

GEOLOGICAL FIELD TRIPS AND MAPS

2026
Vol. 18 (1.5)

Building stones and urban geology of Bari (southern Italy):
a geoheritage perspective

FT1 Pre-congress field trip of the joined congress
SGI and SIMP “Geology for a sustainable management of our planet”,
Bari, 3-5 September 2024

<https://doi.org/10.3301/GFT.2026.05>



SOCIETÀ GEOLOGICA ITALIANA ETS
FONDATA NEL 1881 - ENTE MORALE S. D. 17 OTTOBRE 1882

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Geological Field Trips and Maps



Periodico semestrale del Servizio Geologico d'Italia - ISPRA e della Società Geologica Italiana ETS
Geol. F. Trips Maps, Vol. 18 No.1.5 (2026), 24 pp., 16 figs. (<https://doi.org/10.3301/GFT.2026.05>)

Building stones and urban geology of Bari (southern Italy): a geoheritage perspective

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Cover page figure: Basilica of Saint Nicholas, Bari.

ISSN: 2038-4947 [online]

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INDEX

INFORMATION

Abstract	4
Program Summary	4
Safety	4
Hospitals	4
Accommodation	4

EXCURSION NOTES

Information	6
Geological background	6
Dimension and Ornamental Stones in the Built Heritage	8

ITINERARY

Stop 1 - Piazza del Ferrarese	11
Stop 2 - Petruzzelli Theatre	12
Stop 3 - The Lungomare (Promenade).....	13
Stop 4 - Basilica of St. Nicholas.....	13
Stop 5 - Cathedral of Saint Sabinus	17
Stop 6 - Norman-Swabian Castle.....	18
Stop 7 - Arco Alto and Arco Basso.....	20
Conclusion	21

REFERENCES	23
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ABSTRACT

The city of Bari, host of the 2024 edition of the joint SGI-SIMP congress “Geology for a sustainable management of our planet”, is the capital of the Apulia region and one of the most important port cities on the Adriatic Sea. Its historical role as the *Porta d’Oriente* (Gateway to the East) since antiquity, together with the legacy of successive dominations, has left a profound imprint on both its tangible and intangible cultural heritage.

This guide offers an opportunity to explore the rich cultural heritage of the old town (*Bari Vecchia*) and the modern Murat district. It also presents a concise overview of the urban geological substratum and its relationship with the city’s-built heritage. The itinerary includes seven stops at sites of particular historical meaning, including *Piazza del Ferrarese*, the *Petruzzelli* Theatre, the seafront promenade (*Lungomare*), the Basilica of Saint Nicholas, the Cathedral of Saint Sabinus, the Norman-Swabian castle and the iconic streets of *Bari Vecchia* (*Arco alto* and *Arco Basso*).

In addition, selected case studies on the diagnostics and restoration of cultural heritage, carried out by researchers and students of the Degree Course in Conservation and Restoration at the University of Bari Aldo Moro, will be presented along the tour.

Keywords: Bari, limestones, calcarenite, Roman marbles, geoheritage, building stones, urban geology.

PROGRAM SUMMARY

This guided tour (Fig. 1) offers an immersive experience into the rich tapestry of Bari’s cultural heritage, blending ancient traditions with iconic monuments. The itinerary begins at Piazza del Ferrarese and proceeds to the *Petruzzelli* Theatre, before following the scenic seafront promenade (*Lungomare*), where the enduring maritime character of the city is still evident in the daily ritual of fishermen bringing in their catch. As the tour winds through the intricate network of streets in the old town (*Bari Vecchia*), participants will trace the city’s historical development, from its origins as an ancient Roman settlements through the medieval citadels and Baroque masterpieces. The atmosphere is enriched by the aroma of freshly baked *focaccia* and the vibrant voices

of residents, capturing the authentic spirit of the city. Key stops include the majestic Basilica of St. Nicholas, the Cathedral of St. Sabinus, the Norman-Swabian Castle and the artworks housed within these iconic monuments. The tour concludes with an opportunity to experience Bari’s culinary heritage: participants will be free to enjoy traditional Apulian cuisine in local trattorias, featuring specialties such as *orecchiette pasta*, *focaccia* and freshly caught seafood.

SAFETY

The walk will take place on foot in flat urban area, except for some short stairs to reach the churches’ underground or the old town walls. Rather high temperatures (25-30° C) and a wet climate are expected. It is advisable to bring sunscreen, hats with visors, sunglasses and a light raincoat in case of light rain. Comfortable shoes are also recommended.

Emergency number: 112.

HOSPITALS

- Azienda Universitaria Ospedaliera Consorziale - Policlinico Bari, Piazza Giulio Cesare 11, 70124 Bari, tel. +39 080 559 1111
- Ospedale San Paolo, Via Capo Scardicchio, 70123 Bari, tel. +39 080 584 3111

ACCOMMODATION

The Tourist Office website of the Apulia Region administration offers valuable services and information translated into five languages (<https://www.viaggiareinpuglia.it/infopoint/6849/en/Info-point-Bari>). Additional accommodation solutions can be discovered through the leading online booking platforms services (www.booking.com; www.airbnb.it; www.trivago.it).



Fig. 1 - Location of the stops in the old town of Bari (Piazza del Ferrarese – Stop 1; Petruzzelli Theatre – Stop 2; Lungomare Nazario Sauro – Stop 3; Basilica of St. Nicholas – Stop 4; Cathedral of St. Sabinus – Stop 5; Norman-Swabian Castle – Stop 6; Arco Basso and Arco Alto – Stop 7) (modified from <https://ontheworldmap.com/>).



INFORMATION

Bari is a major port city on the Adriatic coast of southern Italy and the capital of the Apulia region. Its historical development spans several millennia and reflects the succession of different political powers and cultural traditions, each of which has contributed to shaping the city's urban form, architectural heritage, and economic role within the Mediterranean. Archaeological evidence indicates that the area was already inhabited during the Bronze Age, with early settlements associated with the Peucetians, later followed by the establishment of the Greek colony of Barium, whose strategic coastal position favoured maritime trade and intercultural exchange.

Under Roman rule, Bari became an important urban and commercial centre, integrated into the imperial infrastructure through the Via Traiana, which connected Rome to Brindisi and enhanced the city's strategic and economic relevance. During this period, Bari's economy was strongly supported by fisheries, agriculture, and olive oil production (Beatillo, 1637; Petroni, 1857; Tateo, 1989). After the fall of the Western Roman Empire, the city assumed a central administrative and military role within Byzantine Italy, becoming the seat of the Catapan and a key outpost linking the eastern and western Mediterranean worlds. Byzantine control, marked by political and economic consolidation, lasted until 1071, when Bari surrendered after a prolonged Norman siege led by Robert Guiscard (Petroni, 1857; Tateo, 1989).

A particularly significant phase occurred between 847 and 871, when Bari was occupied by Muslim forces and became the capital of the Emirate of Bari. Although short-lived, this period left important traces in terms of fortifications and administrative organisation, before the city was reconquered by Byzantine forces under Emperor Louis II (Petroni, 1857; Tateo, 1989). From the late 11th century, under Norman rule, Bari developed into a densely populated, multi-ethnic seaport and the most economically advanced urban centre in Apulia. The translation of the relics of Saint Nicholas from Myra to Bari in 1087 represented a turning point in the city's history, transforming it into a major pilgrimage destination with wide-ranging religious and political significance (Tateo, 1990).

Despite its growing prestige, Bari was repeatedly affected by conflicts with Norman authority, culminating in the destruction of large parts of the city in 1156 by King William I of Sicily, with the exception of key religious and monumental areas such as the Nicolaian complex, the cathedral, and the castle (Lucatuorto, 1971; Tateo, 1990). Subsequent incorporation into the Hohenstaufen and later Angevin dominions was followed by a prolonged phase of socio-economic decline between the late 13th

and mid-15th centuries, caused by famines, epidemics, and recurrent episodes of violence and destruction (Licinio, 1990).

A gradual recovery began under Aragonese rule from the mid-15th century, despite the severe damage caused by the 1456 earthquake. Significant urban renewal and fortification programs were promoted, particularly under Isabella of Aragon and her daughter Bona Sforza, who aligned Bari's development with Renaissance cultural models and courtly life until the mid-16th century (Pepe, 1990). In the early modern period, under Spanish and later Bourbon rule, the city retained administrative importance but experienced relative economic stagnation.

Following Italian unification in 1861, Bari underwent profound modernisation, characterised by port expansion, demographic growth, and extensive urban and architectural transformation between the late 19th and early 20th centuries. During the Second World War, the city's strategic port made it a target of heavy bombing, most notably in 1943, when an air raid caused severe destruction and a catastrophic chemical incident in the harbour (Tateo, 1997). In the post-war period, Bari experienced sustained economic recovery and urban expansion, consolidating its role as a major commercial, cultural, and educational centre in southern Italy, a position it continues to hold today (Tateo, 1997).

GEOLOGICAL BACKGROUND

From a geological perspective, the Apulia region largely corresponds to the emerged sector of the Apulian Carbonate Platform, forming the foreland of the southern Apennines (D'Argenio et al., 1973). The extensive outcrops of carbonate rocks extending from the Gargano Promontory to the Salento Peninsula record sedimentary processes that have affected the region from the Mesozoic through the Quaternary (Richetti et al., 1988) (Fig. 2).

The 1: 50,000 geological map of the 438 Sheet "Bari" (Servizio Geologico d'Italia, 2011), simplified in Figure 3, shows as the local bedrock is made up of Cretaceous inner shelf carbonates of the *Calcare di Bari* fm, which are unconformably overlain by: i) Lower Pleistocene shallow-marine calcarenites (*Calcarenite di Gravina* fm), ii) deep marine clays and silts (*argille subappennine* fm); iii) Middle-Upper Pleistocene terraced shallow-marine and coastal mixed carbonate and siliciclastic units (Murge supersynthem); iv) Middle-Upper Pleistocene terraced alluvial conglomerates (Lame delle Murge supersynthem), v) Holocene alluvial sediments (Pieri et al., 2009, 2011, 2024; Sabato et al., 2010; Spalluto et al., 2010). These latter infill ephemeral channels (*lame*) and represent the

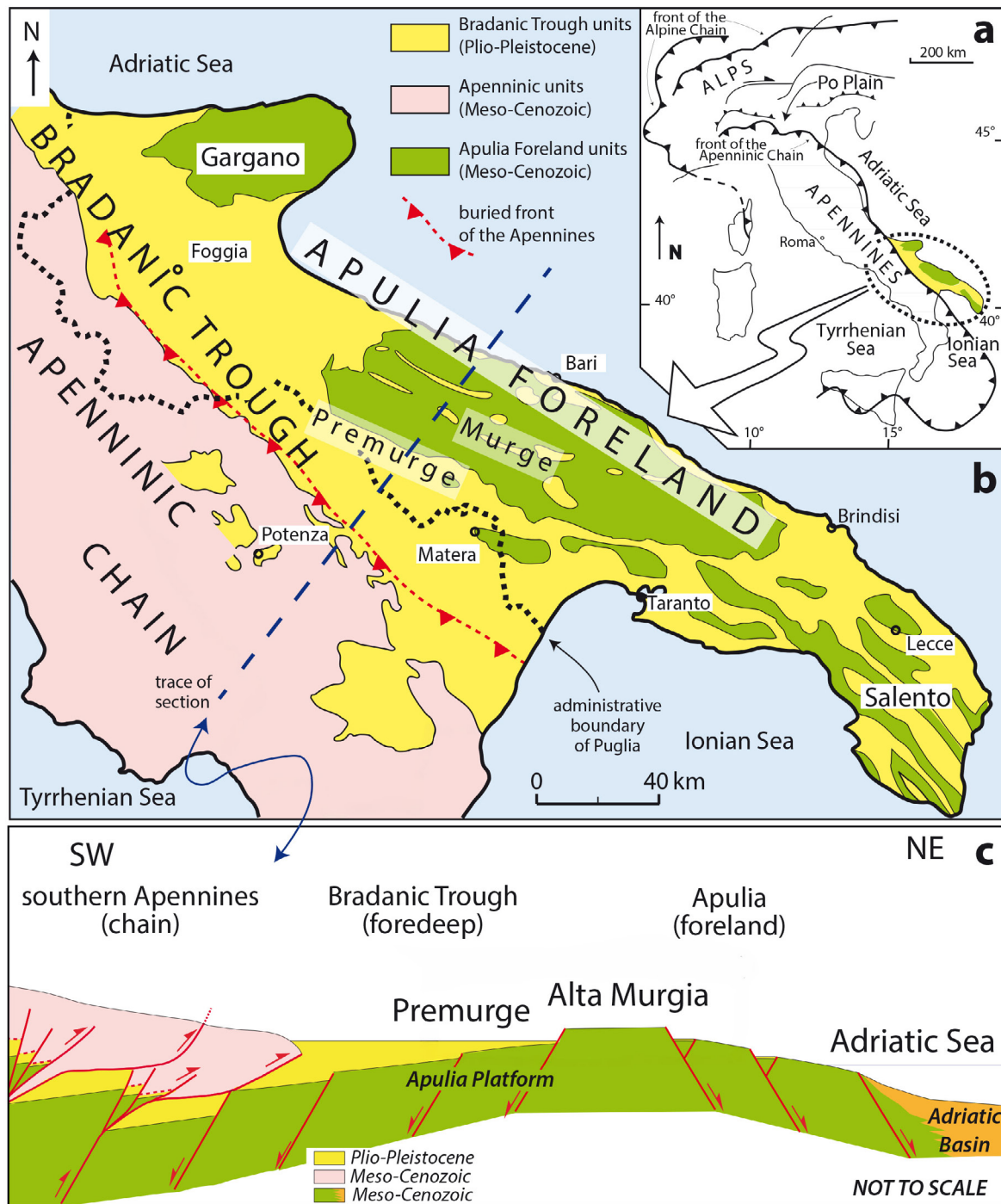


Fig. 2 - (a) Schematic structural map of Italy; (b) geological sketch-map of the Apulia Foreland in southern Italy; (c) geological cross-section through the southern Apennine orogenic system (modified from Tropeano et al., 2023).

major hydrogeological risk for the human settlements in the area (Moretti, 2005).

The 1: 25,000 geological map of the Bari metropolitan area (Fig. 4) (Pieri et al., 2009, 2024; Sabato et al., 2010) further distinguishes in more detail the above cited units and refines their stratigraphic features. The *Calcarea di Bari* (lower Albian *p.p.*-upper Cenomanian) was mainly deposited in shallow peritidal settings affected by recurrent subaerial

exposure, with rudist-rich marginal facies in its upper part (Laviano et al., 1996; Spalluto, 2012; Spalluto et al., 2024). Lithologies consist predominantly of well-bedded mud-supported limestones (wackestone–packstone), commonly stromatolitic and locally dolomitised (Spalluto, 2012). The *Calcarenite di Gravina* (Lower Pleistocene) unconformably overlies the Cretaceous bedrock across a karstified surface, locally filling WNW–ESE-trending depressions (Iannone and

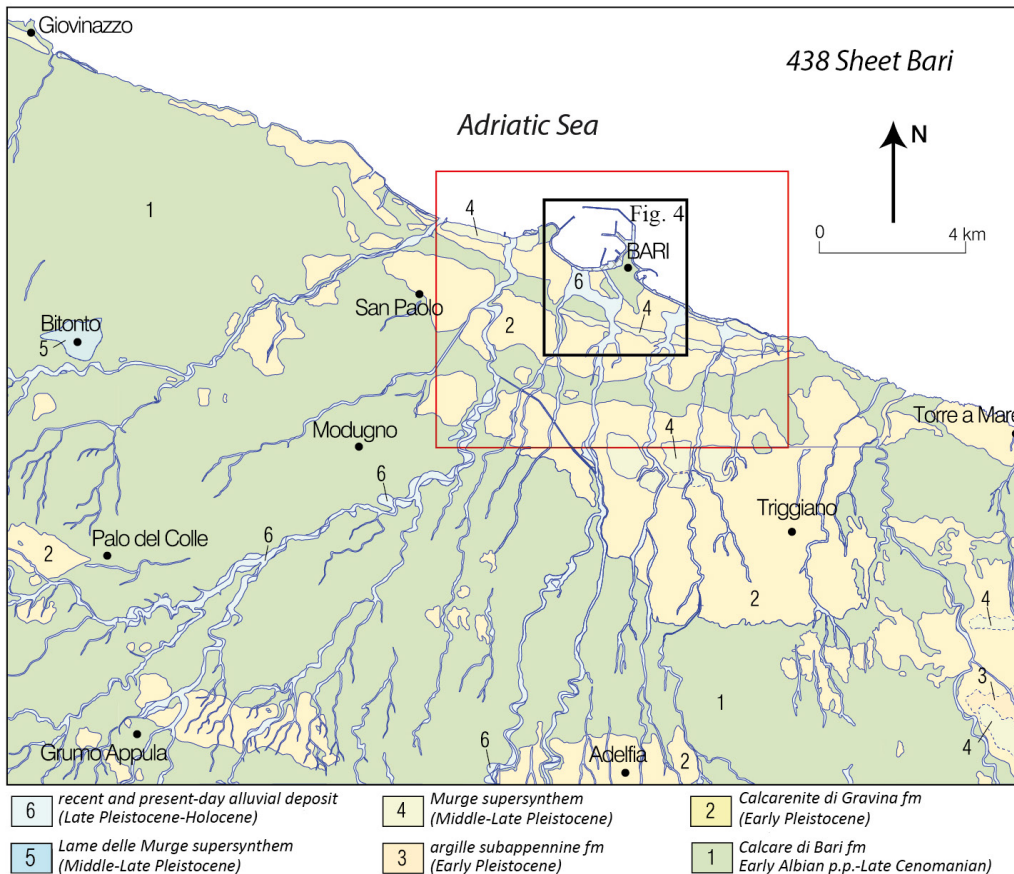


Fig. 3 - Simplified geological map of the 438 Sheet "Bari". The red rectangle outlines the area depicted in the 1: 25,000 geological map of the Bari metropolitan area (Pieri et al., 2024). The black rectangle outlines the area shown in Figure 4.

Pieri, 1979). This unit, up to ~20 m thick, comprises weakly cemented, highly porous biocalcarenites (packstone to grainstone textures) rich in benthic fauna and red algae. Overall, its facies architecture is consistent with deposition in a wave-dominated carbonate system (Tropeano and Sabato, 2000).

The Murge supersynthem (Middle-Upper Pleistocene) includes five orders of marine terraces identified in the 438 Sheet "Bari" (Spalluto et al., 2010; Pieri et al., 2011). It comprises coastal mixed carbonate and siliciclastic deposits accumulated during distinct Middle-Late Pleistocene highstands. Both lower and upper boundaries are erosional; the latter is locally capped by a thin (decimetre-scale) soil. Only the San Pasquale synthem (Upper Pleistocene) is shown in Figure 4. The Lame delle Murge supersynthem (Middle-Upper Pleistocene) includes terraced alluvial deposits occurring a few metres above the present thalwegs of the main *lame*, which are incised into the carbonate bedrock. It unconformably overlies the *Calcare di Bari* and consists mainly of clast-supported conglomerates, locally with a silty–sandy matrix. Unconsolidated Upper Pleistocene-Holocene alluvial sediments are associated with recent and present-day channel activity.

The stratigraphic units cropping out in the Bari urban area (Fig. 4) have significantly influenced the historic architecture of the city. Notably, the locally sourced carbonate rocks,

derived primarily from the *Calcare di Bari* and *calcarenite di Gravina* formations, have been extensively used in the construction of Bari Vecchia's monuments, buildings, and paved streets (AA. VV., 1982; Laviano, 2006).

DIMENSION AND ORNAMENTAL STONES IN THE BUILT HERITAGE

In recent years, a growing body of geo-cultural and urban geological research has focused on historic Italian cities, emphasizing the relationships between local geology, building materials, and cultural heritage. Studies carried out in cities such as Pisa and Naples have documented how urban architecture reflects both the availability of local lithotypes and the selective use of extra-regional stones, integrating petrographic analyses, lithological mapping, and assessments of decay processes (Lezzerini et al., 2019; De Gennaro et al., 2000; La Felice et al., 2019; Petrosino et al., 2021). Similar approaches have been applied in other historic contexts, including Urbino, where the predominance of local sedimentary rocks is complemented by imported ornamental materials, highlighting the influence of historical, artistic, and socio-economic factors on stone selection (Santi et al., 2021).

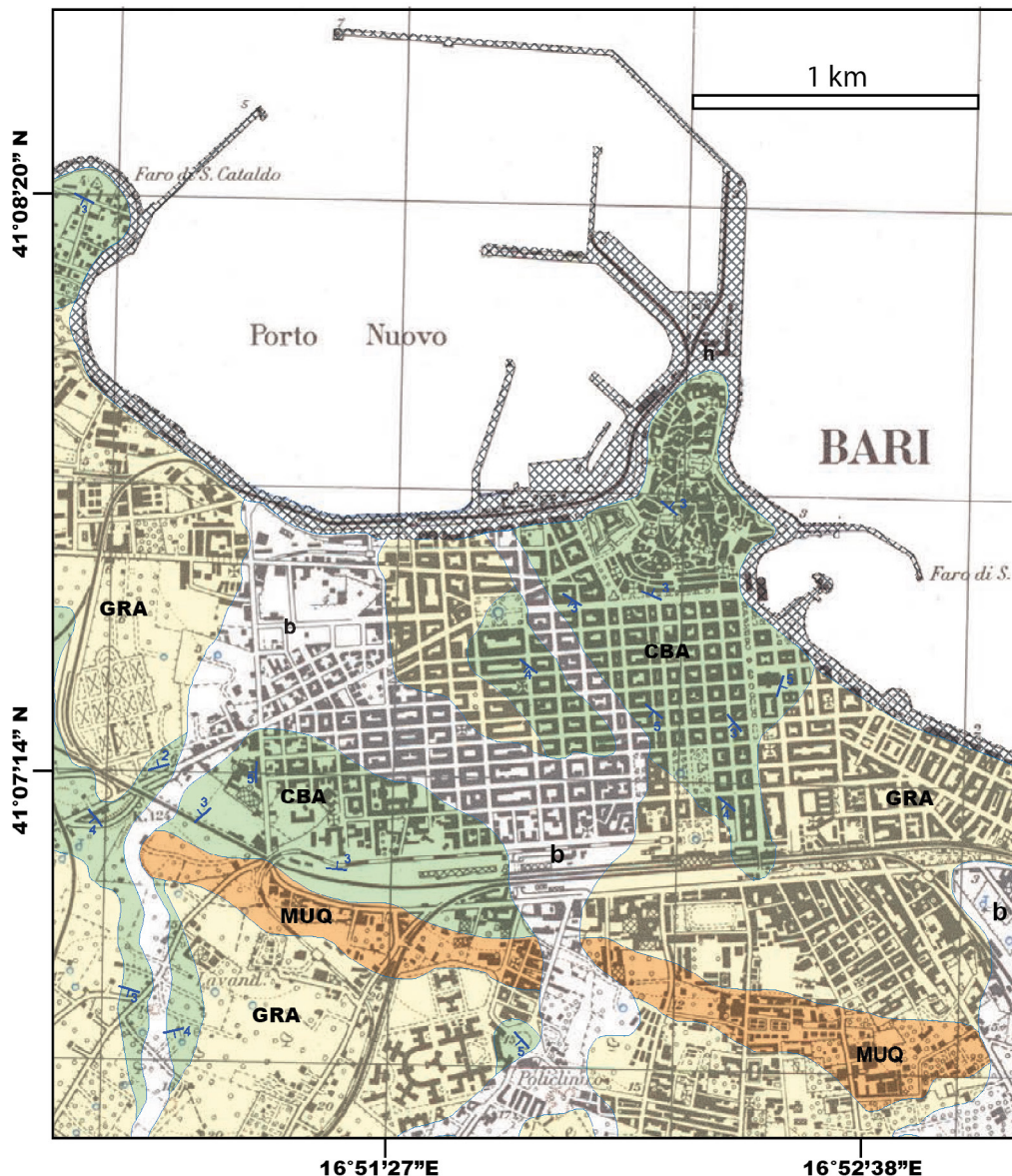


Fig. 4 - Excerpt from the geological map of the city of Bari (Pieri et al., 2024). The whole map was distributed to all participants at the SGI-SIMP Congress in Bari. Key: b - Actual and present-day alluvial deposits (Upper Pleistocene-Holocene); MUQ - Murge supersynthem (San Pasquale synthem, Upper Pleistocene); GRA - *Calcareniti di Gravina* (Lower Pleistocene); CBA - *Calcare di Bari* (lower Albian *p.p.*-upper Cenomanian); h - anthropogenic deposit. Full map freely available at <https://smallpdf.com/it/file#s=a7e4daf9-1dc8-4044-92b6-8a5191c82dda>. Topographic base from the *Istituto Geografico Militare* (Authorisation No. 6137 - 11.01.2016). Note that the topography reflects the urban expansion of the city of Bari at the end of the 1940s."

Within this national framework, the Bari case study fits into an established yet still expanding field of urban geoheritage research, while offering a distinctive perspective rooted in the long-term exploitation of Apulian carbonate resources. The widespread use of local ornamental stones such as *Filetto Rosso di Apricena*, and *Serpeggiante di Trani* belonging to the *Calcare di Bari* fm, alongside reused regional and extra-regional stones, reflects both functional constraints and cultural choices that have shaped the urban fabric over centuries. In this sense, Bari not only aligns with comparable Italian experiences but also contributes original insights into the role of Italian stones in the construction, reuse, and valorisation of urban geological heritage.

Focussing on the Apulia region, the material culture and landscape are deeply influenced by the carbonate geological substratum. Over time, the widespread availability of limestone outcrops across the region has facilitated its systematic exploitation as primary raw

material for both building and ornamental purposes. Furthermore, comparable uses of limestone have been reported in the production of mortars used in architectural and artistic contexts (Eramo et al., 2024).

The on-site availability of limestones of various ages, colours, and physico-mechanical properties favoured their extensive application in construction activities, together with the foreign ornamental stones spoliated from pre-existing structures (De Lachenal, 1995). In the historic centre of Bari, the masonry of houses and monuments in features squared blocks of *Calcare di Bari* (lower Albian *p.p.*-upper Cenomanian), *Calcareniti di Gravina* (Lower Pleistocene), as well as calcarenites of Murge supersynthem (Middle-Upper Pleistocene) (Fig. 5). In the southern area of the urban area, beyond the railway line, a series of quarries of calcarenite and compact limestones were historically documented, although they have been largely obliterated by contemporary urban expansion (e.g., Masseria Prete, Via Cifarelli).

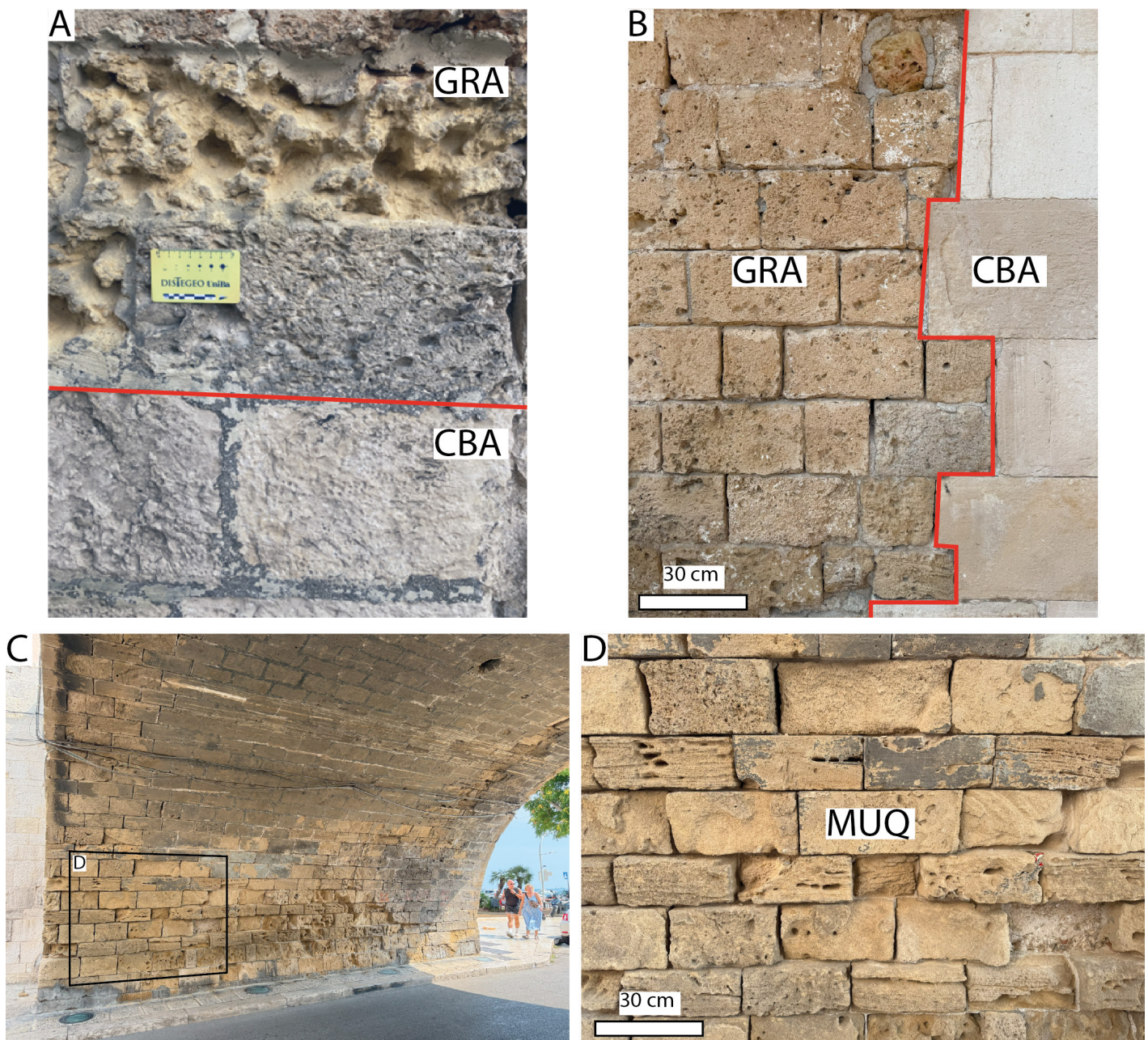


Fig. 5 - Building blocks in Bari Vecchia. A) Wall of Corte S. Triggiano. The red line marks the boundary between the underlying blocks made up of Cretaceous limestones (CBA) and the overlying ones made up of Lower Pleistocene calcarenites and calcirudites; B) Wall of the main entrance portal of the Swabian Castle. Blocks of Cretaceous limestone were used to build the entrance arch of the castle (CBA), blocks of Lower Pleistocene calcarenites were used to build the walls of the castle (GRA); C) Entrance arch to the Basilica of St. Nicholas from the seafront promenade (*Largo Papa Urbano II*); D) detail of the blocks made up of Upper Pleistocene calcarenites used to build the arch shown in C). Keys: *Calcarea di Bari* (CBA), *Calcarenite di Gravina* (GRA); San Pasquale synthem (MUQ).

Some of the non-local Apulian stones, particularly those extracted from the Apricena and Trani quarrying basins (Cotecchia et al., 1982; Laviano, 2006) were used as substitutes of more valuable Roman marbles, better described in the sections dedicated to each tour stop. Starting from the 5th century and throughout the Middle Age, the end of the Western Roman Empire and the Europe Christianisation led to the systematic abandonment, spoliation and demolition of pagan architectural complexes. The valuable lithic elements recovered from these sites were

repurposed in the construction of new buildings dedicated to Christian worship. Temples were converted into churches, columns were adapted as holy water fountains, and column shafts were reworked into tiles and disks (*rotae*) for mosaic pavements. The custom to reuse materials, precious or not, coming from other nearby buildings is very significant in Bari, because, as better explained in the following sections, a large part of ornamental stone visible in the crypt of the St. Nicholas's Basilica and in the Cathedral, belonged to earlier architectural contexts.



ITINERARY

Stop 1 - Piazza del Ferrarese

Piazza del Ferrarese (Fig. 6), named after a merchant from Ferrara (Stefano Fabri or Fabbro) who settled in Bari during the 17th century, constitutes a lively square that serves as both a cultural hub and a historical gateway to *Bari Vecchia* (Tateo, 1991). Situated between the harbour and the old town, Piazza del Ferrarese represents a stratified palimpsest in which Roman, medieval, modern and contemporary architectural and urban elements coexist. Its strategic location makes it a primary access point for visitors exploring *Bari Vecchia*, a district characterised by a dense network of narrow alleyways, charming stone houses, and notable monuments. The square is bordered by a variety of architectural styles, juxtaposing the medieval fortifications of the old town with the more modern facades of the Murat district.

The square faces the *Lungomare Augusto Imperatore* and the old harbour. The western perimeter is bounded by the contemporary *Sala Murat* exhibition space and the Vallisa church, while the eastern side incorporates the former Fish Market, built in 1840, together with the access ramp of Via Venezia. The square also features a fragment of the

medieval city walls, which attest to Bari's role as fortified outpost during periods of recurrent conflict and incursion (Fig. 6). One of the most notable features of *Piazza del Ferrarese* is the preserved segment of an ancient Roman road, the *Via Appia Traiana*, dated to the 2nd century CE. The exposed stone pavement, reminding the Bari's historical importance as a crossroad for commerce and culture in the Mediterranean region, is made up of large slabs of local limestones belonging to the *Calcare di Bari*. As described in the geological background section, the *Calcare di Bari* is a compact, well-stratified carbonate rock, whitish to light grey in colour, composed mainly of micritic, microfossil-bearing limestones with interbedded dolomitic. It is characterised by the frequent presence of macrofossils, particularly rudists. The *Calcare di Bari* constitutes a significant portion of the Apulian carbonate platform of the Murge Plateau. Owing to its hardness and wide availability, it has been extensively used as a building material in the city and in the near centres (Cotecchia et al., 1982 and reference therein). Close to Piazza del Ferrarese, there are Piazza Mercantile and the Fortino of St. Anthony. The Fortino was built by Prince Antonio del Balzo Orsini in 1440 on the site of an earlier 14th century castle that suffered several destructions, including damage during the riots of 1463. The fort houses a 12th century chapel dedicated to St. Anthony the Abbot, which is still visible in the basement. Access to the fort is provided



Fig. 6 - Piazza del Ferrarese. On the bottom, ruins of the *Via Appia Traiana*.



by a single hall and an underground room containing a small church. It was restored and fortified between 1501 and 1524 under Isabella of Aragon, who equipped it with underground stairways designed for escape. The arrival of Isabella and her daughter, Bona Sforza, constituted a significant event in the 16th century, marking, among other innovations, the introduction of printing technology in Apulia (Pepe, 1990; Tateo, 1991).

Stop 2 - Petruzzelli Theatre

The Petruzzelli Theatre (Fig. 7) is the largest theatre in Apulia and the fourth largest in Italy. It was built at the end of the 19th century by a family of local merchants, Onofrio and Antonio Petruzzelli, who envisioned creating a grand venue that would host opera, theatre, and musical performances. The construction began in 1898 and was completed in 1903, following the architectural design of Angelo Messeni, the Petruzzelli brothers' brother-in-law. The theatre officially opened its doors on February 14, 1903, with a performance of "Gli Ugonotti" by Giacomo Meyerbeer, marking the beginning of its role as a cultural beacon in Bari (Melchiorre, 1992; Mascellaro, 2016).

The Petruzzelli Theatre is an example of Italian eclectic architecture, blending neoclassical and Liberty (Italian Art Nouveau) styles. Its facade is distinguished by its vibrant red colour, ornate decorations, and large arched windows that enhance its elegant appearance. The facade also features Corinthian-style columns and sculptural elements in *Calcare di Bari* stone, including medallions depicting famous composers such as Verdi, Rossini, and Bellini, reflecting its dedication to the performing arts (Melchiorre, 1992).

The interior is equally magnificent, with a horseshoe-shaped auditorium that seats over 1,500 people. The auditorium is adorned with opulent gilded decorations, crystal chandeliers, and frescoed ceilings painted by Raffaele Armenise, depicting allegorical scenes of music, dance, and drama. The theatre's remarkable acoustics and rich decor have made it a premier venue for opera and other performances, attracting renowned artists from around the world.

In 1991, it suffered a devastating fire that destroyed much of the building, including its ornate interiors. The fire was a significant blow to Bari's cultural life, and the theatre remained closed for nearly two decades. However,



Fig. 7 - The facade of the Petruzzelli Theatre.



a dedicated effort to restore and rebuild the Petruzzelli began soon after, led by local authorities and supported by the community. The restoration aimed to recreate the theatre's original splendour while incorporating modern safety standards.

The theatre reopened on October 4, 2009, with a performance of Beethoven's Ninth Symphony, marking a triumphant return to its role as a cultural hub (Mascellaro, 2016). Today, the Petruzzelli Theatre is home to the "Fondazione Lirico Sinfonica Petruzzelli e Teatri di Bari", which manages its extensive calendar of opera, ballet, symphonic concerts, and theatrical productions. It continues to host both Italian and international artists, reaffirming its status as a leading cultural institution in southern Italy.

Stop 3 - The Lungomare (Promenade)

The promenade (Fig. 8) starts at the Bari harbour wall, made in *Calcare di Bari* stone, and reaches the famous city beach "Pane e Pomodoro", for a length of about 3 km. The semicircular square *Largo Luigi Giannella* separates *Lungomare Araldo di Crollalanza* from *Lungomare Nazario Sauro*. The northern section, *Lungomare Imperatore Augusto*, runs along the old city and lies between the Margherita Theatre and the port.

The history of the *Lungomare* dates back to the early 20th century, during a period of rapid urban expansion and modernisation in Bari. The construction of the promenade began in the 1920s as part of a broader plan to transform the city into a more modern and attractive destination. The project was initiated under the rule of Benito Mussolini, who sought to enhance the city's infrastructure and aesthetic appeal. Named after Mayor Araldo di Crollalanza, who started the project in 1926 and Nazario Sauro, an Italian naval hero and patriot of World War I, the promenade was officially inaugurated in 1932. The *Lungomare* is renowned for its elegant design, which reflects the rationalist architectural style prevalent during the Fascist era in Italy (Tateo, 1997).

Along the promenade, one can find a series of neoclassical buildings, including the *Palazzo della Provincia* and the former *Palazzo della Prefettura*, which stands out for its imposing facade and clock tower. These structures showcase the architectural aspirations of the early 20th century, aiming to convey a sense of power, order, and elegance.

The promenade is characterised by its wide, paved walkway lined with tall palm trees, 197 iconic iron lampposts, and benches, creating an inviting environment for leisurely strolls. Its balustrades are made of local limestone, which adds a sense of harmony with the surrounding historical buildings and the natural landscape.

Between the *Lungomare Araldo di Crollalanza* and the Margherita Theatre, the Molo San Nicola, also known to



Fig. 8 - Lungomare Araldo di Crollalanza and Nazario Sauro as seen from Molo San Nicola.

the people of Bari as "*N' dèrr'a la lanze*" (on land from the boat), was traditionally the place where fishermen sold (and still sell today) their freshly caught fish.

The *Lungomare* is more than just a seafront walkway; it is a symbol of Bari's evolution and identity, embodying the essence of Bari's lifestyle, where the sea and the community are deeply interconnected.

Stop 4 - Basilica of St. Nicholas

The Basilica of St. Nicholas is a key example of Apulian Romanesque architecture and a major reference for sacred buildings in the Land of Bari between the 12th and 13th centuries. Built on the site of the former Byzantine Catepan's court, the church extensively reused spolia from earlier structures, particularly Roman marble in columns and mosaics (Belli d'Elia, 1985).

The Basilica follows a Latin cross plan with three naves and a transept, while its slightly irregular layout reflects the incorporation of pre-existing foundations (Schettini, 1967). The facade, articulated by pilaster strips and flanked by asymmetrical towers, mirrors the internal tripartite division. Although characterised by the austerity of the Romanesque style, the building features refined sculptural decoration, especially on the portals and hexaforates. The main portal, with a porch supported by stylophore bulls, combines



Eastern and Western decorative traditions (Belli d'Elia, 2003). The lateral elevations are marked by deep blind arcades surmounted by hexaforates, whose misalignment indicates later construction phases aimed at addressing structural stresses (Belli d'Elia, 2003). The walls were built in sack masonry using carefully cut local limestone from the *Calcare di Bari*, laid with minimal mortar, in accordance with building practices typical of 11th-century Apulia (Belli d'Elia, 1990). On the facade, entirely built of local stone (*Calcare di Bari*), there are also reused columns made of

cipollino verde marble. It, also known as *marmor Carystium*, is an impure chlorite-bearing marble, characterised by a light green background crossed by veins with wavy or planar-parallel schistosity, in darker green or grey-blue tones. Imported to Rome from northern Euboea, it was used primarily for columns, as well as for wall and floor revetment slabs and sculptures (Lazzarini, 2004). The interior of the Basilica is marked by twelve marble columns and four pillars arranged according to an AABAA rhythm (Fig. 9a). The columns originate from the *spolia* of the Catepan court



Fig. 9 - The central nave of the Basilica of St. Nicholas (a), two *spolia* columns in *marmor troadense* (b), a particular of a column basement in *marmor numidicum* (c), the *ciborium* (d) and a particular of the columns in *greco scritto* (e) and *marmor triponticum* (f).



and are mainly made of *marmor troadensis/granito violetto* (Fig. 9b), with occasional inserts of reused ancient elements in *marmor numidicum/giallo antico* (Fig. 9c; Conte et al., 2015). The first lithotype is a quartz monzonite quarried during the proto-Byzantine period from several locations on the slopes of Mount Çığır Dağ (Turkey). Owing to its exceptional hardness and durability, it was widely used for columns (Lazzarini, 2004). The second lithotype, is a micritic limestone rich in limonite-hematite, often brecciated, and characterised by a background displaying various shades of yellow and pink. It was quarried in antiquity from the Chemtou quarries in Tunisia (Lazzarini, 2004).

The three naves terminate in a triapsidal transept. In the presbyterial area beneath the *ciborium* columns of *greco scritto* (Fig. 9e) and *marmor triponticum/occhio di pavone* (Fig. 9f) frame the altar, behind which stand the Chair of Abbot Elias and the Renaissance funerary monument of Queen Bona Sforza (Belli d'Elia, 1990). These two marbles are also reused materials and as previously noted, come from the ruins of the Catapan's court. The so-called *greco scritto* marble is a graphite-bearing marble characterised by a white background with medium-sized calcite crystals and thin and short grey-blue veins. Its main quarrying area was located near ancient Annaba, in present-day Algeria. *Marmor Triponticum* belongs to the group of rudist-bearing *lumachelle* limestones. It is characterised by a beige, red, or pink background with white macrofossils. The source quarries were located in the present-day İzmit province, Turkey. Owing to its distinctive macroscopic appearance, high durability, and favorable physical-mechanical properties, both lithotypes were widely employed starting from the Roman Period for architectural elements such as columns, capitals, and floor and wall slabs (Lazzarini, 2004).

Below, the mosaic floor (Fig. 9e) displays a Byzantine-Muslim decoration with kufic characters and geometric patterns, including five decorative *rotae* composed of ancient Roman marbles, such as *serpentine/lapis lacedaemonius*, *porfido rosso antico/lapis porphyrites*, *portasanta/marmor chium*, and *rosso antico/marmor taenarium*. *Serpentino verde* is a diabase-andesite characterised by a dark green matrix with light green to yellow plagioclase phenocrysts and more rarely by sparse black pyroxenes. Cropping out in very limited thicknesses in the Peloponnese (Greece), it was mainly used for small-sized objects. *Porfido rosso* is a dacite-andesite with a red ground due to the presence of hematite and manganese compounds, containing small white or pink plagioclase phenocrysts and black amphiboles. The quarries were located in the Eastern Desert of Egypt (Gebel Dokhan) and, because of its high symbolic value related to its hardness, durability and excellent physical-mechanical properties, this stone was primarily employed for imperial statues, sarcophagi and architectural elements. *Portasanta*

marble is a tectonic breccia quarried on the Greek island of Chios. It is extremely variable in colour and appearance and is characterised by high durability. *Rosso antico* is an impure hematite-bearing marble with a dark to vivid red background, sometimes marked by very thin veins and black or white spots. Although already used in Greece in earlier periods, it was imported by the Romans from several localities of the Mani Peninsula (Greece) starting from the 1st century BC (Lazzarini, 2004). Alongside the most ancient and valuable Roman marbles, in the presbyterial mosaic imitative stones including the Italian *Rosso Levanto*, *verde Alpi*, *Portoro*, and *Rosso Veronese* are also recognised (Fioretti et al., 2020). *Rosso Levanto* is an opicalcitic breccia that is still quarried today in several localities within the province of La Spezia. The term *Verde Alpi* is a generic designation for green opicalcites extracted since the Late Roman period from various sites in the Piedmontese Alps and the Aosta Valley, often as substitutes for the more prestigious and well-known Greek *Verde Antico*. *Rosso Veronese* is a reddish-brown nodular biomicritic limestone belonging to the Rosso Ammonitico Veronese, quarried in the area of the Lessini Mountains and the Asiago Plateau (Lazzarini, 2012).

Above the side aisles rises the *matroneum*, overlooking the *presbyterium* and the central nave through large triple-mullioned windows.

The original wooden truss roof of the central nave was replaced in 1661 by a gilded wooden ceiling executed by Carlo Rosa and his workshop as an ex-voto for the end of the plague epidemic, reflecting a distinctly Baroque aesthetic (Belli D'Elia, 1985). Underneath the Basilica of St. Nicholas lies a crypt (Fig. 10a), the beating heart of both Catholic and Orthodox worship, as it contains the relics of the Saint of Myra. The crypt preserves columns in imperial marbles of great symbolic and artistic value, among which are *marmor chium/portasanta* (Fig. 10c), *marmor triponticum/occhio di pavone*, *marmor carystium/cipollino*, and not yet discussed in the previous paragraphs, *marmor luculleum/africano* (Fig. 10b), *marmor hymettium* (Fig. 10d), and *marmor chalcidicum/fior di pesco*, coming from the court of the Catapan (Conte et al. 2015).

Marmor luculleum is a slightly metamorphosed tectonic breccia with a dark cement (black to grey-green) and white clasts, valued for its high mechanical strength and decorative appearance; it was widely used for columns and architectural elements and quarried at Siğacık (Turkey). *Marmor Hymettium*, extracted near Mount Hymettus (Attica, Greece), is a coarse-grained, crystalline, and heterogeneous marble, recognizable by a characteristic sulfurous odor due to minor H₂S content. *Marmor chalcidicum* is a fine-grained cataclastic limestone with a compact texture and a white background mottled with pink and red, quarried in the Chalcis area (Greece) (Lazzarini, 2004).



Fig. 10 - The crypt of the Basilica of St. Nicholas (a) and details of *spolia* columns in *marmor luculleum* (b), *marmor chium* (c) and *marmor hymettium* (d).

These are harmoniously integrated with replacement columns made of the local limestone *Filetto rosso* from the Apricena district. It is a compact micritic limestone, a variety of Apricena stone, characterised by thin red to reddish-brown veins caused by iron oxides along microfractures and diagenetic discontinuities, quarried in the Apricena area (southern Italy) and widely used as

an ornamental building stone (AA. VV., 1982). The crypt also houses the miraculous column of St. Nicholas, now enclosed within a protective metal cage (Fig. 11A), made of rudist-bearing limestones (*marmor triponticum/occhio di pavone*).

In the crypt, also noteworthy are the floor mosaics, one in correspondence to the Catepan tower (Figs. 12a, 12b, 12c)



Fig. 11 - A) The miraculous column of St. Nicholas enclosed within a protective metal cage; B) detail of the column referable to the ancient *marmor triponticum/occhio di pavone*, composed of rudist-bearing limestone (rudist floatstone) with a red micritic matrix. Note the distinct chromatic contrast between the white to grey rudist shells and the red matrix, the latter coloured by pigmentary hematite precipitated during early diagenetic stages prior to burial.



Fig. 12 - Floor mosaics of the Basilica of St. Nicholas: mosaic in correspondence to the Catepan tower (a), showing little *rotae* in *marmor celticum* (b) and inserts in *lapis lacedemonius*, *lapis porphyrites* and *lapis ophytes* (c), and in correspondence to the tomb of the Saint (d).

and the other under the tomb of St. Nicholas (Fig. 12d) also made using the materials of the court of the Catepan. Both show a perfect chromatic harmony of tesserae in Roman marbles, among which *lapis porphyrites/porfido rosso antico*, *lapis lacedemonius/serpentino*, *marmor numidicum/giallo antico*, *marmor celticum/bianco e nero antico* and *lapis ophytes/granito verde della sedia*, and stones added during the various restorations, among which are *verde Alpi* and *rosso Levanto* (Fioretti et al., 2020).

The present appearance of the Basilica and the Nicolaiian citadel results from early 20th-century restorations.

Beneath the fifth southern arch, a late 13th-century limestone sarcophagus of Sparano da Bari (Chyurlia family) is preserved, decorated with an Agnus Dei between the family coats of arms (Minieri Riccio, 1872; Belli D'Elia, 1985).

Stop 5 - Cathedral of Saint Sabinus

The cathedral is dedicated to Saint Sabinus, a 6th century bishop of Canosa di Puglia venerated as a protector of the city, whose relics were transferred to Bari in 844 CE and housed in the crypt of the cathedral.



The present building was rebuilt from the late 12th century under Bishop Rainaldo on the ruins of a Byzantine Cathedral, itself constructed over a Roman structure and partially destroyed in 1156 by William I known as “Il Malo” (Lucatuorto, 1971).

Built largely using *spolia* from earlier buildings, the cathedral underwent significant Baroque renovations in the 18th century under Bishop Gaeta, designed by the architect Vaccaro, and extensive restorations in the early 20th century following the removal of Baroque additions, which led to the recovery of medieval fresco fragments (Orabona Gazzara, 1943; Pellegrino, 1996).

Originally conceived with a central plan and a large dome typical of the Eastern Christian architecture, the cathedral functioned as a major religious centre during the Byzantine period. Following the Norman conquest, it was reconstructed in Romanesque style in the 11th century, clearly influenced by of the S. Nicholas’ Basilica (Milano, 1982).

The salient facade (Fig. 13a) is divided into three sections by pilasters mirroring the internal naves and crowned by blind arches on figured brackets. Two decorative friezes with Byzantine motifs and rosette frame a large central rose window with partially restored Gothic figures (Fonseca, 2005).

The three Baroque portals are the only surviving elements of the 18th-century modifications, incorporating the original 11th-century structures.

The left side of the cathedral is marked by deep blind arches beneath the hexaforates and includes a side portal retaining earlier decorations, while the cylindrical Trulla, originally a baptistery and later a 17th-century sacristy, marks its termination. The transept head features pairs of blind arches, two levels of mullioned windows, adjoining a bell tower rising to 68.90 meters, with orders of mullioned and lancet windows and a restored spire (Pellegrino, 1996).

The rear facade includes a decorated 12th-century window with vegetal and animal motifs, while the octagonal *tiburio* of the dome displays Oriental-inspired decoration articulated by pilasters, blind arches and a vegetal frieze. The interior of the Cathedral of Bari (Fig. 13b) features three naves separated by marble columns (Figs. 13c, 13d) above which there is a false *matroneum* with large triforas.

The presbytery includes a 20th-century restored *ciborium* in local *Serpeggiante* limestone, probably from Trani, and three semicircular apses (Milano, 1982). *Serpeggiante* is a decorative variety of the Trani Limestone, belonging to the *Calcare di Bari* (Lower Cretaceous), characterised by a light grey to beige micritic carbonate matrix crossed by irregular, sinuous darker veins, quarried in the Trani area

(Italy) and widely used as an ornamental and architectural stone (AA. VV., 1982). The left apse preserves a 13th–14th-century fresco of Saint John the Baptist with four saints and the kneeling donor Archbishop Romualdo Grisone, with Latin-inscribed palimpsests below referring to Grisone and Archbishop Landolfo.

The floor of the central nave (Fig. 14a) contains ancient marbles, among which *marmor triponticum/occhio di pavone* (Fig. 14b), *marmor iassense/cipollino rosso* (Figs. 14c and 14d), *marmor caristyum/cipollino verde*, *marmor sagarium/breccia corallina*, *marmor phrygium/pavonazzetto*, and replacement marbles (i.e., several breccias, *verde Alpi*, *rosso veronese*) including a rose that mirrors the facade’s rose window. Among the reused marbles not yet discussed *marmor caristyum* is a hematite-bearing marble, originates from Turkey in the present-day Muğla Province, is characterised by a dark red background with wavy veins and bands of white and grey colour; *marmor sagarium* is a monogenic calcareous breccia displaying several chromatic varieties, with a coral-pink to brown cement and ivory to pinkish clasts of centimetric to decimetric size; its ancient quarries were located near present-day Bilecik (Turkey); *marmor phrygium*, whose imperial quarries were situated near modern İscehisar (Turkey), is a fine-grained marble, sometimes brecciated, characterised by a white to ivory background with red-violet or green-bluish patches (Lazzarini, 2004). During the summer solstice (21st of June), a unique alignment occurs where the sun’s rays perfectly match the floor mosaic’s design with the rose window above, a phenomenon likely observed for nearly a thousand years.

An underground area, open since 2009, presents archaeological remains spanning four phases from the Roman to the contemporary period, including a Roman road, mosaic pavements, funerary spaces, and Byzantine churches with fresco fragments (Bertelli, 1981; Belli d’Elia, 2003).

Stop 6 - Norman-Swabian Castle

The Castle of Bari (Fig. 15A, B, and C), also known as the *Castello Normanno-Svevo*, is located on the edge of the historic old town (Bari Vecchia) and represents the results of centuries of political, military, and architectural transformations, playing a key role in the defence and governance of the region.

Originally wanted by the Norman king Roger II of Sicily in the 12th century, it was primarily constructed using ashlar blocks of calcarenite belonging to the *Calcarenita di Gravina* (Lower Pleistocene), even if the arch of the main entrance and other scattered elements are made of Cretaceous limestone blocks from the *Calcare di Bari*



Fig. 13 - The facade of the cathedral di Bari (a), the central nave (b) and two details of spolia columns in *marmor chalcidium* (c) and *greco scritto* (d).



Fig. 14 - The flower mosaic in the central nave of the Cathedral of Bari (a) with details of spolia inserts in *marmor triponticum* (a) and *marmor iassense* (c, d).

(Figs. 5B; 15D). It was partially destroyed during a local revolt in 1156 and rebuilt in 1233 by the Holy Roman Emperor Frederick II, who promoted the build of imposing square towers, deep moats, and sturdy walls and whose modifications gave the castle much of its current form, blending Norman, Swabian, and later Aragonese architectural styles (Licinio, 1994).

The castle is characterised by massive medieval walls, a central courtyard, and a Gothic portal from the reign of Frederick II, later enriched with Renaissance elements during its 16th-century transformation into a princely residence under Aragonese rule (Tateo, 1990).

After its use as military fortress, royal residence and prison, in the 16th century, under the rule of Isabella of Aragon and her daughter Bona Sforza, the castle became a courtly palace and was significantly renovated to include more comfortable living quarters and refined architectural details (Pepe, 1990).

Today, the Castle of Bari is a major cultural landmark, thanks to various exhibitions and events held into its grand halls and picturesque inner courtyard. It houses the Gipsoteca, a collection of plaster copies of important sculpture and carvings.

Stop 7 - Arco Alto and Arco Basso

The *Arco Alto* (High Arch) (Fig. 16A) and *Arco Basso* (Low Arch) (Fig. 16B) are two gateways separated by a house, located opposite the entrance to the Swabian Castle. The High Arch is characterised by a simple barrel vault adorned with votive shrines dedicated to Our Lady of Sorrows and St. Nicholas.

The *Arco Basso*, dated to the Angevin age (13th-14th centuries), consists of two quadrangular bays covered with cross vaults. It also has two overlooks surmounted by two levels used as dwellings. Both arches are made up of Lower Pleistocene calcarenite block belonging to the *Calcarenite di Gravina*.

The *Arco Alto*, once called of the Arch of the *zoccolari* (shoe sellers), provides access to one of the most famous streets in Bari Vecchia, also known as the *strada delle orecchiette*. Here, on the doorsteps of ground-floor houses, the women of Bari Vecchia work with their skilled hands and heads to produce *orecchiette* (small ears), a typical pasta shaped like an ear that has become one of Bari's gastronomic symbols. There are two main hypotheses on the origin of *orecchiette*: the first attributes the invention to the Provençals, who produced a thick pasta similar to discs



Fig. 15 - A) View of the Norman-Swabian Castel from the Torre dei Minorenni; B) view of the bastioned defensive wall of the castle from Federico II di Svevia Square; C) view of the arches of the entrance bridge crossing the castle moat; D) Entrance portal to the castle, which also serves as the entrance to the museum. Note that even if the castle was built using Lower Pleistocene calcarenite blocks, some architectural element, such as the portal to the castle, are made up of Cretaceous limestone blocks (see also Fig. 5B).

hollowed in the centre, which was later spread in Apulia by the Angevins. The second hypothesis traces its origins to the Norman-Swabian period, when a Jewish community prepared the so-called Haman's ears, or sweet concave pastries similar in shape to the Bari's *orecchiette*. The *Arco Alto* and *Arco Basso* are part of the more than 50 arches of Bari Vecchia, which since the Middle Ages have served as picturesque passageways through for the dense maze of narrow streets in the old town.

CONCLUSION

In conclusion, the presented tour provides a comprehensive framework for understanding the long-term dynamics that governed the selection, circulation, and reuse of stone materials within the studied architectural context. The predominant use of local and regional carbonate lithotypes, such as *Calcare di Bari* and *Calcarenite di Gravina*, reflects aspects connected to geological



Fig. 16 - A) Arco Alto; B) Arco Basso.

availability, ease of extraction, workability, and long-term durability. These materials, widely accessible within the Apulian carbonate platform, formed the structural and visual backbone of the architectural complex and rooted the monument firmly within its local geological landscape. At the same time, the systematic presence of reused (Roman period marbles) and extra-regional stone attests to the persistence of cultural preferences, symbolic values, and technical knowledge inherited from earlier architectural traditions. The selective reuse of specific lithotypes, particularly those characterised by distinctive colours, textures, and mechanical properties, suggests a conscious interplay between aesthetic intentions and functional requirements, contributing to both the structural articulation and the decorative emphasis of the built space.

From a diachronic perspective, the architectural assemblage emerges as the material outcome of a stratified dialogue between local geological resources and supra-regional cultural influences, in which Apulian carbonate stones and ancient marbles were continuously recontextualised and assigned new meanings. This interplay underscores how the exploitation, circulation, and reuse of stone materials not only shaped the physical fabric of the monument, but also reflect broader socio-economic dynamics, technological continuity, and evolving symbolic frameworks across centuries.

ACKNOWLEDGEMENTS

Claudia Catacchio is kindly acknowledged for her help in the preparation of the text.

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Manuscript received 23 September 2025; accepted 13 March 2026; published online 22 April 2026; editorial responsibility and handling by S. Zanchetta.