

# The Extraction and Use of Limestone in Istria in Antiquity

---

**Buršić-Matijašić, Klara; Matijašić, Robert**

*Source / Izvornik:* **ASMOSIA XI, Interdisciplinary Studies on Ancient Stone, Proceedings of the XI International Conference of ASMOSIA, 2018, 925 - 931**

**Conference paper / Rad u zborniku**

*Publication status / Verzija rada:* **Published version / Objavljena verzija rada (izdavačev PDF)**

<https://doi.org/10.31534/XI.asmosia.2015/08.11>

*Permanent link / Trajna poveznica:* <https://um.nsk.hr/um:nbn:hr:123:681705>

*Rights / Prava:* [In copyright](#)/[Zaštićeno autorskim pravom.](#)

*Download date / Datum preuzimanja:* **2025-01-18**



*Repository / Repozitorij:*

[FCEAG Repository - Repository of the Faculty of Civil Engineering, Architecture and Geodesy, University of Split](#)



UNIVERSITY OF SPLIT

dabar

DIGITALNI AKADEMSKI ARHIVI I REPOZITORIJI



# ASMOSIA XI

Interdisciplinary Studies on Ancient Stone

## PROCEEDINGS

of the XI ASMOSIA Conference, Split 2015

Edited by Daniela Matetić Poljak and Katja Marasović



Interdisciplinary Studies on Ancient Stone  
Proceedings of the XI ASMOSIA Conference (Split 2015)

Publishers:

ARTS ACADEMY IN SPLIT  
UNIVERSITY OF SPLIT

and

UNIVERSITY OF SPLIT  
FACULTY OF CIVIL ENGINEERING,  
ARCHITECTURE AND GEODESY

Technical editor:  
Kate Bošković

English language editor:  
Graham McMaster

Computer pre-press:  
Nikola Križanac

Cover design:  
Mladen Čulić

Cover page:

*Sigma shaped mensa of pavonazzetto marble from Diocletian's palace in Split*

ISBN 978-953-6617-49-4 (Arts Academy in Split)

ISBN 978-953-6116-75-1 (Faculty of Civil Engineering, Architecture and Geodesy)

e-ISBN 978-953-6617-51-7 (Arts Academy in Split)

e-ISBN 978-953-6116-79-9 (Faculty of Civil Engineering, Architecture and Geodesy)

CIP available at the digital catalogue of the University Library in Split, no 170529005

Association for the Study of Marble & Other Stones in Antiquity

# ASMOSIA XI

Interdisciplinary Studies of Ancient Stone

Proceedings of the Eleventh International Conference of ASMOSIA,  
Split, 18–22 May 2015

Edited by  
Daniela Matetić Poljak  
Katja Marasović



Split, 2018

**Nota bene**

All papers are subjected to an international review.

The quality of the images relies on the quality of the originals provided by the authors.

# CONTENT

<b>PRESENTATION</b> .....	15
<b>NECROLOGY: NORMAN HERZ (1923-2013) by Susan Kane</b> .....	17
<b>1. APPLICATIONS TO SPECIFIC ARCHEOLOGICAL QUESTIONS – USE OF MARBLE</b>	
Hermaphrodites and Sleeping or Reclining Maenads: Production Centres and Quarry Marks <i>Patrizio Pensabene</i> .....	25
First Remarks about the Pavement of the Newly Discovered Mithraeum of the Colored Marbles at Ostia and New Investigations on Roman and Late Roman White and Colored Marbles from Insula IV, IX <i>Massimiliano David, Stefano Succi and Marcello Turci</i> .....	33
Alabaster. Quarrying and Trade in the Roman World: Evidence from Pompeii and Herculaneum <i>Simon J. Barker and Simona Perna</i> .....	45
Recent Work on the Stone at the Villa Arianna and the Villa San Marco (Castellammare di Stabia) and Their Context within the Vesuvian Area <i>Simon J. Barker and J. Clayton Fant</i> .....	65
Marble Wall Decorations from the Imperial Mausoleum (4 <sup>th</sup> C.) and the Basilica of San Lorenzo (5 <sup>th</sup> C.) in Milan: an Update on Colored Marbles in Late Antique Milan <i>Elisabetta Neri, Roberto Bugini and Silvia Gazzoli</i> .....	79
Sarcophagus Lids Sawn from their Chests <i>Dorothy H. Abramitis and John J. Herrmann</i> .....	89
The Re-Use of Monolithic Columns in the Invention and Persistence of Roman Architecture <i>Peter D. De Staebler</i> .....	95
The Trade in Small-Size Statues in the Roman Mediterranean: a Case Study from Alexandria <i>Patrizio Pensabene and Eleonora Gasparini</i> .....	101
The Marble Dedication of Komon, Son of Asklepiades, from Egypt: Material, Provenance, and Reinforcement of Meaning <i>Patricia A. Butz</i> .....	109
Multiple Reuse of Imported Marble Pedestals at Caesarea Maritima in Israel <i>Barbara Burrell</i> .....	117
Iasos and Iasian Marble between the Late Antique and Early Byzantine Eras <i>Diego Peirano</i> .....	123

Thassos, Known Inscriptions with New Data <i>Tony Kozelj and Manuela Wurch-Kozelj</i> .....	131
The Value of Marble in Roman <i>Hispalis</i> : Contextual, Typological and Lithological Analysis of an Assemblage of Large Architectural Elements Recovered at N° 17 Goyeneta Street (Seville, Spain) <i>Ruth Taylor, Oliva Rodríguez, Esther Ontiveros, María Luisa Loza, José Beltrán and Araceli Rodríguez</i> .....	143
<i>Giallo Antico</i> in Context. Distribution, Use and Commercial Actors According to New Stratigraphic Data from the Western Mediterranean (2 <sup>nd</sup> C. Bc – Late 1 <sup>st</sup> C. Ad) <i>Stefan Ardeleanu</i> .....	155
<i>Amethystus</i> : Ancient Properties and Iconographic Selection <i>Luigi Pedroni</i> .....	167
<b>2. PROVENANCE IDENTIFICATION I: (MARBLE)</b>	
Unraveling the Carrara – Göktepe Entanglement <i>Walter Prochaska, Donato Attanasio and Matthias Bruno</i> .....	175
The Marble of Roman Imperial Portraits <i>Donato Attanasio, Matthias Bruno, Walter Prochaska and Ali Bahadır Yavuz</i> .....	185
Tracing Alabaster (Gypsum or Anhydrite) Artwork Using Trace Element Analysis and a Multi-Isotope Approach (Sr, S, O) <i>Lise Leroux, Wolfram Kloppmann, Philippe Bromblet, Catherine Guerrot, Anthony H. Cooper, Pierre-Yves Le Pogam, Dominique Vingtain and Noel Worley</i> .....	195
Roman Monolithic Fountains and Thasian Marble <i>Annewies van den Hoek, Donato Attanasio and John J. Herrmann</i> .....	207
Archaeometric Analysis of the Alabaster Thresholds of Villa A, Oplontis (Torre Annunziata, Italy) and New Sr and Pb Isotopic Data for <i>Alabastro Ghiaccione del Circeo</i> <i>Simon J. Barker, Simona Perna, J. Clayton Fant, Lorenzo Lazzarini and Igor M. Villa</i> .....	215
Roman Villas of Lake Garda and the Occurrence of Coloured Marbles in the Western Part of “Regio X Venetia et Histria” (Northern Italy) <i>Roberto Bugini, Luisa Folli and Elisabetta Roffia</i> .....	231
Calcitic Marble from Thasos in the North Adriatic Basin: Ravenna, Aquileia, and Milan <i>John J. Herrmann, Robert H. Tykot and Annewies van den Hoek</i> .....	239
Characterisation of White Marble Objects from the Temple of Apollo and the House of Augustus (Palatine Hill, Rome) <i>Francesca Giustini, Mauro Brilli, Enrico Gallochio and Patrizio Pensabene</i> .....	247
Study and Archeometric Analysis of the Marble Elements Found in the Roman Theater at Aeclanum (Mirabella Eclano, Avellino - Italy) <i>Antonio Mesisca, Lorenzo Lazzarini, Stefano Cancelliere and Monica Salvadori</i> .....	255



Two Imperial Monuments in Puteoli: Use of Proconnesian Marble in the Domitianic and Trajanic Periods in Campania <i>Irene Bald Romano, Hans Rupprecht Goette, Donato Attanasio and Walter Prochaska</i> .....	267
Coloured Marbles in the Neapolitan Pavements (16 <sup>th</sup> And 17 <sup>th</sup> Centuries): the Church of <i>Santi Severino e Sossio</i> <i>Roberto Bugini, Luisa Folli and Martino Solito</i> .....	275
Roman and Early Byzantine Sarcophagi of Calcitic Marble from Thasos in Italy: Ostia and Siracusa <i>Donato Attanasio, John J. Herrmann, Robert H. Tykot and Annewies van den Hoek</i> .....	281
Revisiting the Origin and Destination of the Late Antique Marzamemi 'Church Wreck' Cargo <i>Justin Leidwanger, Scott H. Pike and Andrew Donnelly</i> .....	291
The Marbles of the Sculptures of Felix Romuliana in Serbia <i>Walter Prochaska and Maja Živić</i> .....	301
Calcitic Marble from Thasos and Proconnesos in Nea Anchialos (Thessaly) and Thessaloniki (Macedonia) <i>Vincent Barbin, John J. Herrmann, Aristotle Mentzos and Annewies van den Hoek</i> .....	311
Architectural Decoration of the Imperial Agora's Porticoes at Iasos <i>Fulvia Bianchi, Donato Attanasio and Walter Prochaska</i> .....	321
The Winged Victory of Samothrace - New Data on the Different Marbles Used for the Monument from the Sanctuary of the Great Gods <i>Annie Blanc, Philippe Blanc and Ludovic Laugier</i> .....	331
Polychrome Marbles from the Theatre of the Sanctuary of Apollo Pythios in Gortyna (Crete) <i>Jacopo Bonetto, Nicolò Mareso and Michele Bueno</i> .....	337
Paul the Silentary, Hagia Sophia, Onyx, Lydia, and Breccia Corallina <i>John J. Herrmann and Annewies van den Hoek</i> .....	345
Incrustations from Colonia Ulpia Traiana (Near Modern Xanten, Germany) <i>Vilma Ruppinić and Ulrich Schüssler</i> .....	351
Stone Objects from Vindobona (Austria) – Petrological Characterization and Provenance of Local Stone in a Historico-Economical Setting <i>Andreas Rohatsch, Michaela Kronberger, Sophie Insulander, Martin Mosser and Barbara Hodits</i> .....	363
Marbles Discovered on the Site of the Forum of Vaison-la-Romaine (Vaucluse, France): Preliminary Results <i>Elsa Roux, Jean-Marc Mignon, Philippe Blanc and Annie Blanc</i> .....	373
Updated Characterisation of White Saint-Béat Marble. Discrimination Parameters from Classical Marbles <i>Hernando Royo Plumed, Pilar Lapeunte, José Antonio Cuchí, Mauro Brillì and Marie-Claire Savin</i> .....	379

Grey and Greyish Banded Marbles from the Estremoz Anticline in Lusitania <i>Pilar Lapuente, Trinidad Nogales-Basarrate, Hernando Royo Plumed, Mauro Brilli and Marie-Claire Savin</i> .....	391
New Data on Spanish Marbles: the Case of <i>Gallaecia</i> (NW Spain) <i>Anna Gutiérrez García-M., Hernando Royo Plumed and Silvia González Soutelo</i> .....	401
A New Roman Imperial Relief Said to Be from Southern Spain: Problems of Style, Iconography, and Marble Type in Determining Provenance <i>John Pollini, Pilar Lapuente, Trinidad Nogales-Basarrate and Jerry Podany</i> .....	413
Reuse of the <i>Marmora</i> from the Late Roman Palatial Building at Carranque (Toledo, Spain) in the Visigothic Necropolis <i>Virginia García-Entero, Anna Gutiérrez García-M. and Sergio Vidal Álvarez</i> .....	427
Imperial Porphyry in Roman Britain <i>David F. Williams</i> .....	435
Recycling of Marble: Apollonia/Sozousa/Arsuf (Israel) as a Case Study <i>Moshe Fischer, Dimitris Tambakopoulos and Yannis Maniatis</i> .....	443
Thasian Connections Overseas: Sculpture in the Cyrene Museum (Libya) Made of Dolomitic Marble from Thasos <i>John J. Herrmann and Donato Attanasio</i> .....	457
Marble on Rome's Southwestern Frontier: Thamugadi and Lambaesis <i>Robert H. Tykot, Ouahiba Bouzidi, John J. Herrmann and Annewies van den Hoek</i> .....	467
Marble and Sculpture at Lepcis Magna (Tripolitania, Libya): a Preliminary Study Concerning Origin and Workshops <i>Luisa Musso, Laura Buccino, Matthias Bruno, Donato Attanasio and Walter Prochaska</i> .....	481
The Pentelic Marble in the Carnegie Museum of Art Hall of Sculpture, Pittsburgh, Pennsylvania <i>Albert D. Kollar</i> .....	491
Analysis of Classical Marble Sculptures in the Michael C. Carlos Museum, Emory University, Atlanta <i>Robert H. Tykot, John J. Herrmann, Renée Stein, Jasper Gaunt, Susan Blevins and Anne R. Skinner</i> .....	501
<b>3. PROVENANCE IDENTIFICATION II: (OTHER STONES)</b>	
Aphrodisias and the Regional Marble Trade. The <i>Scaenae Frons</i> of the Theatre at Nysa <i>Natalia Toma</i> .....	513
The Stones of Felix Romuliana (Gamzigrad, Serbia) <i>Bojan Djurić, Divna Jovanović, Stefan Pop Lazić and Walter Prochaska</i> .....	523
Aspects of Characterisation of Stone Monuments from Southern Pannonia <i>Branka Migotti</i> .....	537

The Budakalász Travertine Production <i>Bojan Djurić, Sándor Kele and Igor Rižnar</i> .....	545
Stone Monuments from Carnuntum and Surrounding Areas (Austria) – Petrological Characterization and Quarry Location in a Historical Context <i>Gabrielle Kremer, Isabella Kitz, Beatrix Moshhammer, Maria Heinrich and Erich Draganits</i> .....	557
Espejón Limestone and Conglomerate (Soria, Spain): Archaeometric Characterization, Quarrying and Use in Roman Times <i>Virginia García-Entero, Anna Gutiérrez García-M, Sergio Vidal Álvarez, María J. Peréx Agorreta and Eva Zarco Martínez</i> .....	567
The Use of Alcover Stone in Roman Times ( <i>Tarraco, Hispania Citerior</i> ). Contributions to the <i>Officina Lapidaria Tarraconensis</i> <i>Diana Gorostidi Pi, Jordi López Vilar and Anna Gutiérrez García-M.</i> .....	577
<b>4. ADVANCES IN PROVENANCE TECHNIQUES, METHODOLOGIES AND DATABASES</b>	
Grainautline – a Supervised Grain Boundary Extraction Tool Supported by Image Processing and Pattern Recognition <i>Kristóf Csorba, Lilla Barancsuk, Balázs Székely and Judit Zöldföldi</i> .....	587
A Database and GIS Project about Quarrying, Circulation and Use of Stone During the Roman Age in <i>Regio X - Venetia et Histria</i> . The Case Study of the Euganean Trachyte <i>Caterine Previato and Arturo Zara</i> .....	597
<b>5. QUARRIES AND GEOLOGY</b>	
The Distribution of Troad Granite Columns as Evidence for Reconstructing the Management of Their Production <i>Patrizio Pensabene, Javier Á. Domingo and Isabel Rodà</i> .....	613
Ancient Quarries and Stonemasonry in Northern Choria Considiana <i>Hale Güney</i> .....	621
Polychromy in Larisaeon Quarries and its Relation to Architectural Conception <i>Gizem Mater and Ertunç Denктаş</i> .....	633
Euromos of Caria: the Origin of an Hitherto Unknown Grey Veined Stepped Marble of Roman Antiquity <i>Matthias Bruno, Donato Attanasio, Walter Prochaska and Ali Bahadır Yavuz</i> .....	639
Unknown Painted Quarry Inscriptions from Bacakale at <i>Docimium</i> (Turkey) <i>Matthias Bruno</i> .....	651
The Green Schist Marble Stone of Jebel El Hairech (North West of Tunisia): a Multi-Analytical Approach and its Uses in Antiquity <i>Ameur Younès, Mohamed Gaied and Wissem Gallala</i> .....	659
Building Materials and the Ancient Quarries at <i>Thamugadi</i> (East of Algeria), Case Study: Sandstone and Limestone <i>Younès Rezkallah and Ramdane Marmi</i> .....	673

The Local Quarries of the Ancient Roman City of <i>Valeria</i> (Cuenca, Spain) <i>Javier Atienza Fuente</i> .....	683
The Stone and Ancient Quarries of Montjuïc Mountain (Barcelona, Spain) <i>Aureli Álvarez</i> .....	693
<i>Notae Lapidinarum</i> : Preliminary Considerations about the Quarry Marks from the Provincial Forum of <i>Tarraco</i> <i>Maria Serena Vinci</i> .....	699
The Different Steps of the Rough-Hewing on a Monumental Sculpture at the Greek Archaic Period: the Unfinished Kouros of Thasos <i>Danièle Braunstein</i> .....	711
A Review of Copying Techniques in Greco-Roman Sculpture <i>Séverine Moureaud</i> .....	717
Labour Forces at Imperial Quarries <i>Ben Russell</i> .....	733
Social Position of Craftsmen inside the Stone and Marble Processing Trades in the Light of Diocletian's Edict on Prices <i>Krešimir Bosnić and Branko Matulić</i> .....	741
<b>6. STONE PROPERTIES, WEATHERING EFFECTS AND RESTORATION, AS RELATED TO DIAGNOSIS PROBLEMS, MATCHING OF STONE FRAGMENTS AND AUTHENTICITY</b>	
Methods of Consolidation and Protection of Pentelic Marble <i>Maria Apostolopoulou, Elissavet Drakopoulou, Maria Karoglou and Asterios Bakolas</i> .....	749
<b>7. PIGMENTS AND PAINTINGS ON MARBLE</b>	
Painting and Sculpture Conservation in Two Gallo-Roman Temples in Picardy (France): Champlieu and Pont-Sainte-Maxence <i>Véronique Brunet-Gaston and Christophe Gaston</i> .....	763
The Use of Colour on Roman Marble Sarcophagi <i>Eliana Siotto</i> .....	773
New Evidence for Ancient Gilding and Historic Restorations on a Portrait of Antinous in the San Antonio Museum of Art <i>Jessica Powers, Mark Abbe, Michelle Bushey and Scott H. Pike</i> .....	783
Schists and Pigments from Ancient Swat (Khyber Pukhtunkhwa, Pakistan) <i>Francesco Mariottini, Gianluca Vignaroli, Maurizio Mariottini and Mauro Roma</i> .....	793
<b>8. SPECIAL THEME SESSION: „THE USE OF MARBLE AND LIMESTONE IN THE ADRIATIC BASIN IN ANTIQUITY”</b>	
Marble Sarcophagi of Roman Dalmatia Material – Provenance – Workmanship <i>Guntram Koch</i> .....	809

Funerary Monuments and Quarry Management in Middle Dalmatia <i>Nenad Cambi</i> .....	827
Marble Revetments of Diocletian's Palace <i>Katja Marasović and Vinka Marinković</i> .....	839
The Use of Limestones as Construction Materials for the Mosaics of Diocletian's Palace <i>Branko Matulić, Domagoj Mudronja and Krešimir Bosnić</i> .....	855
Restoration of the Peristyle of Diocletian's Palace in Split <i>Goran Nikšić</i> .....	863
Marble Slabs Used at the Archaeological Site of Sorna near Poreč Istria – Croatia <i>Đeni Gobić-Bravar</i> .....	871
Ancient Marbles from the Villa in Verige Bay, Brijuni Island, Croatia <i>Mira Pavletić and Đeni Gobić-Bravar</i> .....	879
Notes on Early Christian Ambos and Altars in the Light of some Fragments from the Islands of Pag and Rab <i>Mirja Jarak</i> .....	887
The Marbles in the Chapel of the Blessed John of Trogir in the Cathedral of St. Lawrence at Trogir <i>Đeni Gobić-Bravar and Daniela Matetić Poljak</i> .....	899
The Use of Limestone in the Roman Province of Dalmatia <i>Edisa Lozić and Igor Rižnar</i> .....	915
The Extraction and Use of Limestone in Istria in Antiquity <i>Klara Buršić-Matijašić and Robert Matijašić</i> .....	925
Aurisina Limestone in the Roman Age: from Karst Quarries to the Cities of the Adriatic Basin <i>Caterina Previato</i> .....	933
The Remains of Infrastructural Facilities of the Ancient Quarries on Zadar Islands (Croatia) <i>Mate Parica</i> .....	941
The Impact of Local Geomorphological and Geological Features of the Area for the Construction of the Burnum Amphitheatre <i>Miroslav Glavičić and Uroš Stepišnik</i> .....	951
Roman Quarry Klis Kosa near Salona <i>Ivan Alduk</i> .....	957
Marmore Lavdata Brattia <i>Miona Miliša and Vinka Marinković</i> .....	963
Quarries of the Lumbarda Archipelago <i>Ivka Lipanović and Vinka Marinković</i> .....	979

Island of Korčula – Importer and Exporter of Stone in Antiquity <i>Mate Parica and Igor Borzić</i> .....	985
Faux Marbling Motifs in Early Christian Frescoes in Central and South Dalmatia: Preliminary Report <i>Tonči Borovac, Antonija Gluhan and Nikola Radošević</i> .....	995
<b>INDEX OF AUTHORS</b> .....	1009

## THE EXTRACTION AND USE OF LIMESTONE IN ISTRIA IN ANTIQUITY

Klara Buršić-Matijašić and Robert Matijašić

Juraj Dobrila University of Pula, Pula, Croatia (kbursic@unipu.hr; rmatija@unipu.hr)

### Abstract

Due to the presence of abundant and thick outcrops, several types of limestone were the main natural building materials until the emergence of modern technologies, and the quarrying of limestone was an important activity in Prehistory, Antiquity and the Middle Ages. The prehistoric population used stone blocks for building the drywall ramparts of the fortifications on hilltops. The Roman conquest in the 2<sup>nd</sup> century B.C., and particularly the establishment of the colonies in the mid-1<sup>st</sup> century B.C. prompted the introduction of new technologies of quarrying. Istrian limestone quickly established itself as an important building material and was transported by sea to centres along the north Adriatic coast. The stone blocks came from quarries along the coast, and could thus be transported by sea. Most of them bear traces of use in the Middle Ages, when historical sources confirm that Istrian limestone was extensively used in Venice and north Italian towns.

### Keywords

Istria, limestone, quarry

The Istrian peninsula has been, owing to its geographical position, an ideal intersection between the Mediterranean and Central Europe, between the Dinaric Alps and the Northern Italian Plain, so that since prehistory, goods, people and ideas have circulated around and through it. But it is above all else the karstic nature of the Istrian environment that has deeply influenced the ways of life in the peninsula since the remotest times. Cretaceous limestone is the main geological substratum of the greater part of south and west Istria (Fig. 1),<sup>1</sup> and it did not affect only agriculture (as terra rossa is the main pedological feature)<sup>2</sup> and hydrology (lack of rivers and streams, reliance on ponds and rainwater for human

supply; underground water flows),<sup>3</sup> but it was also the main building material since the earliest prehistoric and historical periods. In the Istrian Peninsula in the course of ancient times several types of limestone with different aspects (colour, compactness, composition etc.) and properties were exploited.

Karstic caverns and caves were inhabited by the earliest human groups,<sup>4</sup> while the first Neolithic villages in the open are poorly documented.<sup>5</sup> The few remains available to study, among which the site of Vižula near Medulin is the most important, show that the foundations of huts above the ground (there are no traces in Istria of pit houses) were built of roughly shaped stones as foundations, on which a construction of organic material (wood and straw) and clay was placed for walls and roofs.<sup>6</sup> Some caves continued however to be inhabited in the Neolithic, because they continued to offer a convenient shelter. In the bigger semi-caves the cattle could also be kept, and that was increasingly important with the development of agriculture and cattle-breeding.

The next radical cultural change documented archaeologically in Istria is the beginning of Bronze Age, with the arrival of new, more numerous human groups. Immigration profoundly changed the historical landscape of Istria, as settlements on hilltops began to appear, the *castellieri* (*gradine*), whose fortifications (the essence of their organization) had to be built largely of stone, with single buildings inside such a settlement covered with organic material (wood, twigs, branches and straw).<sup>7</sup> The use of hilltops for settlements continued after the Bronze Age, all through the Iron Age of Istria, i.e. until the Roman conquest (Fig. 2). More than 400 such sites have been identified,<sup>8</sup> but due to the erosion of

1 VLAHOVIĆ *et al.* 2005, 333-360.

2 BENAC, DURN 1997, 7-17; MERLAK 2014, 5-20.

3 BONACCI 1996, 45-56.

4 KOMŠO 2008, 60-72.

5 MIHOVILIĆ 1986, 49-50.

6 ZLATUNIĆ 2002, 38-48.

7 BURŠIĆ-MATIJAŠIĆ 2012, 16-19.

8 BURŠIĆ-MATIJAŠIĆ 2007; MIHOVILIĆ 2013, 32-57.

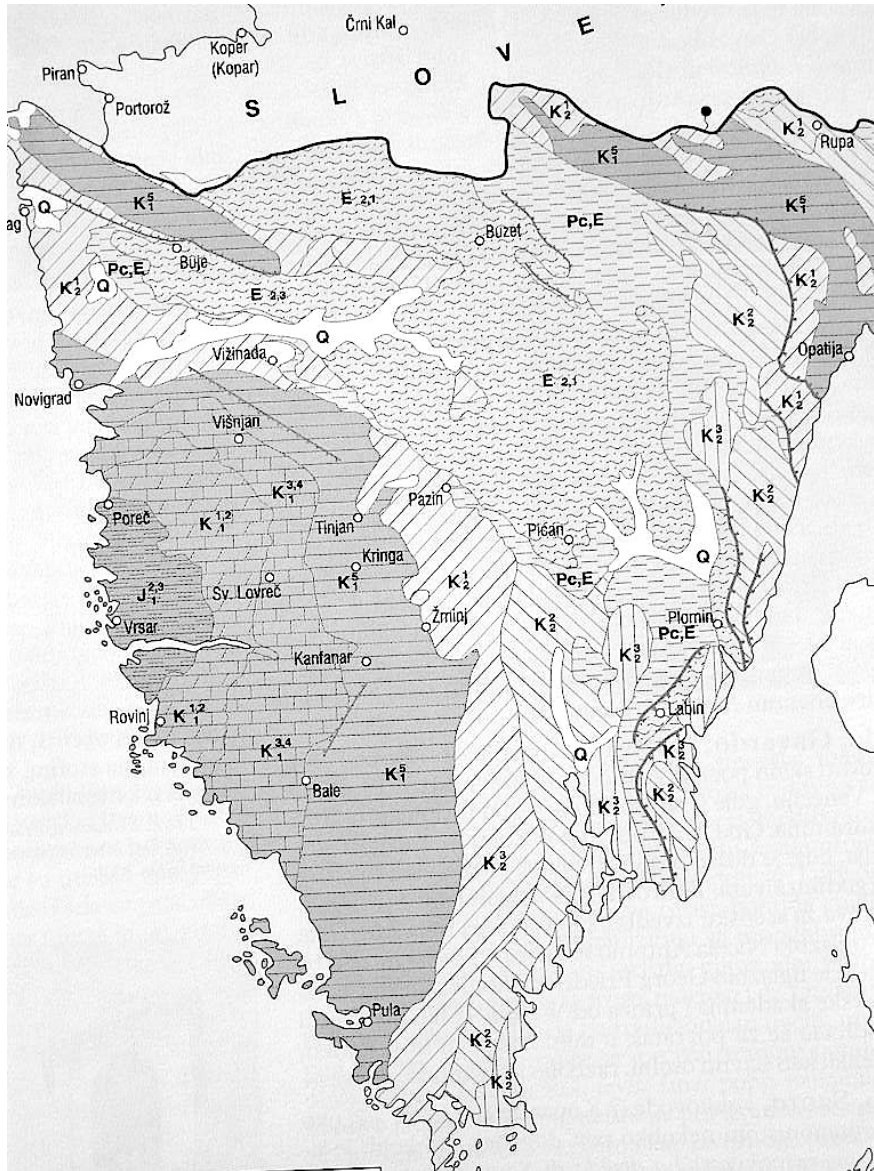


Fig. 1.  
Geological map of Istria (adapted from CRNKOVIĆ 1981):  
E – Eocene,  
P – Palaeocene;  
K – Cretaceous,  
J – Jurassic

hilltops it is difficult to reconstruct an exact chronology of their use within that period, except in a few cases of better explored sites, such as Monkodonja near Rovinj.<sup>9</sup> Only in the Iron Age can we identify the ethnic name of the community living in Istria: the Histri gave the name to the peninsula, and they are mentioned by the earliest Greek written sources in the 6<sup>th</sup>-5<sup>th</sup> century B.C., such as Hecataeus of Miletus.

In the majority of cases the main source of stone was of course the hilltop itself. The builders did not have to go far, as they could easily use the limestone layers on the top of the hill, and so besides obtaining the necessary stones they also levelled the area protected by the walls. The ramparts were built in the dry-stone technique, using medium sized stones for the visible surfaces of the

fortification wall, filling in the interior with small stones. Due to the dry-stone technique used, the prehistoric walls are generally preserved as heaps of stones, so that the lines of the walls are visible, but the structure has disintegrated. The stones were worked only very roughly, so that a very rustic *opus incertum* was the result.

Bigger blocks were used only in a few known cases in Istria, generally – it seems – in sacred and/or burial contexts (Sveti Anđeo, Karaštak), and they are also only roughly shaped. Only towards the end of prehistory, under the influence of Hellenistic architecture, known also from other sites along the eastern Adriatic coast (Osor, Asseria, Ošanići) do finely worked and arranged big stone blocks appear in the fortifications (*Nesactium*, Mutvoran, Plomin and some other). Stonecutting craftsmanship was anyway needed throughout the prehistoric period for the slabs used to form tombs for the deposition of the body (in the Bronze Age) or cinerary urn (in the Iron Age),

9 HÄNSEL et al. 2015.





Fig. 2. The three Picugi hilltops, from the west



Fig. 3. Horseman, with naked woman nursing a child, from Nesactium (from MIHOVILIĆ 2013, 332-333)

but decoration is generally absent, as the tomb itself was covered with a heap of small rough stones.

The only Istrian examples of possible prehistoric funerary stone monuments come from *Nesactium*, where fragments of 6<sup>th</sup> century B.C. sculptures may belong to the decoration of tombs: slabs with spirals and meanders, a block with a roughly shaped figure of a naked woman nursing a child on the front and the figure of a horseman (Fig. 3). There is also a series of fragments of kouros-like sculptures. This group of sculptures was once dated to the 12<sup>th</sup> century B.C., but its belonging to the 6<sup>th</sup> century<sup>10</sup> is today generally accepted. They were however found within the ruins of the Roman period walls, so that their original position and use cannot be established. The stone came from a nearby quarry of excellent limestone (Marčana), which was also used in Roman and modern times.

The use of stone in prehistory was thus quite extensive, but we cannot speak of quarrying in the full sense of

the word. Stones were collected from the surface, with only limited digging, and only where suitable layers of limestone were visible and at hand. We cannot deny that the Istri had the ability to work the stone in more sophisticated ways as well, but there are no traces of prehistoric extraction of stone blocks in sites where ancient quarrying activity can be presumed. Of course, the main reason might be the fact that Roman quarrying has obliterated the remains of earlier traces, just as early modern and modern exploitation of stone layers has destroyed traces of Roman use.

Nevertheless, Roman age quarrying is much more visible, although chiefly along the coast, where marine erosion maintains a clean profile. There are at least 20 sites along the coast, from Premantura to the mouth of the Mirna, where traces of ancient quarrying are evident, although there can be no absolute certainty that all of those belong to Roman times and not to the medieval and/or early modern period.<sup>11</sup> There are two obvious reasons why Roman quarries are known almost only from the coast. One is that those in the interior are difficult to identify today because of soil sediments and vegetation. The other is that it was most convenient, given the ancient transportation technology level, to load the stone blocks directly onto the ships or barges, so most quarries were along the coast. Having them pulled by oxen on wood sleds along a road, which also had to be prepared, was time- and energy-consuming so that other good reasons had to exist, such as for example the exceptional quality of the stone. The quality of Istrian limestone was almost uniform in western and southern Istria, there were no deposits of marble or other types of stone, so that the dependence on coastal sites is understandable.

There are only a handful of sites with traces of quarrying in Roman times away from the sea. The quarry on the western slopes of the Draga near Marčana, away from the coast, can be explained by the vicinity of *Nesactium* (3 km as the crow flies), and the need to provide good quality stone for the prehistoric sculptures of *Nesactium*, and for the decorations of Roman buildings in the ancient town. The quarry was last used at the beginning of the 20<sup>th</sup> century, but – interestingly – there are plans to reopen it. Nearer to Pula, on the slopes of the hill of San Daniele (Šandalja), about 3.5 km east of the Roman colony of *Pola*, there are, in a quarry that is still in use, the remains of unfinished stone blocks, and there are clear traces of ancient extraction visible on the walls of the quarry. An exception that proves that quarries were active on a smaller scale also in the interior for practical purposes, is the site of Skačota (Skvačota, Squaciotta), a small hill about 6 km from the sea, halfway between Bale (Valle) and Golaš, where there are clear traces of the

10 FISCHER 1986.

11 MATIJAŠIĆ 1998, 395-401.

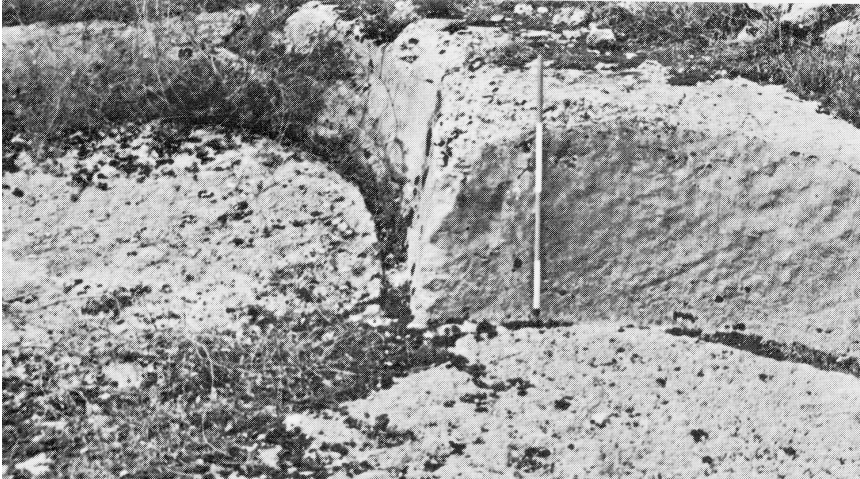


Fig. 4. Skačota near Bale / Valle, negative imprints of two extracted stone blocks (from MARUŠIĆ 1990, 415)

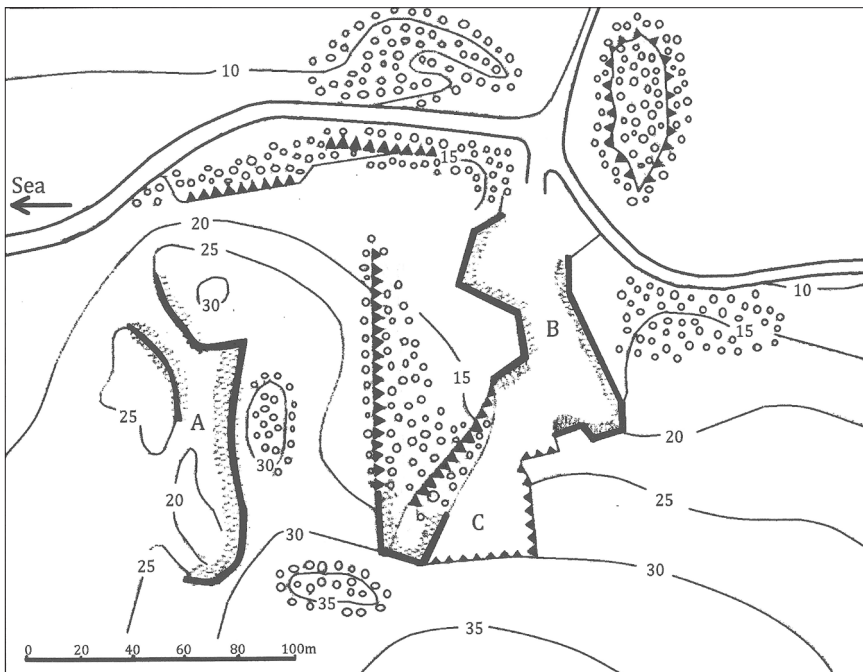


Fig. 5. Topographical sketch of the Vinkuran quarry, the bold black line indicates the surfaces quarried in Antiquity (adapted from CRNKOVIĆ 1991)

extraction of round shaped blocks (Fig. 4) which were used for the manufacture of stone vessels used in the production of olive oil for the decantation of the freshly pressed juice.<sup>12</sup> The dimensions of the negative imprints of the two extracted stone blocks whose shape is visible today (diameter 2 m, height 75 cm) correspond to such vessels, or to the bases of olive-mills, for even millstones were made of limestone, and have been found in a number of Roman rural sites with production facilities.<sup>13</sup> Given the considerable distance to the coast (almost 6 km), it was probably used for local purposes, for supplying stone blocks to nearby estates. The local production of these vessels and other stone components of oil and

wine presses is of course logical: they would not have been carried from far away. Cato the Elder, in his treatise on agriculture in the 2<sup>nd</sup> century B.C., suggested that the transport of a millstone 10-20 km could add up to 40% to the purchase price, while moving it up to 100 km could add 70% to the original price.<sup>14</sup> It is obvious that, given the geological conditions, a lot of small quarries would exist in the territory, for extracting stone for local use.

The most interesting, famous and monumental ancient quarry is that near Vinkuran, about 3.5 km south of Pula, but 1 km from a bay that could have been used for loading ships and barges. The interesting thing is that it is known locally as *Cave Romane* (Roman quarries), a name which stems from the correct popular tradition

12 MARUŠIĆ 1990, 415.

13 MATIJAŠIĆ 1998, 151-219.

14 *Cato, Agr.*, 22, 3-4.



Fig. 6.  
Remains of an ancient  
quarry in San Polo Bay  
near Rovinj (MATIJAŠIĆ  
1998, 397)

that it was used in Roman times. It is believed that the Pula Amphitheatre was built of stone blocks from this quarry.<sup>15</sup> Of course, most other ancient buildings in Pula were built with this stone.<sup>16</sup> The effort needed to transport the blocks to the sea was compensated by the exceptional quality of the stone. The site was used in the Middle Ages and in modern times until recently, and it certainly was one of the most important Istrian quarries (Fig. 6). High on the face of the cut there are traces of ancient exploitation, but it is since been excavated down to the level of the base of the hill.

An abandoned quarry near the village of Banjole, not far from Vinkuran, is situated on a hill directly above the sea.<sup>17</sup> It was used in Roman times, as confirmed by finds of unfinished monumental blocks, of a small female head and recently of a yet unpublished female sculpture in full size. Both were discarded during the process of carving, so they remained among the rubble. The quarry has been used in medieval times, but all the quarries around Pula were extensively used also by Austrian builders of military fortifications between 1856 and 1914, so that they added to the disfiguration of ancient traces.<sup>18</sup> The same is true for the quarries on the island of Brijuni, exploited in antiquity, in the Middle Ages and in the early modern period, until in the 19<sup>th</sup> century two big forts and some smaller ones were also built of stone from the same quarry.

Along the coast, there are several smaller quarries, which were used as long as they could yield sufficient material, and then abandoned. Such sites are known in southern Istria, around Premantura (Porto Rosso, Pomerski školjić and Ližnjan along the southernmost tip of Istria).<sup>19</sup> The specialists in stone extraction were looking for sites with sufficiently thick, solid and compact layers of limestone, and such places were easily visible on the coast line. One such example can still be seen, in the Bay of St. Paul (San Polo), south of Rovinj, where it can be seen that the extraction was abandoned as the interesting layer was exhausted, and the quarry was not enlarged towards the interior (Fig. 6).<sup>20</sup>

The area between Rovinj and Poreč, where the limestone is of Jurassic origin, was also extensively exploited for quarrying in antiquity. Besides San Polo, four other ancient quarries are located around Rovinj (Montauro, Monte delle Arni, Valsaline, Santa Eufemia near Rovinj),<sup>21</sup> three around Vrsar (Montraker, Monte Ricco and San Giorgio),<sup>22</sup> and three around Poreč (Sveti Nikola, Vabriga and Tarska vala).<sup>23</sup> Traditionally it was believed that the monolithic stone that covers the Mausoleum of the Ostrogothic king Theodoric in Ravenna (300 tons) came from Istria, and it was thought that the quarry was one near Poreč (Sveti Nikola),<sup>24</sup>

15 CRNKOVIĆ 1991.

16 FISCHER 1996; LETZNER 2005.

17 ŠONJE 1980, 151.

18 BEGOVIĆ, SCHRUNK 2007, 147-154.

19 MATIJAŠIĆ 1998, 395-397.

20 MATIJAŠIĆ 1998, 397.

21 MATIJAŠIĆ 1998, 397-398.

22 MATIJAŠIĆ 1998, 399.

23 MATIJAŠIĆ 1998, 399.

24 ŠONJE 1980, 153.

but recent laboratory analysis definitely proved that it was from Aurisina near Trieste that the stone came from.<sup>25</sup>

The Istrian limestone is of very good quality, and we know from medieval and early modern sources that stone was extracted for buildings in Venice, where most decorative artwork is of Istrian white limestone,<sup>26</sup> and in other North Italian towns, like Rimini, Ravenna, Palmanova, Padua, Ancona, Loreto and Fermo, where it is known as “pietra d’Istria” (Istrian stone).

Today the Istrian limestone, extracted from four main quarries (Kanfanar, Selina, Kirmenjak and Valtura) is still exported mainly for building purposes, in a continuity that has persisted since Roman times, although adapted to new requirements and means of transport.

## BIBLIOGRAPHY

- BEGOVIĆ V., SCHRUNK I. 2007: *The Brioni Islands. Past, Architecture and Cultural Heritage*, Zagreb.
- BEVILACQUA F., FABBRI R., GRILLINI G. C. 2003: “Il mausoleo di Teodorico. La pietra di Aurisina. Tecniche e strumenti di lavorazione”, in F. LENZI (ed.): *L’archeologia dell’Adriatico dalla preistoria al medioevo. Atti del convegno internazionale, Ravenna 7 - 8 - 9 giugno 2001, Firenze, 572-580.*
- BENAC Č., DURM G. 1997: “Terra rossa in the Kvarner area. Geomorphological conditions of formation”, *Acta Geographica Croatica* 32, 7-17.
- BONACCIO. 1996: “Hydrology of the Gradole Karst Spring (Istria – Croatia)”, *Acta Karstologica* 25, 45-56.
- BURŠIĆ-MATIJAŠIĆ K. 2007: *Gradine Istre – povijest prije povijesti, Pula.*
- BURŠIĆ-MATIJAŠIĆ K. 2012: “Neki aspekti naselja i nastambi u Istri u prapovijesti (Alcuni aspetti degli insediamenti e delle abitazioni in Istria durante la preistoria)”, *Tabula* 10, 7-38.
- CRNKOVIĆ B. 1981: “Geološka građa Istre”, *Liburnijske teme* 4, 34-62.
- CRNKOVIĆ B. 1991: “The origin of the dimension stone of the Arena in Pula”, *Rudarsko-geološko-naftni zbornik* 3, 63-67.
- FISCHER G. 1996: *Das römische Pola. Eine archäologische Stadtgeschichte*, Bayerische Akademie der Wissenschaften, Philosophisch-historische Klasse, *Abhandlungen, Neue Folge, Heft 110, München.*
- FISCHER J. 1986: “Die vorrömischen Skulpturen von Nesactium”, *Hamburger Beiträge zur Archäologie* 11, 9-98.
- HÄNSEL B., MIHOVILIĆ K., TERŽAN B. 2015: *Monkodonja. Istraživanje protourbanog naselja brončanog doba Istre, Knjiga 1. Iskopavanje i nalazi građevina / Forschungen zu einer protourbanen Siedlung der Bronzezeit Istriens, Teil 1, Die Grabung und der Baubefund, Monografije i katalozi* 25, Pula.
- KOMŠO D. 2006: “Mezolitik u Hrvatskoj / The Mesolithic in Croatia”, *Opuscula Archaeologica* 30, 55-91.
- LAZZARINI L. 1981: “I materiali lapidei delle vere da pozzo di Venezia e la loro conservazione”, in A. RIZZI (ed.): *Vere da pozzo di Venezia, Venezia, 371-377.*
- LAZZARINI L. 2008: “Pietra d’Istria: uso, genesi, proprietà, cavatura e forme di deterioramento della pietra di Venezia”, *Terra Histria* 9, 2008, 7-43.
- LAZZARINI L. 2012: “Pietra d’Istria: Quarries, characterisation, deterioration of the stone of Venice”, *12<sup>th</sup> International Congress on the Deterioration and Conservation of Stone*, Columbia University, New York, <http://iscs.icomos.org/pdf-files/NewYorkConf/lazzarin.pdf> (accessed 21. 5. 2016).

25 LAZZARINI 1981; BEVILACQUA, FABBRI, GRILLINI 2003, 572-580, see also the recent PREVIATO 2015, 415-445.

26 LAZZARINI 2008; LAZZARINI 2012.

- LETZNER W. 2005: Das römische Pula. Bilder einer Stadt in Istrien, Zaberns Bildbände zur Archäologie, Mainz.
- MARUŠIĆ B. 1990: “Še o istrski Kisi (Cissa) in kessenskem škofu (Episcopus Cessensis) (Noch einiges über das istrische Cissa und das kessensche bistum (Episcopatus Cessensis)”, *Arheološki vestnik* 41, 403-429.
- MATIJAŠIĆ R. 1998: *Gospodarstvo antičke Istre, arheološki ostaci kao izvori za poznavanje društveno-gospodarskih odnosa u Istri u antici (I. st. pr. Kr – III. st. posl. Kr.) (Storia economica dell’Istria antica; Die Wirtschaftliche Istriens in der Antike; The Economic History of Istria in Antiquity)*, Pula.
- MERLAK E. 2014: “Una bibliografia selezionata delle bauxiti carsiche e terre rosse (Carso classico italiano, Slovenia, Croazia, Paesi dell’ex Jugoslavia, Albania, Ungheria, Romania)”, *Atti dei Musei Civici di Storia Naturale di Trieste* 57, 5-20.
- MIHOVILIĆ K. 1986: “Pregled prahistorije Isgtre od starijeg neolitika do početka romanizacije (Considerazioni sulla preistoria dell’Istria dal primo periodo neolitico all’inizio della romanizzazione)”, in V. JURKIĆ (ed.): *Arheološka istraživanja u Istri u Hrvatskom primorju*, Pula, 49-63.
- MIHOVILIĆ K. 2013: *Histri u Istri. Željezno doba Istre / Gli Istri in Istria. Letà del ferro in Istria / The Histri in Istria. The Iron Age in Istria*, *Katalozi i monografije* 23, Pula.
- PREVIATO C. 2015: *Aquileia. Materiali, forme e sistemi costruttivi dall’età repubblicana alla tarda età imepriale*, Padova.
- ŠONJE A. 1980: “Iz kojeg istarskog kamena potječe kupola Teodorikova mauzoleja u Ravenni (...)”, in M. SUIĆ, M. ZANINOVIĆ (eds.): *Materijali, tehnike, strukture predantičkog i antičkog graditeljstva na istočnom jadranskom prostoru*, Zagreb, 149-159.
- VLAHOVIĆ I., TIŠLJAR J., VELIĆ I., MATIČEC D. 2005: “Evolution of the Adriatic Carbonate Platform: Palaeogeography, main events and depositional dynamics”, *Palaeography, Palaeoclimatology, Palaeoecology* 220, 333-360.
- ZLATUNIĆ R. 2002: “Arheološka interpretacija i rekonstrukcija načina života u neolitičkom razdoblju Istre (Archaeological interpretation and reconstruction of the way of life in the Neolithic period of Istria)”, *Histria Archaeologica* 33, 3-141.