the Republic of Slovenia under record (HRN) 3628, **Vrhpolje pri Kozini – the Church of Saint Thomas the Apostle** as in item of votive built heritage. The photograph shows the church today; it once had a stone flag roof, most probably of **flat limestone**. The information and photograph are from the official website of the Slovenian Bishops' Conference*
Source: http://katoliska-cerkev.si/sv-tomaz-povezuje-slovence-na-meji

A typical frontage blanked in the direction of the Bora wind. As a rule, outside walls were rendered, as there was plenty of material for limestone plaster in the vicinity. Since local construction materials are of a poorer quality prone to dissolution and erosion, rendering façades is a reasonable measure to extend the life of buildings constructed with local stone, while also taking into account all other characteristics and qualities of existing walls and given sound selection of materials and plaster making techniques.
Note the mulberry tree by the wall. Mulberry trees in the Karst communities and substantial parts of Breg recall a time when silkworm rearing was a local business

3. Typical architectural elements

Outside walls

Outside walls normally employ local **alveolina nummulitic limestone** measuring up to approximately 20 cm. The building blocks are only roughly treated without fine surface treatment. The secondary material accounting for 5 to 20 percent of the structure is flysch sandstone shaped in blocks. These are smaller at 5 to 15 cm thick and compensate for the different thicknesses of limestone blocks.

A typical outside wall showing the use of local limestone. Larger and more correctly shaped, roughly treated building stones were used for corners, while the rest of the wall comprises less correctly shaped blocks assembled in horizontal lines. Smaller rocks were used to level the surface. In between are individual blocks of flysch sandstone. They are normally smaller and used mainly for levelling the surface. The wall has traces of rough rendering and inclines to follow the terrain

Roughly treated corner stones from alveolina nummulitic limestone

A typical window reveal with side stays and a lintel of local limestone. The sill is of flysch sandstone. The shape and size of the window is typical of an earlier period predating stone treatment techniques that emerged in the 18th and 19th Centuries. Window reveal sizes depended on the local limestone which has relatively low natural compressive and flexural strength. Technical advances and lifestyle changes brought larger reveals, the trend enduring to this day

Flysch sandstone used as a subsidiary material

Two larger flowstone building blocks. Judging by their treatment, they probably came from nearby caves which are numerous in this area

Stone window and door reveals

As a rule, window and door reveals are shaped from blocks and occasional larger pieces of local limestone. In some cases, the surface of such larger blocks is also roughly treated (conned). Lintels for larger openings are mainly timber as this material has better static mechanical properties than local limestone. Limestone is not appropriate for this application because of its composition and the limited options for quarrying monolithic blocks for bridging larger openings.

Side framing of a gate built of larger blocks of local limestone and flysch sandstone. The lintel is timber because local stones lack suitable mechanical properties

A window lintel of flysch sandstone. The typical cracks visible in the middle manifest pressure overloads

A typical window reveal of Cretaceous limestone from karst quarries

Vertical elements of the window frame (jerte) of local limestone which has been roughly surface treated, in combination with a timber lintel

Portals

We did not find many portals in the historical fibre of the village. This most probably reflects severely limited development options, mainly in the 19th and 20th Centuries. Ordering and fitting a quality portal was affordable by wealthier owners as suitable and properly treated stone was relatively expensive.
Local materials did not afford the larger monolithic stones of which classical portals are composed, additionally circumscribing such decorative elements. There was one semicircular portal, made of segment flysch sandstone building blocks: a construction method likely suggesting an earlier period.

A1 Grozzana/Gročana House No33
A stone portal with a pointed lintel, hewn capitals and bases of Cretaceous limestone. The latter was mainly brought from karst quarries, which is also reflected in architectural elements typical of karst quarrying in the second half of the 19th Century. The canopy above the portal offers weather protection

Remains of an immured arch of flysch sandstone building blocks

Eaves (Roof Hangovers)

The village has typical stone eaves, normally of flysch sandstone, as it was easier to acquire appropriate flysch sandstone panels than ones of local limestone. There are also some local limestone eaves.
Wealthier examples have the stone eaves covered or replaced by timber subframes finished with semicircular plastered festoons.
Eaves on side walls at the junction with roofs (grooved roof tiles on timber roofing) often feature rows of stone plates projecting only slightly from the wall. Side walls are often finished in an even simpler manner, with rows of grooved roof tiles set in cement.

B1
An outbuilding at House No 20 in Grozzana/Gročana
A stone plate eave of flysch sandstone
A side wall without an eave featuring a row of grooved roof tiles in line with the façade

B2
An eave of flysch sandstone grooved roofing flags

An eave of flysch sandstone grooved roofing tiles and a gabled wall with a row of flysch sandstone grooved roofing flags

A short semicircular plastered eave over a timber subframe

B3
An eave of limestone grooved roofing flags

Boundary and retaining walls

As a rule, boundary walls are dry stone wall structures of local limestone, with flysch building blocks represented to a much smaller extent. Larger blocks were positioned lower, their size diminishing towards the top. Wall tops are often finished level with horizontal building block crowns. The wall material was most probably a byproduct of farmland stone clearance.

An example of a drystone wall

We discovered no typical stone sheep pens like those known elsewhere in the karst area. They were used by animals and people as shelter. Above is a niche in a periphery wall which local inhabitants say emerged during landscaping for agricultural purposes and served a similar purpose to that of the stone shelters in the karst area. We cannot claim with certainty that this is an old wall. Regardless of authenticity, it is a fine example of preserved traditional elements

Balconies (gank / baladur: timber balconies/ covered outdoor passages)

We did not find any preserved timber balconies (*gank*). The remains of a building suggest that they existed and were most probably entirely of timber. Local limestone is inappropriate for cantilever beams and we did not record any during the inventory of village architectural elements. If they were present, they most probably originated from karst quarries for Cretaceous limestone which is more appropriate for such structures. We did not discover any signs of timber overhangs extending over the ganks, but a conclusion may be drawn by analogy with other local villages such as Draga.

4. General renovation guidelines

- Conduct an overview of typical architectural features before intervening. Assess their condition and the options of preserving them. Good knowledge of existing building modes should serve as the basis for appropriate refurbishment.

- Where additions are proposed to buildings protected as architectural heritage, both the addition mode typical of the locality (like successive accretion of units) and the importance of preserving yards ought to be taken into consideration.

- In reconstructions, it is reasonable to preserve original window and door reveal features where possible. When opening new reveals, attention should be paid to the local rule of keeping eastern and northern walls predominantly blank (without openings or with a few small openings) and having larger openings in south and west facing walls.

- In fitting new balconies, local experience in insulation and natural lighting ought to be considered. In summer ganks provide shade, and in winter they enable low winter light to enter house interiors. When refurbishing existing ganks, it is sensible to retain the existing elements whenever the structure allows. In putative substitutions or new buildings, it is reasonable to preserve the manner of construction of ganks and especially to avoid stone consoles which are not typical of the village.

- When deciding on new cut stone elements like portals, window and door frames, balcony consoles, the typical modesty and simplicity of such elements which lend the village its character ought to be taken into consideration. When specifying stonemasonry and other products it is reasonable to take into consideration the historical use of stone and other materials in Grozzana/Gročana, like narrow roughly treated flysch stone window sills and door frames (*jerta*) and timber lintels.

- Roof refurbishment ought to retain the shapes and inclines dictated by grooved roofing flags and special attention ought to be paid to renovating the overhangs which are typically short in Grozzana/Gročana on façades and side walls. Stone overhang refurbishment would repay some effort to use local limestone and flysch sandstone blocks.

- Rainwater drainage should not disrupt frontages. Guttering, which traditional architecture did not know, ought to be adapted. It ought to be of semicircular section and light grey, of galvanised steel or plastic. Downpipes should take into consideration typical elements of external wall segmentation like junctions between adjacent buildings. In stone eaves, gutters should be fitted to be visible from the ground.

- It would be sensible to collect rainwater in suitably sized containers. Were wells exist, it would be sensible to restore and reactivate them as part of refurbishment, making a positive gesture in terms of construction and technology, the environment and sheer cost savings.

- When renovating external walls, the colours and appearances of existing plaster ought to be inspected and findings taken into consideration. If possible, original renderings ought to be preserved or repaired using traditional plastering techniques. As a rule, render is coarse and in natural tones dictated by local materials. Residential building rear and side walls traditionally have coarse render unless facing courtyards (normally south or west), when they are polished smooth.

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- Comune di San Dorligo della Valle (110142 AQUILINIA, 110151 GROZZANA, 110152DRAGA SANT'ELIA, 110153SAN DORLIGO DELLA VALLE, 110154BASOVIZZA, 131021BONIFICA NOGHERA, 131034 CARESANA)
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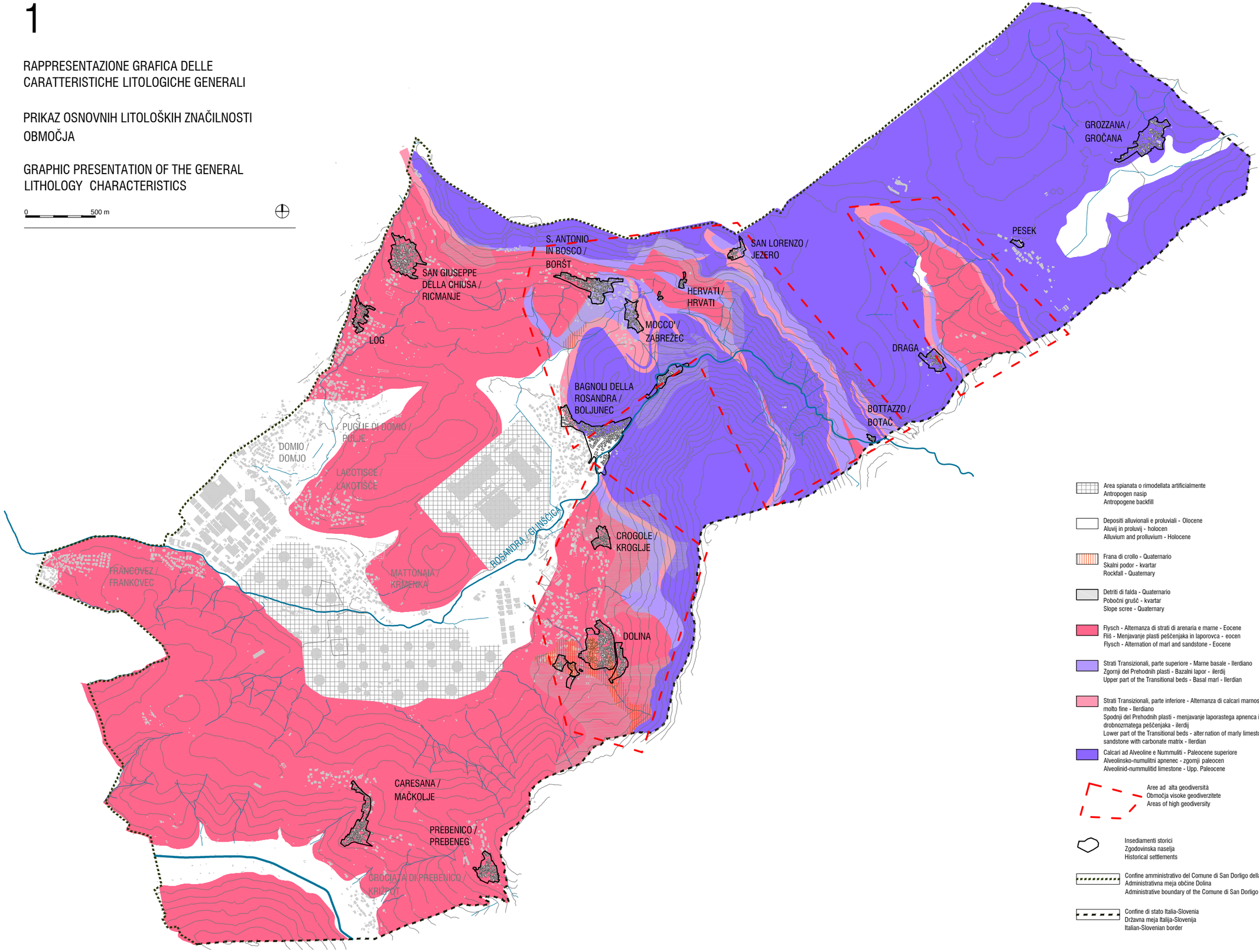
1

RAPPRESENTAZIONE GRAFICA DELLE CARATTERISTICHE LITOLOGICHE GENERALI

PRIKAZ OSNOVNIH LITOLOŠKIH ZNAČILNOSTI OBMOČJA

GRAPHIC PRESENTATION OF THE GENERAL LITHOLOGY CHARACTERISTICS

0 500 m



Area spianata o rimodellata artificialmente
Antropogen nasip
Antropogene backfill

Depositi alluvionali e proluviali - Olocene
Aluvij in proluvij - holocen
Alluvium and prolluvium - Holocene

Frana di crollo - Quaternario
Skalni podor - kvartar
Rockfall - Quaternary

Detriti di falda - Quaternario
Pobočni grušč - kvartar
Slope scree - Quaternary

Flysch - Alternanza di strati di arenaria e marne - Eocene
Fliš - Menjavanje plasti peščenjaka in laporovca - eocen
Flysch - Alternation of marl and sandstone - Eocene

Strati Transizionali, parte superiore - Marne basale - Ilerdiano
Zgornji del Prehodnih plasti - Bazalni lapor - ilerdij
Upper part of the Transitional beds - Basal marl - Ilerdian

Strati Transizionali, parte inferiore - Alternanza di calcari marnosi e marne con strati di arenaria molto fine - Ilerdiano
Spodnji del Prehodnih plasti - menjavanje laporastega apnenca in laporovca s plastmi zelo drobnozrnatega peščenjaka - ilerdij
Lower part of the Transitional beds - alter nation of marly limestone and marl, and fine-grained sandstone with carbonate matrix - Ilerdian

Calcari ad Alveoline e Nummuliti - Paleocene superiore
Alveolinsko-numulitni apnenec - zgornji paleocen
Alveolinid-nummulitid limestone - Upp. Paleocene

Aree ad alta geodiversità
Območja visoke geodiverzitete
Areas of high geodiversity

Insediamenti storici
Zgodovinska naselja
Historical settlements

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Državna meja Italija-Slovenija
Italian-Slovenian border

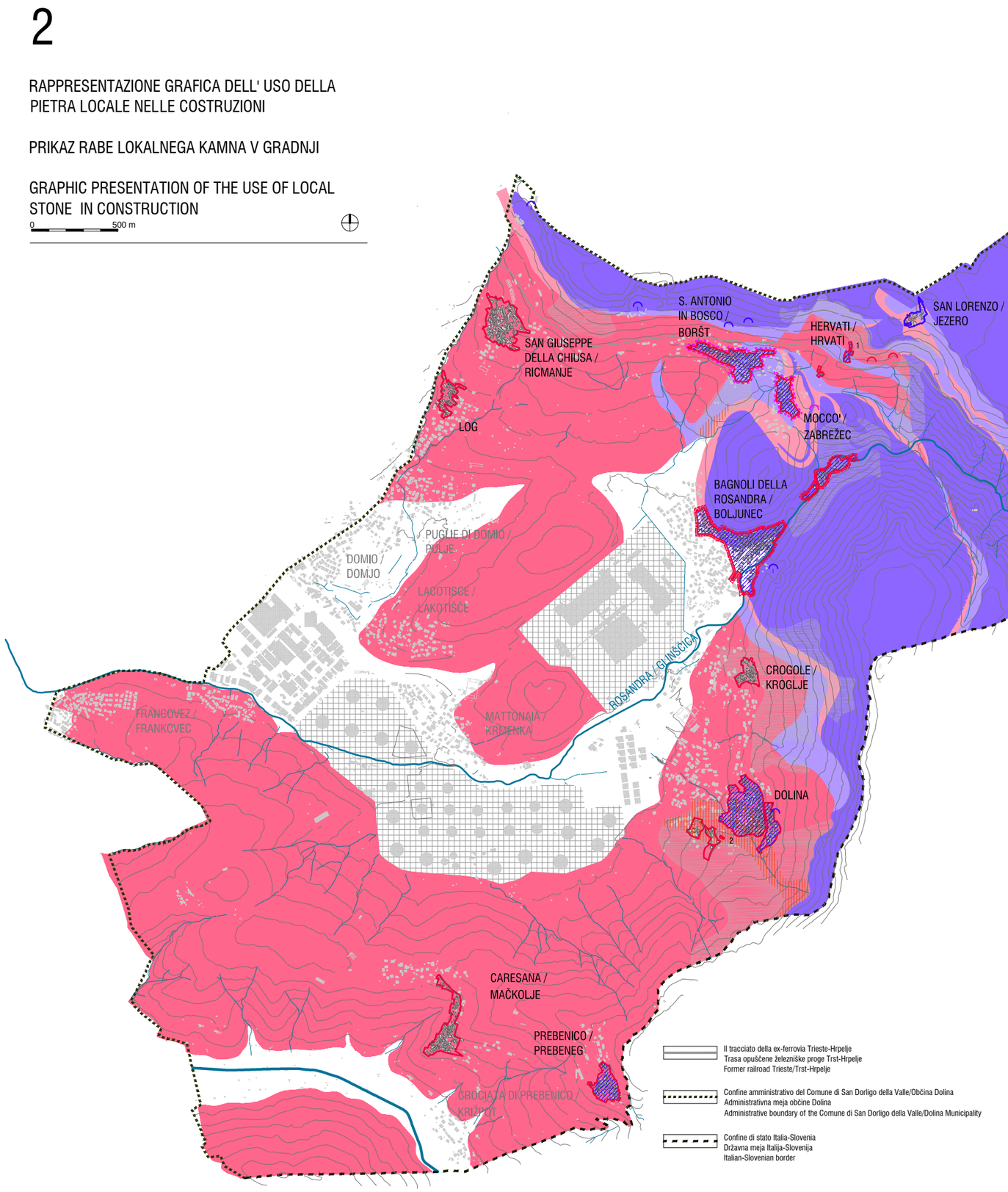
2

RAPPRESENTAZIONE GRAFICA DELL' USO DELLA PIETRA LOCALE NELLE COSTRUZIONI

PRIKAZ RABE LOKALNEGA KAMNA V GRADNJI

GRAPHIC PRESENTATION OF THE USE OF LOCAL STONE IN CONSTRUCTION

0 500 m



Area spianata o rimodellata artificialmente
Antropogen nasip
Antropogene backfill

Depositi alluvionali e proluviali - Olocene
Aluvij in proluvij - holocen
Alluvium and prolluvium - Holocene

Frana di crollo - Quaternario
Skalni podor - kvartar
Rockfall - Quaternary

Detriti di falda - Quaternario
Pobočni grušč - kvartar
Slope scree - Quaternary

Flysch - Alternanza di strati di arenaria e marne - Eocene
Fliš - Menjavanje plasti peščenjaka in laporovca - eocen
Flysch - Alternation of marl and sandstone - Eocene

Strati Transizionali, parte superiore - Marne basale - Ilerdiano
Zgornji del Prehodnih plasti - Bazalni lapor - ilerdij
Upper part of the Transitional beds - Basal marl - Ilerdian

Strati Transizionali, parte inferiore - Alternanza di calcari marnosi e marne con strati di arenaria molto fine - Ilerdiano
Spodnji del Prehodnih plasti - menjavanje laporastega apnenca in laporovca s plastmi zelo drobnozrnatega peščenjaka - ilerdij
Lower part of the Transitional beds - alter nation of marly limestone and marl, and fine-grained sandstone with carbonate matrix - Ilerdian

Calcari ad Alveoline e Nummuliti - Paleocene superiore
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SCAVI E CAVE DELLA PIETRA LOCALE
IZKOPI IN KAMNOLOMI LOKALNEGA KAMNA
EXCAVATIONS AND QUARRIES OF THE LOCAL STONE

Segni visibili di estrazione superficiale - arenaria del Flysch
Vidni znaki površinskih izkopavanj lokalnega kamna - flišni peščenjak
Visible signs of surface extraction of local stone - flysch sandstone

Segni visibili di estrazione superficiale di pietra locale - Strati Transizionali - parte inferiore
Vidni znaki površinskih izkopavanj lokalnega kamna - spodnji del Prehodnih plasti
Visible signs of surface extraction of local stone - Lower part of the Transitional beds

Segni visibili di estrazione superficiale di pietra locale - detriti di falda
Vidni znaki površinskih izkopavanj lokalnega kamna - pobočni grušč
Visible signs of surface extraction of local stone - slope scree

Cave di natura industriale (prevalentemente inerti calcarei)
Proizvodni kamnolomi (pretežno apnenčevih agregatov)
Production quarrying (mainly limestone aggregate)

LA PRESENZA DI ALTRI TIPI DI PIETRA NEL COSTRUITO
PRISOTNOST DRUGIH VRST KAMNA V GRADNJI
THE PRESENCE OF OTHER TYPES OF STONE IN CONSTRUCTION

1 Stalattite
Siga
Flowstone

2 Travertino
Lehnjak
Travertine

E' presente l'uso diffuso dei calcari cretacici (provenienti dalle cave del Carso negli elementi architettonici la qui lavorazione richiedeuna pietra di qualità (portali, stipiti delle finestre e delle porte, ecc). La pietra appare anche nelle pareti, come un uso secondario di elementi architettonici.

Razširjena je raba krednih apnencev iz kraških kamnolomov pri vgrajenih arhitekturnih elementih, katerih izdelava zahteva kvalitetenkamen (portali, okenski in vratni okvirji, itd.). Kamenina se pojavlja tudi v zidovih, kot sekundarna raba arhitekturnih elementov.

There is an extended use of cretaceous limestone from Karst quarries for architectural elements, the production of which requires high-quality stone (portals, door and window frames, etc.). The stone occurs in the walls, as a secondary use of architectural elements.

L'USO DELLA PIETRA LOCALE NEGLI INSEDIAMENTI STORICI
RABA LOKALNEGA KAMNA V ZGODOVINSKIH NASELJIH
THE USE OF LOCAL STONE IN THE HISTORIC SETTLEMENTS

Calcare locale ricavato dai terreni circostanti
Lokalni apnenec iz neposredne okolice
Local limestone from the immediate surroundings

Arenaria del Flysch ricavata dai terreni circostanti
Flišni peščenjak iz neposredne okolice
Flysch sandstone from the immediate surroundings

Uso sporadico di ciottoli di arenaria ricavati dai terreni circostanti
Omejena raba prodnikov flišnega peščenjaka iz neposredne okolice
Limited use of flysch sandstone pebbles from the immediate surroundings

Uso sporadico dei Strati Transizionali - parte inferiore (ricavati dai terreni circostanti)
Omejena raba spodnjega dela Prehodnih plasti (iz neposredne okolice)
Limited use of Lower part of the Transitional beds (from the immediate surroundings)

La presenza limitata di blocchi di calcare locale, ricavati dai terreni circostanti, nelle murature
Omejena prisotnost gradnikov iz apnenca, iz neposredne okolice, v zidovih
Limited presence of imestone blocks, from the immediate surroundings, in walls

La presenza limitata di blocchi di arenaria (ricavati dai terreni circostanti) nelle murature
Omejena prisotnost gradnikov iz flišnega peščenjaka (iz neposredne okolice) v zidovih
Limited presence of flysch sandstone blocks (from the immediate surroundings) in walls

La presenza limitata di blocchi di detriti di falda (calcare locale)
Omejena prisotnost gradnikov pobočnega grušča (lokalni apnenec)
Limited presence of slope scree (local limestone)

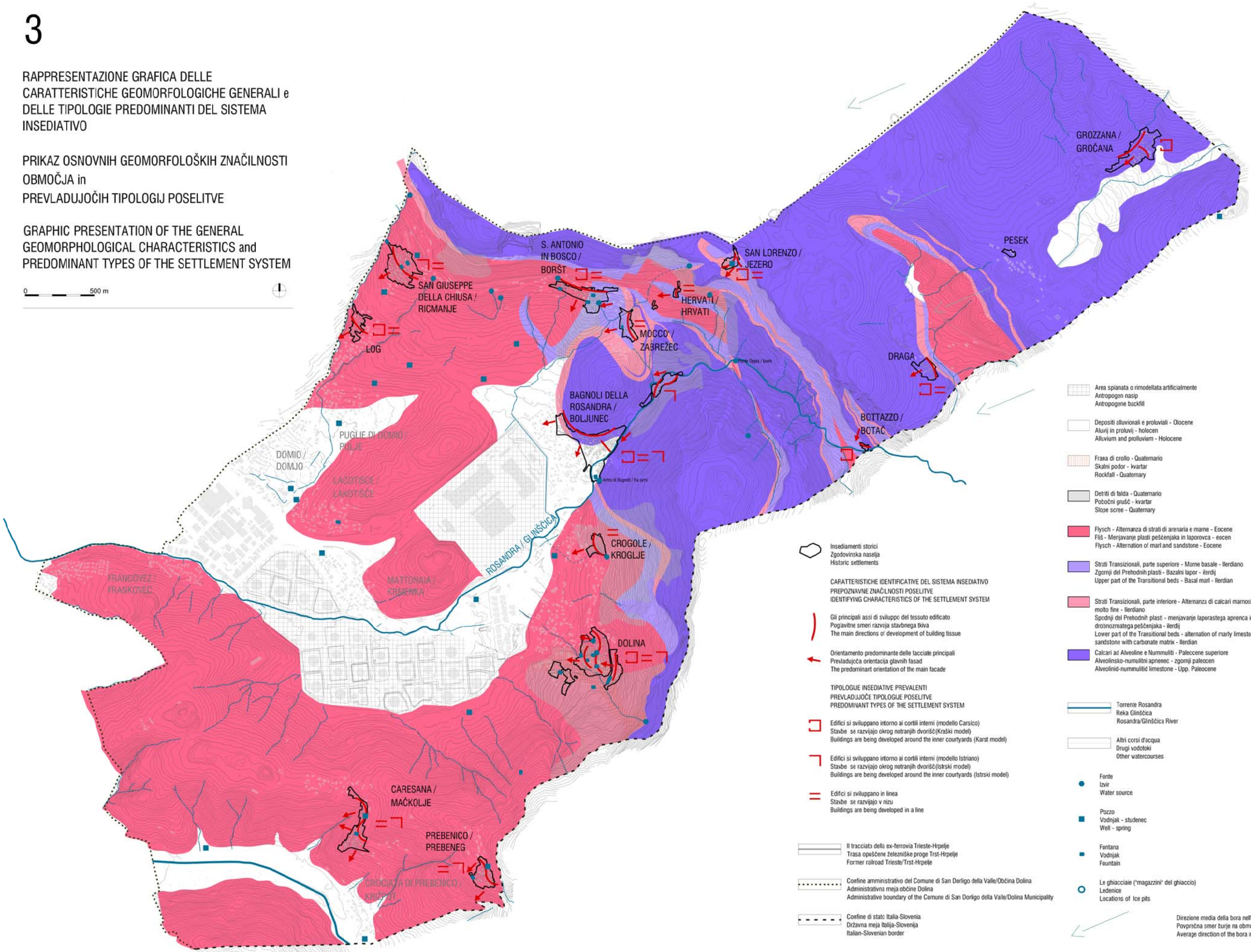
3

RAPPRESENTAZIONE GRAFICA DELLE CARATTERISTICHE GEOMORFOLOGICHE GENERALI e DELLE TIPOLOGIE PREDOMINANTI DEL SISTEMA INSEDIATIVO

PRIKAZ OSNOVNIH GEOMORFOLOŠKIH ZNAČILNOSTI OBMOČJA in PREVLADUJOČIH TIPOLOGIJ POSELITVE

GRAPHIC PRESENTATION OF THE GENERAL GEOMORPHOLOGICAL CHARACTERISTICS and PREDOMINANT TYPES OF THE SETTLEMENT SYSTEM

0 500 m



4

RAPPRESENTAZIONE DELLE COSTRUZIONI LOCALI

PRIKAZ LOKALNIH GRADENJ

PRESENTATION OF THE LOCAL CONSTRUCTION

0 1000 m

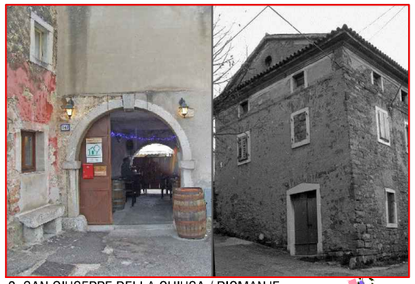
3. S. ANTONIO IN BOSCO / BORŠT

5. SAN LORENZO / JEZERO

6. DRAGA

7. GROZZANA / GROČANA

1. LOG



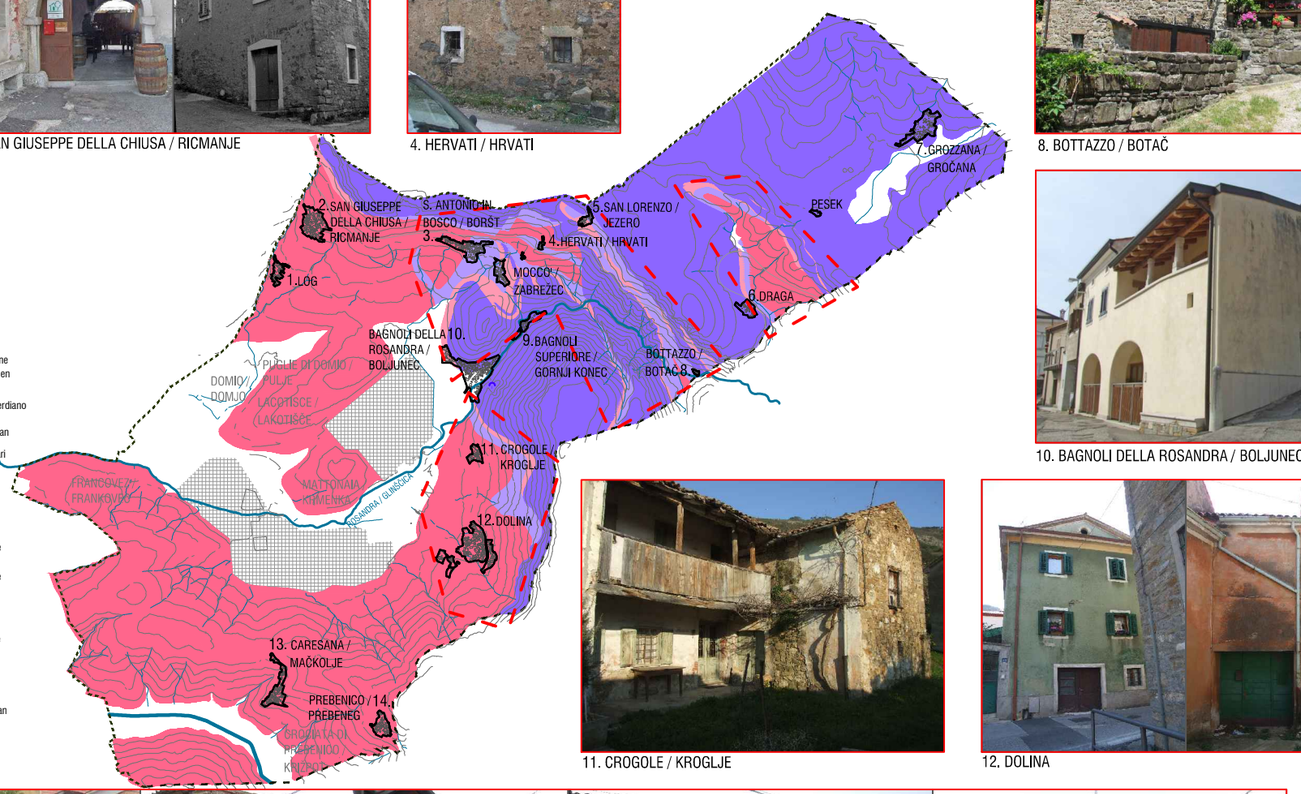
2. SAN GIUSEPPE DELLA CHIUSA / RICMANJE

4. HERVATI / HRVATI

8. BOTTAZZO / BOTAČ

9. BAGNOLI SUPERIORE / GORNJI KONEC

10. BAGNOLI DELLA ROSANDRA / BOLJUNEC



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11. CROGOLE / KROGLJE

12. DOLINA

13. CARESANA / MAČKOLJE

14. PREBENICO / PREBENEG