

The Impact of Local Geomorphological and Geological Features of the Area for the Construction of the Burnum Amphitheatre /

Glavičić, Miroslav; Stepišnik, Uroš

Source / Izvornik: **ASMOSIA XI, Interdisciplinary Studies on Ancient Stone, Proceedings of the XI International Conference of ASMOSIA, 2018, 951 - 956**

Conference paper / Rad u zborniku

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

<https://doi.org/10.31534/XI.asmosia.2015/08.14>

Permanent link / Trajna poveznica: <https://urn.nsk.hr/urn:nbn:hr:123:003016>

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

Download date / Datum preuzimanja: **2025-02-24**



Repository / Repozitorij:

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



UNIVERSITY OF SPLIT


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

PRESENTATION	15
NECROLOGY: NORMAN HERZ (1923-2013) by Susan Kane	17
1. APPLICATIONS TO SPECIFIC ARCHEOLOGICAL QUESTIONS – USE OF MARBLE	
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 th C.) and the Basilica of San Lorenzo (5 th 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 nd C. Bc – Late 1 st C. Ad) <i>Stefan Ardeleanu</i>	155
<i>Amethystus</i> : Ancient Properties and Iconographic Selection <i>Luigi Pedroni</i>	167
2. PROVENANCE IDENTIFICATION I: (MARBLE)	
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 th And 17 th 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 Silentiary, 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>Marmorata</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
3. PROVENANCE IDENTIFICATION II: (OTHER STONES)	
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
4. ADVANCES IN PROVENANCE TECHNIQUES, METHODOLOGIES AND DATABASES	
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
5. QUARRIES AND GEOLOGY	
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
6. STONE PROPERTIES, WEATHERING EFFECTS AND RESTORATION, AS RELATED TO DIAGNOSIS PROBLEMS, MATCHING OF STONE FRAGMENTS AND AUTHENTICITY	
Methods of Consolidation and Protection of Pentelic Marble <i>Maria Apostolopoulou, Elissavet Drakopoulou, Maria Karoglou and Asterios Bakolas</i>	749
7. PIGMENTS AND PAINTINGS ON MARBLE	
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
8. SPECIAL THEME SESSION: „THE USE OF MARBLE AND LIMESTONE IN THE ADRIATIC BASIN IN ANTIQUITY”	
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
INDEX OF AUTHORS	1009

THE IMPACT OF THE LOCAL GEOMORPHOLOGICAL AND GEOLOGICAL FEATURES OF THE AREA FOR THE CONSTRUCTION OF THE BURNUM AMPHITHEATRE

Miroslav Glavičić¹ and Uroš Stepišnik²

¹Department of Archeology, University of Zadar, Zadar, Croatia (glavicic@unizd.hr)

²Department of Geography, University of Ljubljana, Ljubljana, Slovenia (uros.stepisnik@ff.uni-lj.si)

Abstract

In the middle of the 1st century intensive construction activities were conducted on the north-western boundary of the Roman military camp at Burnum. An amphitheatre, along with some additional military structures, was erected by the XI Legion CPF (*Legio XI CPF*) in that period. A natural doline was modified for the purposes of the amphitheatre construction, and therefore the physical and cultural landscape settings were permanently altered. The task of the interdisciplinary research team was to define the effect of the geomorphological and geological landscape settings on the formation of the Burnum agglomeration and to determine the physical and cultural landscape changes in the past.

Keywords

Burnum, archaeology, geology, geomorphology, the Krka river

1. Introduction

At the end of Bato's rebellion in Illyricum (AD 6-9) the Romans built the Burnum legionary military camp (*castra*).¹ It is located on the right bank of the river Krka (*Titius flumen*), on the opposite side of the Liburnian hillfort (*oppidum*) of *Burnistae* on the Gradina near Puljani (Fig. 1). It had the function of the strategic-military control of the area and control of the Krka River Canyon as well as of river crossings.² In Burnum during

the first century legions (*legiones*) were stationed, as well as various auxiliary units (*auxilia*) (CAMBI *et al.* 2007, 11-30; MILETIĆ 2010, 120-135), the soldiers of which built a number of objects intended for military requirements (*castellum*, *amphitheatrum*, *campus*, *aqueductus*, *viae*). In the vicinity of the camp a civilian settlement (*canabae*) was established when the *oppidum* of *Burnistae* still existed. They together formed the Burnum agglomeration, which became a *municipium*. That probably happened after the legions left Burnum, maybe in the period of the Emperor Hadrian.³

In the middle of the 1st century a military camp, amphitheatre (*amphitheatrum*) and military training ground (*campus*) were built on the NW outskirts. Prior to their construction the rocky karst surface was levelled and filled with material that is abundant in small archaeological finds (parts of military equipment and weapons and objects from everyday life).

In this article, we have used an interdisciplinary approach in the exploration of the archaeological site within case study of the Burnum amphitheatre and its surroundings. The main aim of the research was to determine the influence of the geomorphological and geological characteristics of the area on the formation of the Burnum agglomeration and to detect changes in the physical and cultural landscape throughout history.

2. Outline of archeological research within the study area

A systematic archaeological survey has been conducted in the area of the Burnum agglomeration since 2003. The research was carried out by the Department of

1 It is possible that in the area of Burnum there already existed a temporary military camp (*castra aestivalis*). The end of the construction works of a permanent military camp (*castra stativa*), which was built of stone by soldiers of *Legio XI*, supported by soldiers of auxiliary units of *Ala I Hispanorum*, is dated between AD 14-17.

2 The garrison of Burnum controlled the passage across the Krka River by Puljane as well as passages several ki-

lometres upstream by Bobodol and downstream in the area of Roški slap. A system of fortifications was erected within key locations (Strmica and Pađani on Mokropolje, Kapitul by Knin, Kadina glavica by Promona etc.) where *vexillationes* of legion and auxiliary units controlled the main communication lines of a wider area.

3 Inscription *CIL* III, 2828 = 9890, which was erected by *ordo decurionum* in honour of Hadrian, is dated AD 118.

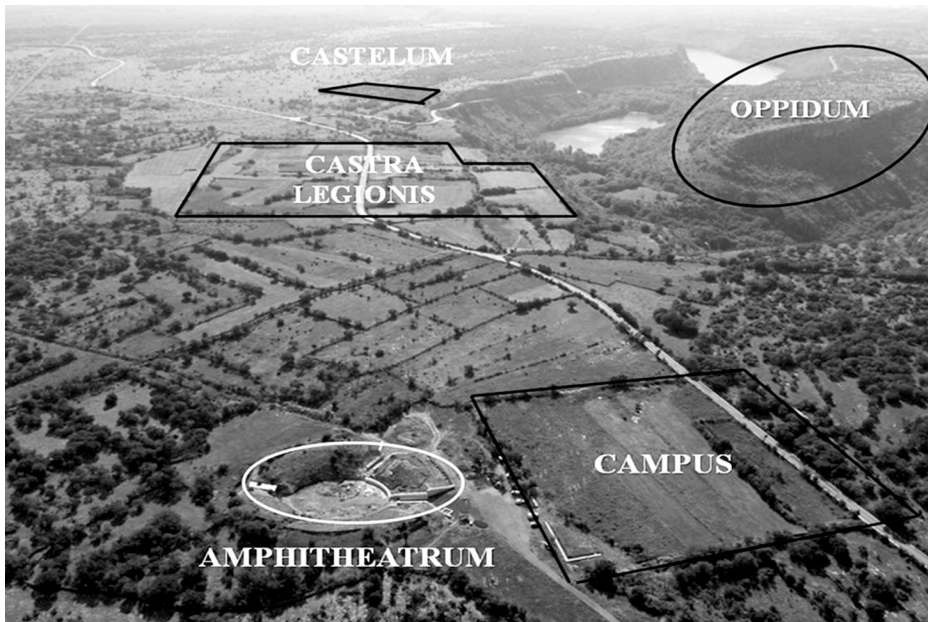


Fig. 1.
Position of the amphitheatre within the Burnum legionary camp



Fig. 2.
Aerial photograph of Burnum amphitheatre prior to archaeological works

Archaeology of the University of Zadar and the Municipal Museum of Drniš in cooperation with Laboratorio di Rilievo delle Strutture Archeologiche del Dipartimento di Archeologia dell'Università di Bologna supported by Krka National Park (e.g. CAMBI *et al.* 2006; CAMBI *et al.* 2007; CAMBI *et al.* 2008, 397-408; GLAVIČIĆ, MILETIĆ 2009, 75-84; GLAVIČIĆ 2011, 289-313; GLAVIČIĆ, MILETIĆ 2013, 157-172). The research revealed the construction of an amphitheatre (*amphitheatrum*) and some other military structures on the northwest margin of the Roman military camp (Fig. 1). It was also determined that the karst area was levelled, small depressions being filled by material consisting of small scale archaeological remains such as military equipment, arms fragments and everyday items. About the whole expanse of the amphitheatre was explored in detail. Constructional solutions that were adopted for the integration of objects within the natural

configuration of the landscape were precisely documented since the amphitheatre was built within the perimeters of a doline (Fig. 2). The amphitheatre can be described as a four entrance amphitheatre type with two main entrances in the ellipse vertex and two side entrances. The asymmetrical arrangement of the entrances is interpreted as a consequence of the uneven terrain configuration within the doline. The funnel shaped walls of the side entrances were constructed for converging groups of the audience into the passages leading into auditorium. The south and north entrance extended to the arena. The side entrance walls were the foundation of an arch that was constructed in such a way that stripes of marly limestone and tufa interchanged (Fig. 3). The arena had a regular ellipsoid shape with a longer axis of 44 m and a shorter axis of 33 m. Its floor was of gravel and sand, which covered the levelled bedrock surface. Natural



Fig. 3. Use of local tufa and marly limestone as a construction materials in the amphitheatre

widened cracks between grikes in the lower section of doline slopes were modified so as to function as drainage channels. Although the auditorium was in very poorly preserved state, the construction method the the seating rows was documented. It is hypothesised that the capacity of the Burnum amphitheatre was suitable for six or more thousand spectators.

Two main construction phases were identified by means of archaeological explorations: the first phase from the period of Claudius and the second one from Vespasian. The first phase of construction was defined on basis of small-scale archaeological material discovered in the levelling layer that consisted of stone and soil below the substructures of the buildings. They were also identified within drainage channels, the east and west entrance and around the amphitheatre. An abundance of various artefacts of military provenance and other everyday life items was discovered within those strata (Fig. 4). The age of this material was typologically set to the late Augustan-early Tiberian period to the Claudian period. That age was also confirmed by about 300 coins that were discovered in the levelled layer. Bronze denominations prevailed among them, struck from the period of Augustus to the early period of Claudian rule. All the construction works related to terrain altering and levelling and the first phase of amphitheatre building were therefore carried out by the soldiers of the XI legion that was stationed in Burnum in that period. The results of archaeological excavations make it possible to relate the construction to historical context. Because in AD 42 the legionaries disobeyed imperial legate of the Dalmatian province, Lucius Aruntius Scribonianus, who had wanted to overthrow the newly installed emperor Claudius, legion XI was awarded the title *Claudia pia fidelis*. In the following years, the area of military camp in Burnum became the site of great construction works. Those building activities lasted a decade and incorporated the



Fig. 4. Infill of grikes for the purpose of levelling the surface prior to construction works

northwestern periphery where the *Legio XI CPF* soldiers built an amphitheatre and other military buildings.⁴

The second building phase was dated by the monumental Vespasian inscription that was put on the south facade of the amphitheatre entrance in the year 76/77 AD.⁵ This was the final act of the reconstruction and rebuilding of the amphitheatre, financed by the Emperor as confirmed by his name, written in the nominative. At

4 Remains of the foundations of parallel walls were discovered on the south side of the amphitheatre. The space between those wall remains is approximately 9m and they were a part of a monumental building with dimensions about 150 x 150m. It is assumed that these are the modest architectural building remains of a military training ground (*campus*). The *campus* had series of chambers that were situated in a processional part that surrounded a central open area (*palestra*). In the middle of the structure on the eastern side, a monumental three-piece entrance with a barrel vault made of tuff blocks was discovered. The exterior wall on the north side was strengthened by a counterfort. During the archaeological excavations that were conducted along the northern perimeter of the military training ground, it was proven that this area was also levelled. The levelling of karstic terrain was done by pruning the bedrock and filling the grikes with a layer consisting of stone and soil in the same way as was defined in the area of the nearby amphitheatre. Discovered within the levelling layer was the same amount and type of archaeological military provenance material and items used in everyday life as in the amphitheatre substructures and around it.

5 The inscription inscribed onto a big block of quality fine-grained limestone (294 x 100 x 32cm): *Imp(erator) Caesar Ve[s]pasianus Aug(ustus) pont(ifex) max(imus) / trib(unicia) pot(estate) VIII imp(erator) XVIII p(ater) p(atriciae)*.



Fig. 5.
The large tufa dams of the
Manojlovac waterfall within
the Krka River canyon

that time, the construction of side entrance walls, covered passages, auditorium and arena walls took place. As a result of the extensive construction works, the Burnum amphitheatre took on monumental proportions. The works were conducted by the soldiers of *Legio III Flavia felix*, stationed in Burnum during that period.

After the IV legion left Burnum in 86 AD, the amphitheatre maintained its primary function. The amphitheatre remained a strong medium for promotion of Imperial policy as well as for the Romanisation of the local population, since it was a place for spectacles that attracted a great number of visitors. It is not known when the amphitheatre ceased to operate. It gradually collapsed most likely in late antiquity due to weathering of construction materials. This was confirmed by means of an archaeological survey that revealed collapsed arches and building material within passages.

3. Materials and methods

The geomorphological and geological survey of the area was conducted during campaigns in 2014. It was supported by analysis of a digital terrain model (DTM field), topographical maps and geological maps. The aim of the field survey was to acquire data on general geomorphological settings of the area and the bedrock variety along with data of possible exploitation of natural resources in the past. Geomorphologic analysis of the study area was conducted by applying basic analytic geomorphological methods (PAVLOPOULOS, EVELPIDOU, VASSILOPOULOS 2009). Morphographic analyses included identification and spatial documentation

of geomorphological features and the surrounding plateau using topographic maps and detailed morphographic mapping in the field. The morphographic field mapping that was carried out was accompanied by morphometric analysis of landforms such as dolines and other elongated depressions along the plateau. Morphometric data regarding landforms were obtained in the field using barometric altimeters and GPS. Furthermore, the morphometric analyses were supported by analysis of topographic maps. Morphostructural analyses of bedrock and sediments were conducted in exposed bedrock areas and within excavated profiles.

4. Geological and geomorphological settings of the area and their impact on construction of the Burnum amphitheatre

The whole area of the Burnum campus is located in the central part of an extensive North Dalmatian corrosion plain (Sjevernodalmatinska zaravan) close to the Krka River. It is an area of levelled lowland at elevations between 220 and 320 m dissected by the deep canyons of the Zrmanja, Krka and Čikola Rivers (ROGLIĆ 1957, 107). It is built mostly of carbonate bedrock that hosts a karst landscape. As a result, there is almost complete vertical drainage of precipitation. With exception of the three bigger rivers intersecting the area, there is an almost complete absence of surface drainage (PERICA, OREŠIĆ, TRAJBAR 2005, 143). Therefore the surface is dissected only by typical karst features such as grikes, dolines, isolated cone hills and other non-typical middle sized karst depressions (MIHEVC 2010, 33).



Fig. 6.
Location where there were
quarries of bedded marly
limestone in antiquity

The surrounding plain in the wider area of the Burnum amphitheatre is built of Paleogene age carbonates. North of the site is an axis of an anticline in the northwest-southeast direction. A limited area around the amphitheatre consists of Eocene and Oligocene carbonate conglomerate with thin beds of limestone. It is surrounded by Eocene and Oligocene bedrock, which comprise limestone conglomerate, breccia and layers of marl (GRIMANI *et al.*, 1966, 36). Throughout our survey relatively thick layers of marly limestone were identified only in a few isolated strata.

The area of the amphitheatre and its surrounding is almost completely flattened at an elevation of 250m. Surface karst features as dolines and grikes are positioned westwards where the surface is barren and predominantly rocky. The karst surface east of the amphitheatre has been completely altered by human activity. It is densely covered by dry stone walls, larger piles of rock, ruins and soil layers. Almost no karst features are exposed on the surface except sporadic outcrops of the carbonate bedrock. The extent of the modified karst area illustrates the approximate extent of the Burnum *campus* that was clearly located eastwards of the amphitheatre.

The canyon of the Krka River is located a few hundred meters southeast of the amphitheatre. It is entrenched more than a hundred metres deep into the surrounding plain forming a vast, almost half a kilometre wide canyon. In the close proximity of the Burnum *campus* in the canyon, there are extensive tufa dams with a number of waterfalls (Fig. 5). Two types of tufa are formed within the riverbed. Fine grained silty tufa deposits are accumulated within lakes in the hinterland of the dams. Great quantities of compact and porous tufa are positioned within the dams (PERICA, OREŠIĆ, TRAJBAR 2005, 135).

For construction of the amphitheatre, a natural dissolution doline was utilized. The dimensions of the amphitheatre were strongly influenced by the initial doline. Through detailed morphometric analysis of surrounding dolines towards the northwest we establish that the dimensions and orientation of their longer axis strongly correspond to those of the amphitheatre. Prior to the beginning of construction works the karren surface of the area was levelled by cutting and hewing. Numerous cavities between the karren were filled by stone debris and soil. Those cavities provided abundance of archaeological remains. The majority of the finds can be easily dated to the early Imperial period along with numerous coins.

Analysis of the construction material of the amphitheatre exhibits that limestone conglomerate and breccia are the prevailing materials. External walls are constructed of blocks of marly limestone and travertine. Limestone conglomerate and breccia are common local materials, available in large quantities.

Within our field investigations we identified small quarries where bedded marly limestone was excavated (Fig. 6). They are positioned more than a kilometre towards the southwest where the bedrock alters to Lower Oligocene marly limestone along with fine-grained conglomerates (GRIMANI *et al.* 1966, 36). Those quarries that provided construction material for the amphitheatre were opened here in antiquity. Large amounts of tufa, which is present as a construction material in the amphitheatre and also plenty of other structures in the *campus*, were obtained from nearby tufa dams within the canyon.

Both marly limestone and tufa are porous and prone to intense mechanical weathering when exposed on the surface. Local climatic conditions that also favour

intense frost action add to the dynamics of the process. This eventually led to the gradual decay of the amphitheatre and the final collapse of vaults and side walls.

5. Summary

Constructions over the wider area of the Burnum military camp permanently changed the physical and cultural landscape. An interdisciplinary approach, involving archaeologists and geologists, is aimed at determining how the formation of the Burnum agglomeration was influenced by the geomorphological and geological characteristics of the area and at detecting the changes in the physical and cultural landscape during the course of history.

The utilization of the local resources and construction materials significantly influenced the spatial position, morphology and structure of the amphitheatre. The lack of any local material more resistant to mechanical weathering eventually led to the significant decay of the majority of the structures within the Burnum legionary military camp along with the amphitheatre.

BIBLIOGRAPHY

- CAMBI N., GLAVIČIĆ M., MARŠIĆ D., MILETIĆ Ž., ZANINOVIĆ J. 2006: Amfiteatar u Burnumu. Stanje istraživanja 2003.-2005. Javna ustanova "Nacionalni park Krka", Drniš - Šibenik - Zadar, 32.
- CAMBI N., GLAVIČIĆ M., MARŠIĆ D., MILETIĆ Ž., ZANINOVIĆ J. 2007: Rimska vojska u Burnumu / L' esercito romano a Burnum. Javna ustanova "Nacionalni park Krka", Gradski muzej Drniš, Sveučilište u Zadru, Drniš - Šibenik - Zadar, 62.
- CAMBI N., GLAVIČIĆ M., MARŠIĆ D., MILETIĆ Ž., ZANINOVIĆ J. 2008: "Amfiteatar u Burnumu – preliminarno izvješće o istraživanjima", in D. MARGUŠ (ed.): Zbornik radova sa znanstvenog skupa 10. obljetnica "Oluje", Knin, 397-408.
- GLAVIČIĆ M. 2011: "Arheološka istraživanja amfiteatra u Burnumu", Izdanja Hrvatskog arheološkog društva 27, Zagreb, 289-313.
- GLAVIČIĆ M., MILETIĆ Ž. 2009: "Excavations on the legionary amphitheatre of Burnum, Croatia", in T. WILMOTT (ed.): Roman Amphitheatres and Spectacula, a 21st Century Perspective: Papers from an International Conference Held at Chester, 16th-18th February, 2007, Oxford, 75-84.
- GLAVIČIĆ M., MILETIĆ Ž. 2013: "Arhitektura amfiteatra u Burnumu", *Histria antiqua* 22, Pula, 157-172.
- GRIMANI I., JURIŠA M., ŠIKIĆ K., ŠIMUNIĆ A. 1966: Tumač za list Knin, L 33-141. Institut za geološka istraživanja, Zagreb, 55.
- MIHEVC A. 2010: "Geomorphology", in A. MIHEVC, M. PRELOVŠEK, N. ZUPAN HAJNA (eds.): Introduction to Dinaric karst, Postojna, 30-43.
- MILETIĆ Ž. 2010: "Burnum – vojničko središte provincije Dalmacije", in I. RADMAN LIVAJA (ed.): Nalazi rimske vojne opreme u Hrvatskoj / Finds of the Roman Military Equipment in Croatia, Zagreb, 113-141.
- PAVLOPOULOS K., EVELPIDOU N., VASSILOPOULOS A. 2009: Mapping Geomorphological Environments. Springer, Berlin Heidelberg, 235.
- PERICA D., OREŠIĆ D., TRAJBAR S. 2005: "Geomorfološka obilježja doline i poriječja rijeke Krke s osvrtom na dio od Knina do Bilušića buka", *Geoadria* 10, 2, 131-156.
- ROGLIĆ J. 1957: "Zaravni na vapnencima", *Geografski glasnik* 19, 1, 103-134.