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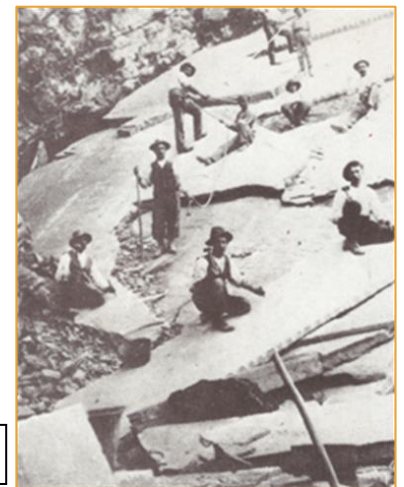


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EuroLithos Country Atlas Emilia-Romagna Region, Italy



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Photos and references

1, https://www.eurocavesnc.com/foto/cave/canala/big/f_06.jpg; 2, <https://www.arenariadicarnigliaagazzi.it/fotoalbum.php>; 3, <http://www.lapietradicassio.it/cava.html>; 4, <https://www.trekkingtaroceno.it/la-valle-di-pietra-bedonia-e-le-cave-di-carniglia/> Reference: arch. Emanuele Mazzadi

EuroLithos Atlas

Ornamental stone resources in Emilia-Romagna, Italy

Thematic focus: Country, Region

Responsible partner(s): Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli, SGSS

Author(s): Maria Teresa De Nardo

Year: 2021

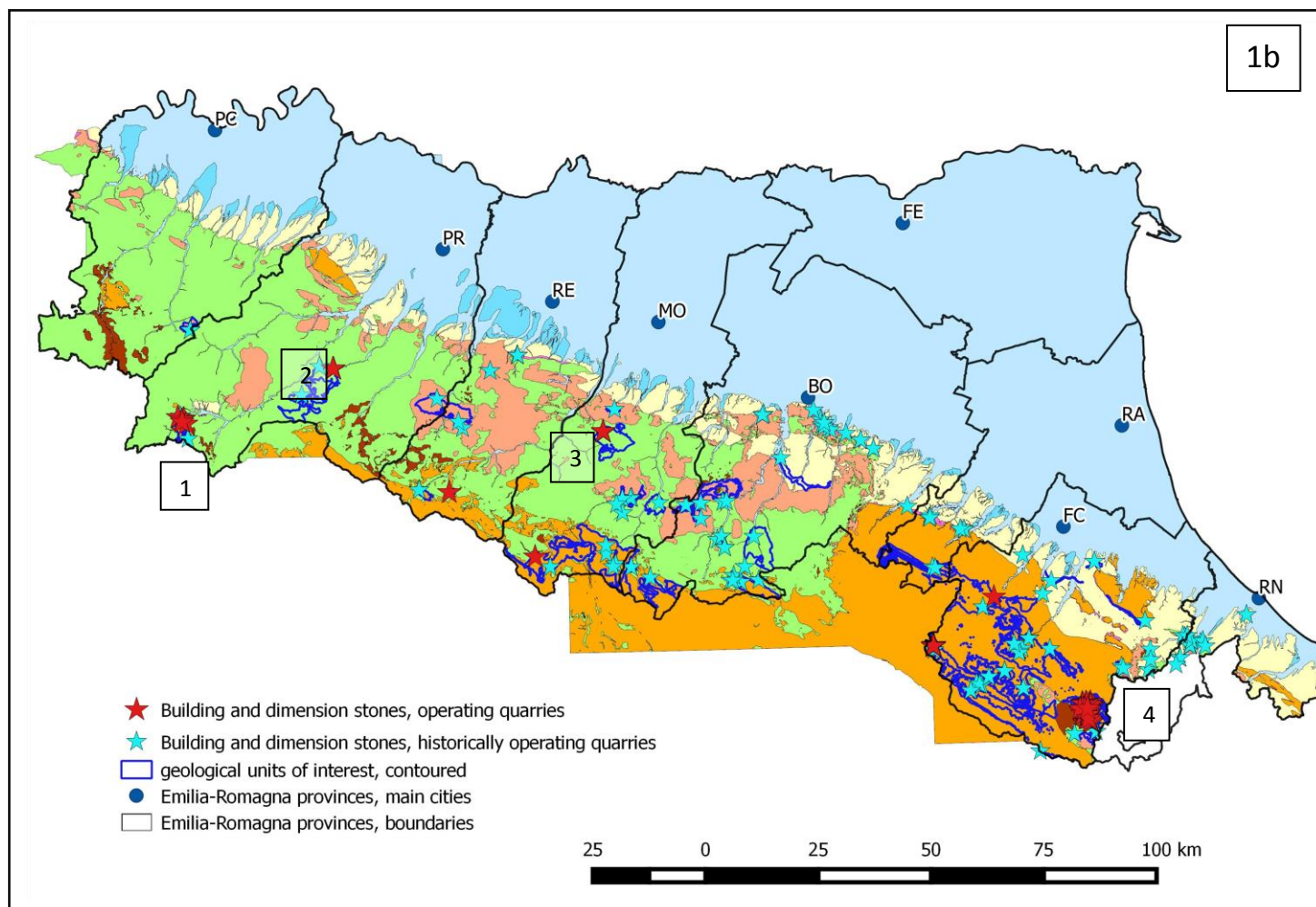
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Geology of Emilia-Romagna Region



Figure 1 – location of the Emilia-Romagna region (1a) and simplified geological map (1b), building and dimension stones quarries (centroids) are symbolized by stars, geological units of interest in blue contours. Explanations in the text



Emilia-Romagna is an Italian region located in the northern part of the country, South of the Po River course (figure 1a); figure 1b shows a simplified geological map. The territory is made up of a southern mountain and hilly sector (40% of total surface), geologically pertaining the Northern Apennines, and a northern alluvial plain (light-blue area in figure 1b) related to the deposits of the Po River and Apennine river-courses, which are either tributaries of the Po River or flow into the Adriatic Sea to the East. In the figure 1b, sub-regional, province boundaries and main cities are symbolized as well: Piacenza (PC), Parma (PR), Reggio-Emilia (RE), Modena (MO), Bologna (BO), Ferrara (FE), Ravenna (RA), Forlì-Cesena (FC), Rimini (RN)

The Emilia-Romagna Apennines are characterized by NE-verging, WNW-ESE oriented tectonic structures (thrust-faults and folds, mainly), either outcropping in the chain or buried beneath the alluvial plain, expression of the compressional stresses related to Alpine orogenetic phases. NE-SW oriented transverse faults interrupt the main structures laterally. In the Emilia-Romagna Apennines, geological units are mainly made up of clastic, sedimentary rocks, except some peculiar ophiolitic bodies of magmatic origin.

The structurally lowermost geological units are mainly represented by several hundreds of metres thick, foredeep arenitic and pelitic turbidites (orange areas in figure 1b); their age ranges from Late Oligocene to Middle Miocene. They widely outcrop in the Romagna Apennines (Formazione Marnoso-Arenacea in the Ravenna, Forlì-Cesena and Rimini Apennines) or make up the ridge of the Emilia Apennines ("Tuscan Units", Parma, Reggio Emilia, Modena and Bologna provinces) or outcrop within tectonic windows (Piacenza and Parma Apennines mainly). During the orogenetic phases, they were overridden by deformed terrains pertaining the Ligurian Domain, corresponding to original stratigraphic sequences deposited in the Tethys Ocean (as testified by the ophiolitic slabs), dating back to the Jurassic to Middle Eocene. Ligurian Units (green areas in figure 1b) are made of shaly chaotic units and of preserved, locally very thick, turbiditic sequences: among them, the Late Cretaceous and Paleocene-Middle Eocene Helminthoid or Tertiary Ligurian flysches. The so-called Subligurian Units (Late Cretaceous- Oligocene age, brown areas in figure 1b) are tectonically interposed between the Ligurian and the underlying Tuscan Units.

During the orogenetic phases, the translation of the Ligurian, overriding the Subligurian Units and towards the foredeep turbiditic basins was accompanied by the sedimentation of the clastic formations of the Epiligurian Sequence (pink areas in figure 1b), unconformably deposited on the deformed Ligurian Units during the Early Eocene- Middle Miocene period. Nearby the Apennine foothills, Messinian gypsum outcrops. Late Messinian and Pliocene to Early Pleistocene, mainly clayey, formations (whitish areas in figure 1b) seal older, displaced geological units.

Ornamental stone resources in Emilia-Romagna

In the simplified geological map in figure 1b, quarries of building and dimension stones (centroids of corresponding polygons) are subdivided into two classes: operating or planned (red stars) and historical ones (light-blue stars). Data derive from the Servizio Difesa del Suolo, della Costa e Bonifica of the Regione Emilia-Romagna; several data on historical, nowadays abandoned, quarries derive from bibliography as well.

In the Emilia-Romagna region, operating or planned dimension stones quarries are almost residual, with respect to the past, that is till the 1950s-1970s.

Blue contours in figure 1b indicate geological units, mainly arenitic, of interest. In historical times lithologies other than arenites were quarried and employed as ornamental stones: gypsum (known as "selenite"), coloured limestones, ophiolites; nowadays they are no more of economic interest, local historical quarries may thus become a matter of interest for geoturistic itineraries.

As a synthesis, nowadays dimension stone quarries are to be found in the following geological settings, according to figure 1b:

- 1, Parma province, Late Oligocene-Early Miocene arenaceous turbidites outcropping in the Monte Zuccone tectonic window
- 2, Parma province, Cretaceous arenitic turbidites in a slab within the Ligurian Units
- 3, Modena province, Late Cretaceous arenitic and marly-calcareous turbidites in a slab of Helminthoid Flysch within the Ligurian Units
- 4, Forlì-Cesena province, Middle Miocene foredeep arenite turbidites (Formazione Marnoso-arenacea)

Use of ornamental stone and heritage values

As aforesaid, dimension stone quarries in the Emilia-Romagna Apennines are not widespread nowadays. Thus, this makes them even more interesting, both because of the remarkable natural quality of rock-types (mainly, arenites) and for the local significance of this resource. In fact, the use of autochthonous dimension stones (according to planning and regulation measures at provincial extent, after the 17/1991 Regional Law) is preferable, to avoid incongruous remediation interventions on public and rural buildings.

The Emilia-Romagna dimension stones are mostly sandstones, or better, arenites, as clasts may present a variable petrographic composition with respect to end members as feldspar or quartz grains; metamorphic, volcanic and carbonate lithic grains and carbonate intraclasts. The cement is mostly calcareous.

These arenites are well-cemented, compact and resistant to atmospheric agents, resilient to ice and freezing. They are very suitable for coverings and flooring, for outdoor paving and façades, balconies, portals; compact, fine-grained arenites with ornamental, sedimentary laminae are employed indoor as well, for decorative coverings, bathroom and kitchen tops.

Grey, in different tones, is the most common color; light-grey to whitish color is more distinctive of “Alberese” fine-grained arenites or limestones.

Historically, the use of most of these arenites was widespread, as testified by villages and churches or remarkable buildings. Some examples are given in the Parma Apennines, along the so called «Via Francigena», the main road used by pilgrims walking from Canterbury to Rome in the Middle Ages. In the Reggio Emilia and Modena Apennines, several romanic parish churches (some of them built up in the Early Middle Ages by order of Matilde, countess of Canossa) were built using local calcareous arenites or the siliciclastic ones known as “Macigno”, though the location of original quarries is often unknown. In the Bologna Apennines, the surroundings of the Riola village host fairly recent examples of artistic buildings in local arenites, among them a church by the Finnish architect Alvar Aalto. In the Forlì-Cesena Apennines, the extraction of “Pietra serena” and “Alberese” is still active; these lithotypes are typical of Tuscan architecture as well.

Some historical dimension stones were rare and typical to the region and they are no longer in use: translucent selenite gypsum (employed in Bologna during the Roman Age and in the Middle Ages), red or grey limestones, green ophiolitic rocks and travertines.

Descriptions of ornamental stone resources

Ornamental stone resources in Emilia-Romagna are described below subdivided in three tables. In Table 1, ornamental stone resources extracted in planned and operating quarries within the four geological settings located in figure 1b.

Stone name	Commodity	Lithology
Pietra di Bedonia	sandstone	arenite
Arenaria di Cassio	sandstone	arenite
Arenaria di Varana	sandstone	arenite
Pietra Alberese	limestone	arenite (very fine grained) or calcareous marlstone
Pietra Serena	sandstone	arenite

In Table 2, ornamental stones of historical use, examples of planned or not operating quarries:

Stone name	Commodity	Lithology
Pietra di Scurano	sandstone	arenite
Pietra di Montovolo	sandstone	arenite

In Table 3, a list of building and dimension stones historically used in Emilia Romagna, quarries may be abandoned or hard to be located:

Stone name	Commodity	Lithology
Arenaria di Castel d'Aiano	sandstone	arenite
Arenaria di Castelvechio	sandstone	arenite
Arenaria di Monghidoro	sandstone	arenite
Arenaria di Monte Balduccio	sandstone	arenite
Arenaria di Sasso Marconi	sandstone	arenite
Arenaria di Vetto	sandstone	arenite
Basalto Val di Sasso	basalt	basalt
Calcare del Montefeltro	limestone	biocalcarearenite
Calcare di Gorgo Scuro	limestone	limestone
Granitone diallagico di Renno	miscellaneous dimension stones	gabbro
Grigio Ducale	limestone	limestone
Grigio Ducale Rosato	limestone	limestone
Macigno	sandstone	arenite
Macigno di Montardone	sandstone	arenite
Macigno di Porretta	sandstone	arenite
Marmo Verde Stella	miscellaneous dimension stones	ophiolites
Arenaria di Varignana	sandstone	arenite
Pietra da conci	sandstone	arenite
Pietra di Canossa	sandstone	arenite
Pietra di Vergato	sandstone	arenite
Pietra Paesina (very rare)	limestone	limestone
Rosso Napoleone	miscellaneous dimension stones	hydrothermalite
Selenite	miscellaneous dimension stones	gypsum
Serpentiniti e Gabbri Ranocchiai	miscellaneous dimension stones	serpentinites and gabbros
Sponga	limestone	travertine
Spungone	limestone	biocalcarearenite
Tufo di Renno	limestone	travertine

Pietra di Bedonia

Pietra di Carniglia



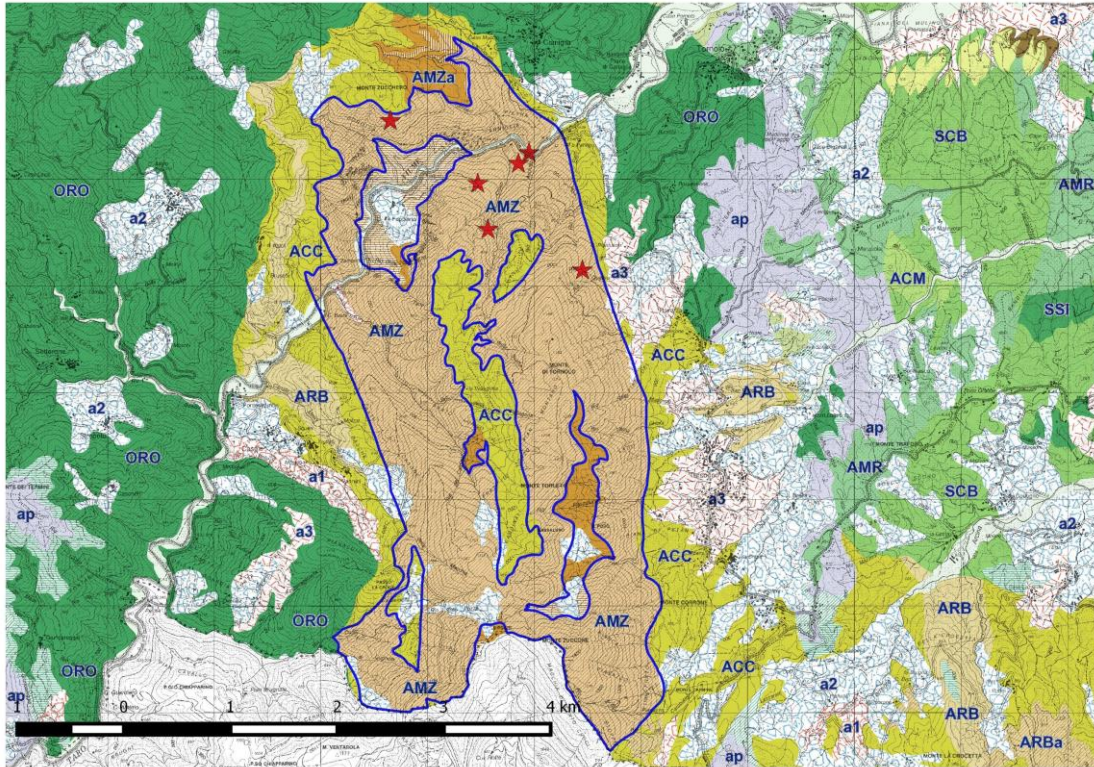
2 cm

Short description:

Grey, medium to coarse grained sandstones, deriving from arenaceous layers within coupled arenaceous (A) - pelitic (P) beds of turbiditic origin, A/P ratio > 1. The presence of laminae within thick-bedded layers and their appreciable lateral continuity allow the extraction of stone slabs.

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Sandstone	Arenite	Grey	Italy	Emilia-Romagna, Parma Province	Bedonia Tornolo	Carniglia Ravezza

Geological setting



Geology: The Pietra di Bedonia is extracted from the Arenarie di Monte Zuccone formation (AMZ, blue contour), outcropping in a tectonic window in the high Parma Apennines. Similar geological unit are otherwise deep-seated within the Apenninic chain, as they were overridden by the Sub-ligurian (Argille e Calcari di Canetolo, ACC; Arenarie di Ponte Bratica, ARB) and Ligurian (Flysch di Monte Orocco, ORO) Units during the Miocene orogenic phases.

1:50.000 scale Geological Map, Foglio 215 Bedonia (2005), with Notes
https://www.isprambiente.gov.it/Media/carg/note_illustrative/215_Bedonia.pdf

Production: Main, historically exploited, quarries (centroids as red stars) are south of the village of Carniglia, Bedonia municipality, High Parma Apennines

Geological age: Late Oligocene (Chattian)- Early Miocene (Aquitanian)

Geological unit: Arenarie di Monte Zuccone

Application, use and heritage



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2



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Description:

The high resistance of this sandstone to atmospheric agents and the ease in dividing into slabs makes it very suitable for use for coverings and flooring, since historical times. In the 19th century, the Carniglia quarries became industrially exploited, providing also European countries.

Notable examples are the paving of the promenade of Chiavari (Genoa) and the Caruggio, the façades of the churches of Carniglia, S. Maria del Taro, Tarsogno, as well as that of the Seminario of Bedonia (photo1), a very large complex built in 1841-1846 as a school for Catholic priests and now transformed in a congress and study centre.

Ancient rural buildings in Pietra di Bedonia are well-preserved in the Foppiano small village (photo 2)

Photo: <https://scn.caiparma.it/schede/foppiano-bedonia/>

In photo 3, men at work in one of the historical quarries, extraction ruled by strata geometry.

Photo: <https://www.trekkingtaroceno.it/la-valle-di-pietra-bedonia-e-le-cave-di-carniglia/> Reference: arch.

Emanuele Mazzadi

Nowadays the use of this sandstone is less widespread than in the past.

Petrography

Description: Feldspar-rich sandstones, with abundant clasts of metamorphic rocks, lithic clasts of sedimentary rocks are nearly absent

Source of information: 1:50.000 Geological Map, Foglio 215 Bedonia (2005), with Notes
https://www.isprambiente.gov.it/Media/carg/note_illustrative/215_Bedonia.pdf

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Mineral 1 (%)	Mineral 2 (%)	Mineral 3 (%)	Mineral 4 (%)	Mineral 5 (%)	Mineral 6 (%)	Mineral 7 (%)
Mineral 8 (%)	Mineral n (%)					

Source of information:

Physical properties

Apparent density (EN 1936) kg/m ³	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa

Real density (EN 1936) kg/m ³	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m ² x s ^{0,5})	Flexural strength under constant moment (EN 13161) MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm ³ / 50cm ²	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information:

Chemical properties

Main elements

SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	TiO ₂ (%)	MgO (%)	CaO (%)	Na ₂ O (%)	K ₂ O (%)	MnO (%)	P ₂ O ₅ (%)	SO ₃ (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

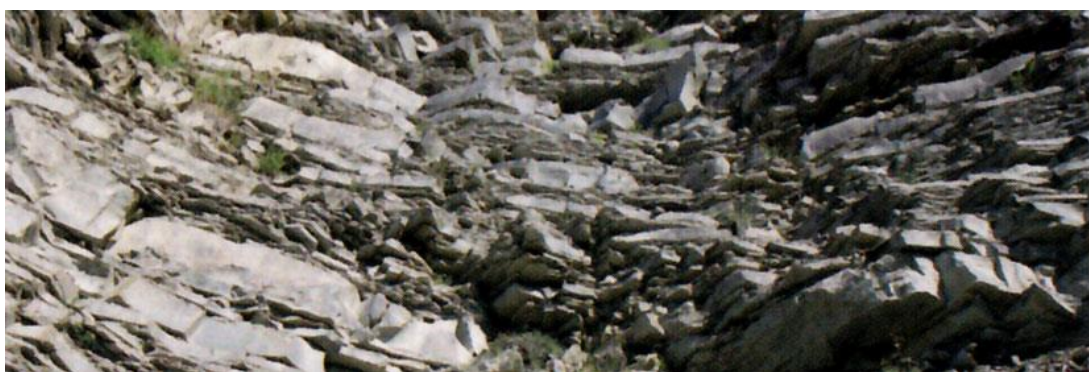
Sources of more information

Type of information	Name of provider	URL
This data sheet	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli. Location of quarries: centroids of polygons are derived from the Emilia-Romagna regional databases (in preparation), made available by the Servizio Difesa del Suolo, della Costa e Bonifica	
Non-commercial directory		
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli https://ambiente.regione.emilia-romagna.it/it/geologia/servizio-geologico-sismico-e-dei-suoli	 Regione Emilia-Romagna DIREZIONE GENERALE CURA DEL TERRITORIO E DELL'AMBIENTE
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Arenaria di Cassio

Pietra di Cassio



<http://www.lapietradicassio.it/cava.html>

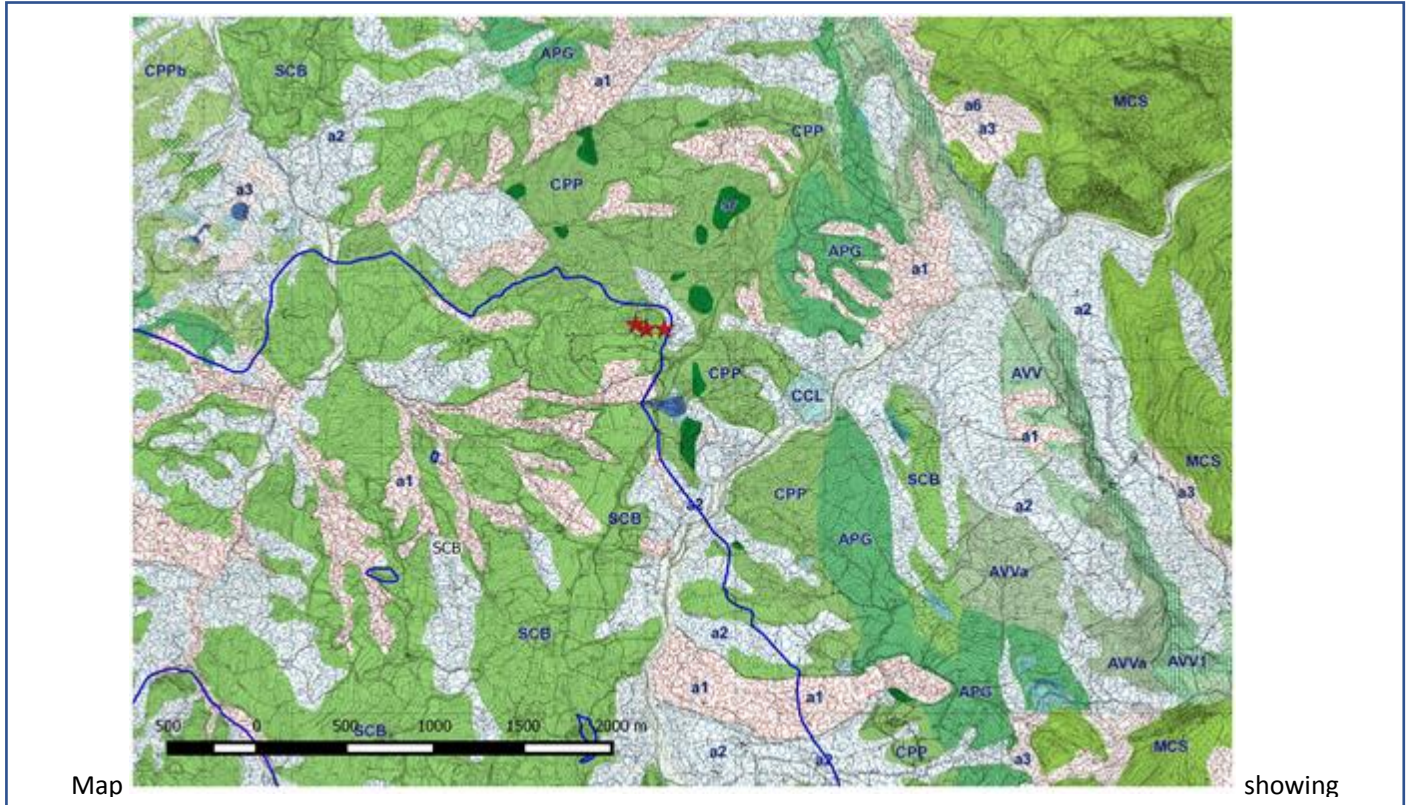
2 m

Short description: Grey or grey-bluish, fine- to very fine-grained arenites, extracted from arenitic layers coupled with pelites in strata of turbiditic origin. Locally, they may present an ocraceous colour, due to alteration along joint surfaces.

Photo: <http://www.lapietradicassio.it/cava.html>

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Sandstone	Arenite	Grey	Italy	Emilia-Romagna Region, Parma Province	Terenzo	Scanso

Geological setting



Geology: The Arenaria di Cassio is extracted from the Arenarie di Scabiazza formation (SCB, blue outline), an arenitic and pelitic geological unit of turbiditic origin pertaining the Ligurian Domain, within the Emilia-Romagna Apennines. SCB is interpreted as a part of an original stratigraphic sequence at the base of the so called Helminthoid Flysch, marly-calcareous turbidites of Late Cretaceous age (Flysch di Monte Cassio, MCS). Other formations which made up this interpreted, original stratigraphic sequence (Basal Complexes AUCTT.,) are mapped as AVV, CPP, APG; they are bounded by surfaces of tectonic origin, due to multi-phase deformation related to the displacement of Ligurian Units during the orogenesis.

1: 50.000 scale Geological Map, Foglio 216 "Borgo Val di Taro" in:

https://www.isprambiente.gov.it/Media/carg/note_illustrative/216_Borgo_Val_di_Taro.pdf

Production: Main quarries (centroids as red stars) are nearby the road leading to Scanso (or Scanzo) locality, in the municipality of Terenzo, Parma Apennines. Nowadays, this arenite is quarried for local use only.

Geological age: Late Cretaceous

Geological unit: Arenarie di Scabiazza

Application, use and heritage



Description: The stone is heavy and compact, with low water absorption and ice-resistant; these characteristics make it suitable for both indoor and outdoor installation.

Historically, the Arenaria di Cassio is related to the “Via Francigena”, the main road used by pilgrims walking from Canterbury to Rome in the Middle Ages. It crossed the middle Val Baganza in the Parma Apennines. Here parish churches and medieval villages settled, made up by natural stones extracted from small surrounding quarries. Over the centuries, the same building and dimension stones have been used in the reconstruction and restoration works. Recently, among the few quarries that have remained in activity, there is the so-called Quarry of Perdera, in the locality of Scanzo di Terenzo, where the Pietra di Cassio is extracted for local use.

Petrography

Description:

Source of information:

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Mineral 1 (%)	Mineral 2 (%)	Mineral 3 (%)	Mineral 4 (%)	Mineral 5 (%)	Mineral 6 (%)	Mineral 7 (%)
Mineral 8 (%)	Mineral n (%)					

Source of information:

Physical properties

Apparent density (EN 1936) kg/m ³	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa

Real density (EN 1936) kg/m ³	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m ² x s ^{0,5})	Flexural strength under constant moment (EN 13161) MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm ³ / 50cm ²	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information:

Chemical properties

Main elements

SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	TiO ₂ (%)	MgO (%)	CaO (%)	Na ₂ O (%)	K ₂ O (%)	MnO (%)	P ₂ O ₅ (%)	SO ₃ (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli. Location of quarries: centroids of polygons are derived from the Emilia-Romagna regional databases (in preparation), made available by the Servizio Difesa del Suolo, della Costa e Bonifica	
Non-commercial directory		
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli https://ambiente.regione.emilia-romagna.it/it/geologia/servizio-geologico-sismico-e-dei-suoli	 Regione Emilia-Romagna DIREZIONE GENERALE CURA DEL TERRITORIO E DELL'AMBIENTE
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Arenaria di Varana



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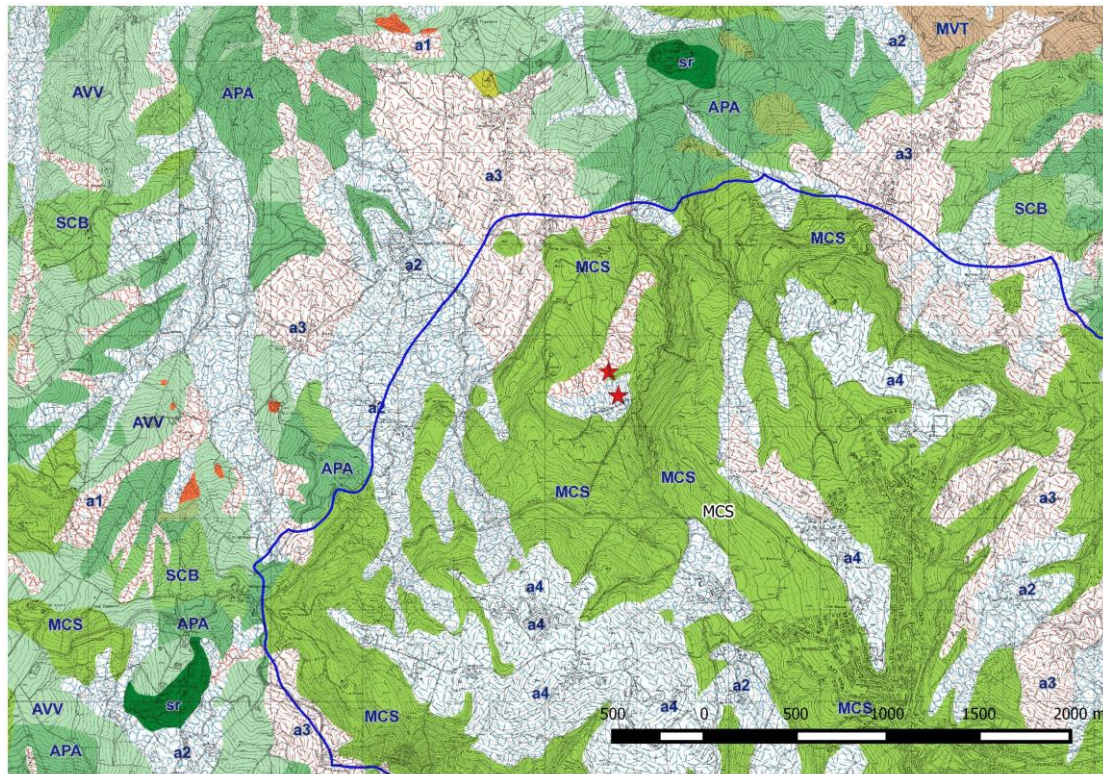
Short description:

The Arenaria di Varana is quarried in the Serramazzoni municipality, Modena Apennines. The material is extracted in blocks already squared on site. The quarry provides two materials: the so called "Zebra Gray" because of its stripy aspect and the cloudy and / or homogeneous "Gray 14", in various shades of gray.

From: <https://cavavarana.com/it/chi-siamo>

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Sandstone	Arenite	Grey	Italy	Emilia-Romagna, Modena	Serramazzoni	Varana

Geological setting



Geology: The Arenaria di Varana derives from a peculiar sedimentary facies in the arenitic and marly-calcareous, very thick bedded turbidites of the Flysch di Monte Cassio (MCS), a Helminthoid flysch of Late Cretaceous age, pertaining the Ligurian Domain.

Production:

The Varana quarry (centroids as red stars in the map) is located in the Serramazzoni municipality, in the Modena Apennines.

Geological age: Late Cretaceous (Campanian-Maastrichtian)

Geological unit: Flysch di Monte Cassio

Application, use and heritage



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2

Description:

The “Gray 14” type is a material suitable for different applications: exterior and interior spaces, ideal for landscaping, urban architecture, walkways, roads and squares. Available in various sizes and thicknesses, in slabs, tiles and cubes. In photo 1, outdoor flooring in the Marsciano municipality, Perugia.

The “Zebra Grey” type is a new stone with high aesthetic value: suitable for interior (photo 2) and exterior, ideal for floor, wall and staircase applications .

From: <https://cavavarana.com/en/>

Petrography



Description:

Source of information:

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Mineral 1 (%)	Mineral 2 (%)	Mineral 3 (%)	Mineral 4 (%)	Mineral 5 (%)	Mineral 6 (%)	Mineral 7 (%)
Mineral 8 (%)	Mineral n (%)					

Source of information:

Physical properties

Apparent density (EN 1936) kg/m ³	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa

Real density (EN 1936) kg/m ³	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m ² x s ^{0,5})	Flexural strength under constant moment (EN 13161) MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm ³ / 50cm ²	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information:

Chemical properties

Main elements

SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	TiO ₂ (%)	MgO (%)	CaO (%)	Na ₂ O (%)	K ₂ O (%)	MnO (%)	P ₂ O ₅ (%)	SO ₃ (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli. Location of quarries: centroids of polygons derived from the Emilia-Romagna regional databases (in preparation), made available by the Servizio Difesa del Suolo, della Costa e Bonifica	
Non-commercial directory		
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli https://ambiente.regione.emilia-romagna.it/it/geologia/servizio-geologico-sismico-e-dei-suoli	 Regione Emilia-Romagna DIREZIONE GENERALE CURA DEL TERRITORIO E DELL'AMBIENTE
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Pietra Alberese

Colombino



2 m

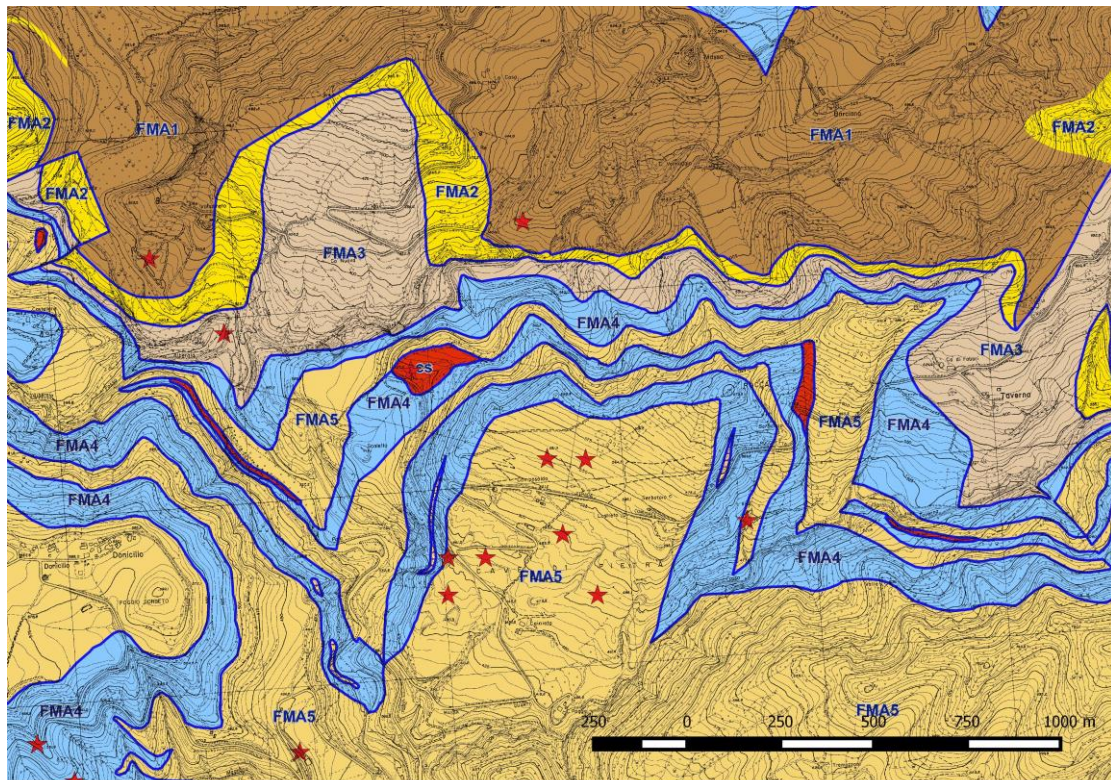
Short description:

Historically, the name “Alberese” was used in Tuscany, to indicate light-grey to whitish calcareous marlstones, mainly deriving from the Formazione di Monte Morello (MLL). The use of this term was very widespread in the past, referred to ornamental stones of similar or nearly-similar aspect, though deriving from geological units other than the MLL. In the Eastern Romagna Apennines, Pietra Alberese is provided by a geologically well-known, thick-bedded, arenitic and marly-calcareous turbidite layer, the so called «Contessa» key-bed within the Formazione Marnoso-arenacea. Quarries may be scattered, according to the location of outcropping «Contessa» key-bed; locally, in the same quarry or in neighbouring quarries both Pietra Alberese and Pietra Serena are extracted from the Formazione Marnoso-arenacea itself. Photo:

https://www.comune.sarsina.fc.it/documents/17581443/17654012/eaborato_2_signed.pdf/38ab8f7d-23f4-43e5-9922-903dc0961d72 and https://www.eurocavesnc.com/pietra_alberese.php

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Limestone	Marlstone	Light-grey	Italy	Emilia-Romagna, Forlì- Cesena	Sarsina	Lastreto-Fosso Taverna

Geological setting



Geology: The Pietra Alberese derives from the “Contessa” megaturbiditic key-bed (“cs” in the geological sketch-map), interbedded in the stratigraphically lowermost part of the Membro di Galeata (FMA4), a sub-unit of the Formazione Marnoso-arenacea (FMA). The Contessa key-bed is made-up of basal, fine to very fine-grained hybrid arenites, 3 to more than 5 metres thick, upgrading to calcareous marlstones, 5 to 8 meters thick.

Derived from the Geological Map of the Emilia-Romagna Apennines, at the scale of 1:10.000 (simplified, Quaternary continental deposits are not mapped).

<https://ambiente.regione.emilia-romagna.it/it/geologia/cartografia/webgis-banchedati/webgis>, issued by the Servizio Geologico, Sismico e dei Suoli, Regione Emilia-Romagna.

Production: Quarries (centroids as red stars in the map) are mainly located in the Sarsina municipality, in the Eastern Forlì-Cesena Apennines.

Geological age: Langhian-Serravallian boundary

Geological unit: Contessa key-bed, Membro di Galeata, Formazione Marnoso-arenacea

Application, use and heritage



Description:

It's a remarkable limestone with outstanding physical and mechanical characteristics. An elegant and refined stone, the Alberese is gray-silver colored with a fine grain. It's resilient and compact and sounds like glass when hit. This stone and his remarkable features make it resilient to ice and freezing, very well suited for outdoor utilization and in the restoration of historical buildings, sidewalks flooring, ladders, curbs and walls covering.

(From: https://www.eurocavesnc.com/pietra_alberese.php)

Petrography

Description:

The Pietra Alberese is made up by hybrid arenites; silicoclasts are mainly represented by quartz and feldspar with more abundant K-feldspar than plagioclases. Among the lithics, the siltstones clearly prevail, less abundant flints and acid volcanites, rare and subordinate serpentinoscists and phyllites. Carbonatic clasts are given by carbonate intraclasts, bioclasts (relict structures of corals, brachiopods and Foraminifera) and subordinately by extrabacinal clasts. The cement is very abundant and calcareous.

Source of information:

<https://www.unionevallesavio.it/documents/1484590/5731062/2.+RELAZIONE+GEOLOGICO-MINERARIA-CON+ALLEGATO.pdf/225fb630-1890-4211-a26e-141a8269250b>

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Mineral 1 (%)	Mineral 2 (%)	Mineral 3 (%)	Mineral 4 (%)	Mineral 5 (%)	Mineral 6 (%)	Mineral 7 (%)
Mineral 8 (%)	Mineral n (%)					

Source of information:

Physical properties

Apparent density (EN 1936) kg/m ³	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa

Real density (EN 1936) kg/m ³	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m ² x s ^{0,5})	Flexural strength under constant moment (EN 13161) MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm ³ / 50cm ²	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information:

Chemical properties

Main elements

SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	TiO ₂ (%)	MgO (%)	CaO (%)	Na ₂ O (%)	K ₂ O (%)	MnO (%)	P ₂ O ₅ (%)	SO ₃ (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli. Location of quarries: centroids of polygons derived from the Emilia-Romagna regional databases (in preparation), made available by the Servizio Difesa del Suolo, della Costa e Bonifica	
Non-commercial directory		
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli https://ambiente.regione.emilia-romagna.it/it/geologia/servizio-geologico-sismico-e-dei-suoli	 Regione Emilia-Romagna DIREZIONE GENERALE CURA DEL TERRITORIO E DELL'AMBIENTE
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Pietra Serena



100 m

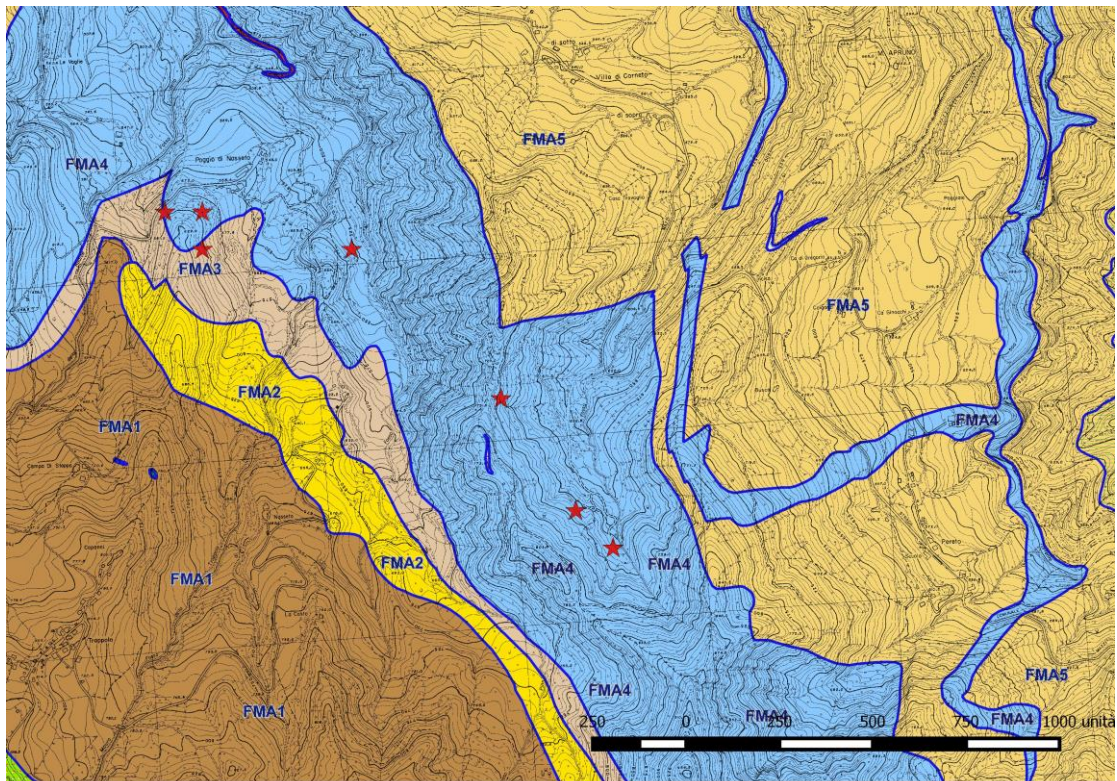
Short description:

“Pietra Serena” is a gray sandstone, notably and historically used in architecture and partly also in sculpture, typical of historical Tuscan architecture. The use of this term is quite widespread and commercially named “Pietra Serena” gray sandstones may derive from different geological units, mainly pertaining stratified silicoclastic turbidites of Oligocene to Miocene age, geologically pertaining the Tuscan and Umbro-Marchean-Romagna Sequences. In the eastern Romagna Apennines the “Pietra Serena” is quarried from the Formazione Marnoso-arenacea.

Photo: https://www.eurocavesnc.com/foto/cave/canala/big/f_06.jpg

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Sandstone	Arenite	Blue-grey	Italy	Emilia-Romagna, Forlì- Cesena province	Verghereto	Corneto

Geological setting



Geology:

Stratified, tabular, medium to thick bedded marly-arenaceous turbidites; strata are made up by bottom layers of medium to fine-grained arenites, upgrading into marlstones. In the Romagna Apennines, the Pietra Serena derives from the Formazione Marnoso-arenacea, especially from the sub-unit Membro di Galeata (FMA4, in the map).

Derived from the Geological Map of the Emilia-Romagna Apennines, at the scale of 1:10.000 (simplified, i.e. slope, debris accumulations of Quaternary age are not represented).

In <https://ambiente.regione.emilia-romagna.it/it/geologia/cartografia/webgis-banchedati/webgis>, issued by the Servizio Geologico, Sismico e dei Suoli, Regione Emilia-Romagna.

Production: Quarries (centroids as red stars in the map) are mainly located in the Verghereto and Sarsina municipalities, in the Eastern Forlì-Cesena Apennines.

Geological age: Late Langhian-Early Serravallian

Geological unit: Membro di Galeata, Formazione Marnoso-arenacea

Application, use and heritage



Description:

This stone is resistant and easy to work, frequently used in architecture, i.e. typically, in Tuscany during the Renaissance period.

Its pearly-gray, fine grained texture makes this stone simple and elegant. The stone texture is enriched with sparkling spots made of mica particles. The Pietra Serena is best suitable for ladders, flooring, columns, balconies, portals, fire places, covering, decorations, bathroom and kitchen tops. The particular beauty of this stone can be enhanced with a variety of finishings (after: https://www.eurocavesnc.com/en/pietra_serena.php)

In the photo (<https://www.eurocavesnc.com/en/realizzazione-en-port-channel-in-cesenatico>), an application of the Pietra Serena quarried in the Sarsina municipality: outdoor flooring for the restoration of the turistic Port Channel in Cesenatico, Forlì-Cesena province.

Petrography

Description:

In the Easter Forlì-Cesena Apennines the Pietra Serena is made up of fine to very fine grained sandstones; the siliciclastic component (> 50%) is made up of quartz, feldspar, muscovite, biotite and predominantly phyllic lithic fragments. Among feldspars, plagioclase prevails over K-feldspar. The carbonate component is represented by terrigenous carbonate clasts, both micritic and spatitic, and by abundant cement.

Source of information:

<https://www.unionevallesavio.it/documents/1484590/5731062/2.+RELAZIONE+GEOLOGICO-MINERARIA-CON+ALLEGATO.pdf/225fb630-1890-4211-a26e-141a8269250b>

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Mineral 1 (%)	Mineral 2 (%)	Mineral 3 (%)	Mineral 4 (%)	Mineral 5 (%)	Mineral 6 (%)	Mineral 7 (%)
Mineral 8 (%)	Mineral n (%)					

Source of information:

Physical properties

Apparent density (EN 1936) kg/m ³	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa

Real density (EN 1936) kg/m ³	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m ² x s ^{0,5})	Flexural strength under constant moment (EN 13161) MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm ³ / 50cm ²	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information:

Chemical properties

Main elements

SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	TiO ₂ (%)	MgO (%)	CaO (%)	Na ₂ O (%)	K ₂ O (%)	MnO (%)	P ₂ O ₅ (%)	SO ₃ (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli. Location of quarries: centroids of polygons derived from the Emilia-Romagna regional databases (in preparation), made available by the Servizio Difesa del Suolo, della Costa e Bonifica	
Non-commercial directory		
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Scientific publication		
Other publication		

Compiled by:	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli https://ambiente.regione.emilia-romagna.it/it/geologia/servizio-geologico-sismico-e-dei-suoli	 Regione Emilia-Romagna DIREZIONE GENERALE CURA DEL TERRITORIO E DELL'AMBIENTE
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Pietra di Scurano



5 m

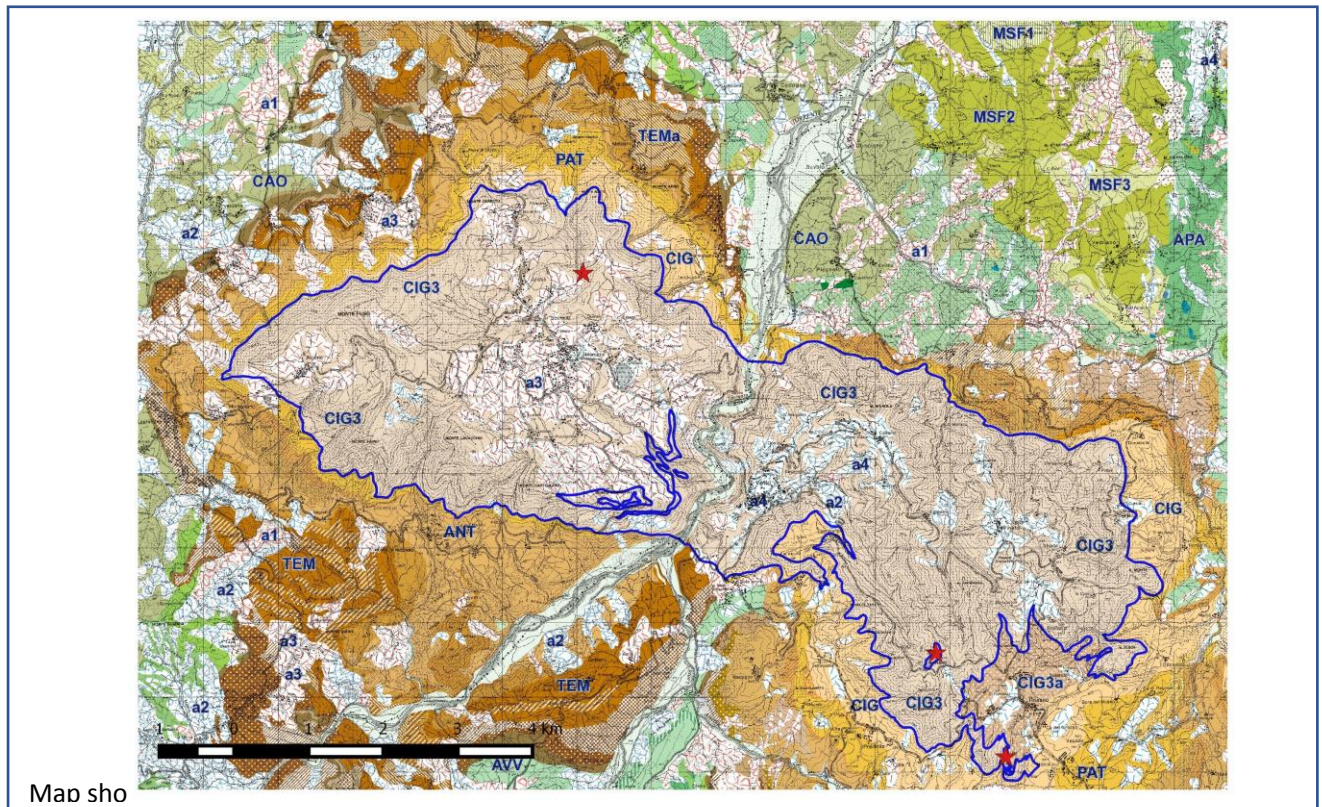
Short description:

The Pietra di Scurano was used as a building and dimension stone historically, quarries are not active at present or nearly unknown. From a geological point of view, the same unit (Gruppo di Bismantova, Formazione di Cigarellino, Membro delle Arenarie di Vetto) also provides the so called Pietra di Vetto, historically quarried like the Scurano one.

In the photo, the Arenarie di Vetto outcropping nearby the course of the Enza River, at the boundary between Parma and Reggio Emilia Apennines, from: <https://www.ilrestodelcarlino.it/reggio-emilia/cronaca/meglio-la-natura-dell-enza-che-la-piscina-1.5315823>

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Sandstone	Arenite	Yellow	Italy	Emilia-Romagna, Parma	Neviano degli Arduini	Scurano

Geological setting



Geology:

The Pietra di Scurano (and Pietra di Vetto as well) was extracted from the Membro delle Arenarie di Vetto (CIG3), a sub-unit within the Formazione di Cigarello of the Gruppo di Bismantova. CIG3 is made up of arenitic (A) – pelitic (P) turbidites, with medium-coarse arenites with limestone clasts and bioclasts, in medium and thick layers, graded, plane-parallel, locally cuneiform, gray pelites ($A / P > / = 1$). Gray-light brown color, the yellow-ocher color typical of the Pietra di Scurano (and one of its most appreciated qualities) is due to alteration.

Production:

Historical quarries were abandoned and their location is uncertain nowadays, the past importance of this ornamental stone (and of the similar Pietra di Vetto as well) can be inferred by widespread rural buildings in the Scurano and Vetto areas.

Geological age: Langhian-Serravallian

Geological unit: Membro delle Arenarie di Vetto, Formazione di Cigarello, Gruppo di Bismantova

Application, use and heritage



Description:

Two examples are given, Scurano village: (left) the Chiesa dei Santi Ippolito e Cassiano, Scurano
<https://www.beweb.chiesacattolica.it/edificidiculto/edificio/55573/Chiesa+dei+Santi+Ippolito+e+Cassiano>
and a rural house, the Casa Malandri (right)
<https://scn.caiparma.it/schede/portale-malandri-neviano-arduni-loc-scurano-mezzadria/>

The warm, yellow color is typical of the Pietra di Scurano; arenites are compact, suitable to low water absorption. Blocky slices were used in outdoor rural architecture, stoneworks and ornamented portals and windows.

Petrography

Description:

Source of information:

Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Mineral 1 (%)	Mineral 2 (%)	Mineral 3 (%)	Mineral 4 (%)	Mineral 5 (%)	Mineral 6 (%)	Mineral 7 (%)
Mineral 8 (%)	Mineral n (%)					

Source of information:

Physical properties

Apparent density (EN 1936) kg/m ³	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa

Real density (EN 1936) kg/m ³	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m ² x s ^{0,5})	Flexural strength under constant moment (EN 13161) MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm ³ / 50cm ²	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information:

Chemical properties

Main elements

SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	TiO ₂ (%)	MgO (%)	CaO (%)	Na ₂ O (%)	K ₂ O (%)	MnO (%)	P ₂ O ₅ (%)	SO ₃ (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli. Location of quarries: centroids of polygons derived from the Emilia-Romagna regional databases (in preparation), made available by the Servizio Difesa del Suolo, della Costa e Bonifica	
Non-commercial directory		
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Scientific publication		
Other publication		

Compiled by:	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli https://ambiente.regione.emilia-romagna.it/it/geologia/servizio-geologico-sismico-e-dei-suoli	 Regione Emilia-Romagna DIREZIONE GENERALE CURA DEL TERRITORIO E DELL'AMBIENTE
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Pietra di Montovolo

Arenarie di Montovolo

Arenarie Ofiolitifere



500 m

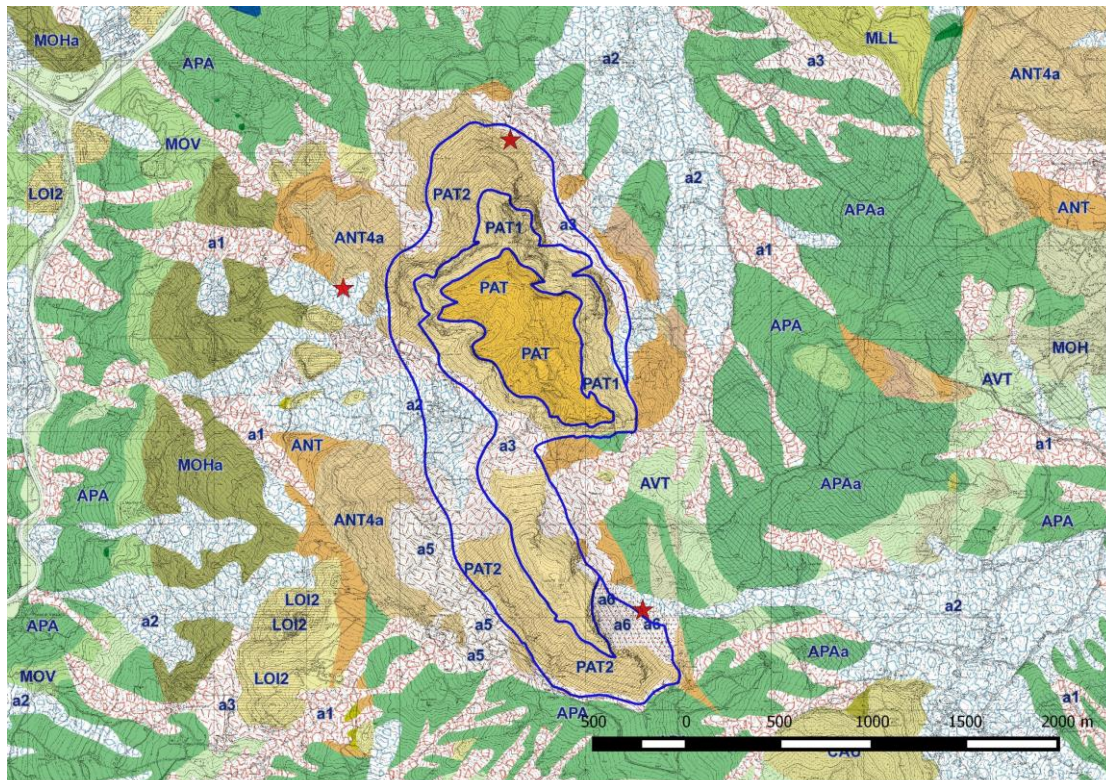
Short description:

Very thick, cross-bedded arenites and micro-conglomerates, historically used as building and dimension stones.

Photo: <https://geo.regione.emilia-romagna.it/schede/geositi/scheda.jsp?id=2128>

Commodity (vocabulary)	Lithology (vocabulary)	Typical colour (code list)	Place of origin			
			Country	County / District / Province	Municipality / Community	Place/town / Village
Sandstone	Arenite	Grey	Italy	Emilia-Romagna, Bologna	Grizzana Morandi Camugnano	Montovolo

Geological setting



Geology:

Historical quarries, now abandoned, are located in the Membro di Montecuccolo (PAT2, blue contour). Fine to coarse, yellowish hybrid biocalcarenites and arenites, locally microconglomerates, with predominantly oblique and medium to large scale stratification; upwards and northwards. At the base there may sometimes be a lens, attaining a maximum thickness of about 10m, made up of massive breccias with mainly calcareous clasts.

Production:

The Pietra di Montovolo had a great historical importance. After Bargossi *et alii*, 2004: «The two main quarries, both active until few decades ago, are located southern of Vergato, on Montovolo, and are called Vecchi Quarry (Cava Vecchi) and Berardi's Quarry (Cava dei Berardi). Even from the adjoining Monte Vigese, mainly in the Greglio and Cardeda localities, great amounts of sandstones were quarried from blocks sloughed from the walls. The stone, in massive strata up to few metres thick, was mined and worked with traditional manual methods inherited from the Comacine masters working in this area during the Middle Ages, of which remain, as proof, numerous villages with towerhouses and churches»

GIUSEPPE MARIA BARGOSSO, FABIO GAMBERINI, GIORGIO GASPAROTTO, GIAN CARLO GRILLINI and MARTA MAROCCHI (2004) - *A showcase of the Italian research in applied petrology. Dimension and ornamental stones from the Tosco-Romagnolo and Bolognese Apennine*. Per. Mineral. (2004), 73, 171-195 <http://go.to/permin>
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Geological age: Late Burdigalian – Early Langhian

Geological unit: Membro di Montecuccolo, Formazione di Pantano, Gruppo di Bismantova

Application, use and heritage



1



2

Description:

After Bargossi *et alii*, 2004: «Among works carried out with the Montovolo Stone we remind the «Santa Maria della Consolazione» Sanctuary, on the top of Montovolo, of the XIII century, built on the remnants of a more ancient IX-X century proto-Romanic church of which only the underground crypt remains, and the «Santa Caterina d'Alessandria» Oratory, next to the Sanctuary, a XIII century Romanic style chapel. A grey-coloured «molassa» sandstone has been used as façade covering for the «Santa Maria di Galliera» church in Bologna (1491) and for the two giants supporting the balcony of the XVII century Davia-Bargellini Palace (Rodolico, 1953). More recently the Montovolo Stone has been used for the external facing of the Government Palace of Bologna (1932-'33), at the present day the police headquarters (Questura), and for the façade covering of Santa Maria Assunta (Riola), a church of the Finnish architect Alvar Aalto ended in 1978 (...) One of the most beautiful examples of employment of the Bismantova Formation (*former geological name of this geological unit, Note of Author*) sandstones is represented by the «Palazzo dei Capitani della Montagna» covering, a XIV-XV century palace in Vergato, rebuilt first in 1885 and then after the Second World War»

Photo 1, Chuch of Santa Maria Assunta, Riola, Bologna Apennines,
<https://andyphoto2017.wordpress.com/2017/02/22/la-chiesa-di-alvar-aalto-a-riola-di-vergato/>).

The Pietra di Montovolo was partly used in the amazing, eccleptic castle of the Rocchetta Mattei, built in the period 1850-1880 (**photo 2**, <https://www.lorenzotaccioli.it/rocchetta-mattei-il-castello-arabeggiante-emilia-romagna/>)

Petrography

Description:

After Bargossi *et alii*, 2004, op. cit:

«The Montovolo Stone, better known in the literature as «Ophiolitic Molassa», is a calcarenite which colour ranges from greybluish to yellowish when oxidized and which grainsize ranges from fine-medium-grained to coarse-grained. It looks massive except for the isoriented disposition of lamellarshaped minerals and elongated biosomes and a low grade of thickening with a moderate amount of points-like contacts between the skeleton grains. It turned out to be mainly made up of a bioclastic component represented by benthonic and planctonic foraminifers' shells and also by echinoderms, bryozoans, and alga and bivalves fragments. Fragments of micritic carbonatic rocks are rarer to be found. The siliciclastic component is made up of quartz, feldspars and micas. The matrix made up of a carbonatic cement doesn't totally obliterate pores and is represented mainly by micrite passing into spatite along the carbonatic clasts grain boundaries»

Source of information:

GIUSEPPE MARIA BARGOSSO, FABIO GAMBERINI , GIORGIO GASPAROTTO , GIAN CARLO GRILLINI and MARTA MAROCCHI (2004) - *A showcase of the Italian research in applied petrology. Dimension and ornamental stones from the Tosco-Romagnolo and Bolognese Apennine*. Per. Mineral. (2004), 73, 171-195 <http://go.to/permin>
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Mineral composition

If no accurate number, use MM=main minerals, SM = Subordinate minerals, AM=accessory minerals

Mineral 1 (%)	Mineral 2 (%)	Mineral 3 (%)	Mineral 4 (%)	Mineral 5 (%)	Mineral 6 (%)	Mineral 7 (%)
Mineral 8 (%)	Mineral n (%)					

Source of information:

Physical properties

Apparent density (EN 1936) kg/m ³	Open porosity (EN 1936) % vol	Water absorption at atmospheric pressure (EN 13755) % wt	Uniaxial Compressive strength (EN 1926) MPa	Flexural strength under concentrated load (EN 12372) MPa

Real density (EN 1936) kg/m ³	Total porosity (EN 1936) % vol	Water absorption coefficient by capillary (EN 1925) (g/m ² x s ^{0,5})	Flexural strength under constant moment (EN 13161) MPa

Frost resistance (EN 12371)				
Technological Test (Test A)				Identification Test (Test B): Number of cycles completed prior to stone failure
Flexural strength (EN 12372) after freeze-thaw cycling, MPa	Number of cycles	Uniaxial compressive strength (EN 1926) after freeze-thaw cycling, MPa	Number of cycles	

Resistance to ageing by thermal shock (EN 14066)			
Change in dynamic modulus of elasticity (increase: +; decrease: -) %	Change in open porosity (increase: +; decrease: -) %	Change in ultrasound pulse velocity (increase: +; decrease: -) %	Change in flexural strength under conc. load (increase: +; decrease: -) %

Abrasion resistance (EN 14157)			Resistance to salt crystallisation (EN 12370)	Breaking load at dowel hole (EN 13364)	
Method A - Wide Wheel Abrasion Test, mm	Method B - Böhme Abrasion Test, cm ³ / 50cm ²	Method C - Amsler Abrasion Test, mm	Change in mass (increase: +; decrease: -), %	Breaking load, N	Thickness of the test specimens, mm

Slip resistance by means of the pendulum tester (EN 14231 / CEN/TS 16165)			Rupture energy (EN 14158), Joule	Thermal Conductivity (EN 1745), W/m·K
Tested surface finish	Slip Resistance Value — SRV			
	Dry test condition	Wet test condition		

Source of information:

Chemical properties

Main elements

SiO ₂ (%)	Al ₂ O ₃ (%)	Fe ₂ O ₃ (%)	TiO ₂ (%)	MgO (%)	CaO (%)	Na ₂ O (%)	K ₂ O (%)	MnO (%)	P ₂ O ₅ (%)	SO ₃ (%)	LOI (%)

Trace elements

V (ppm)	Cr (ppm)	Mn (ppm)	Co (ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	As (ppm)
Sr (ppm)	Cd (ppm)	Ba (ppm)	Pb (ppm)	Be (ppm)	Rb (ppm)	Bi (ppm)	U (ppm)
Sc (ppm)	Y (ppm)	Th (ppm)	Sb (ppm)	Ta (ppm)	Nb (ppm)	Zr (ppm)	Sn (ppm)
Ag (ppm)	B (ppm)	Mo (ppm)	W (ppm)	Ga (ppm)	Ge (ppm)	Se (ppm)	Cs (ppm)
Tl (ppm)							

REE

La (ppm)	Ce (ppm)	Pr (ppm)	Nd (ppm)	Sm (ppm)	Eu (ppm)	Gd (ppm)	Tb (ppm)
Dy (ppm)	Ho (ppm)	Er (ppm)	Tm (ppm)	Yb (ppm)	Lu (ppm)		

Methods applied and source of information:

Sources of more information

Type of information	Name of provider	URL
This data sheet	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli. Location of quarries: centroids of polygons derived from the Emilia-Romagna regional databases (in preparation), made available by the Servizio Difesa del Suolo, della Costa e Bonifica	
Non-commercial directory		
Commercial directory		
Scientific publication		
Other publication		

Compiled by:	Regione Emilia-Romagna, Servizio Geologico, Sismico e dei Suoli https://ambiente.regione.emilia-romagna.it/it/geologia/servizio-geologico-sismico-e-dei-suoli	 Regione Emilia-Romagna DIREZIONE GENERALE CURA DEL TERRITORIO E DELL'AMBIENTE
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