

# The Marble of Roman Imperial Portraits

---

**Attanasio, Donato; Bruno, Matthias; Prochaska, Walter; Yavuz, Ali Bahadir**

*Source / Izvornik:* **ASMOSIA XI, Interdisciplinary Studies on Ancient Stone, Proceedings of the XI International Conference of ASMOSIA, 2018, 185 - 194**

**Conference paper / Rad u zborniku**

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

<https://doi.org/10.31534/XI.asmosia.2015/02.02>

*Permanent link / Trajna poveznica:* <https://urn.nsk.hr/urn:nbn:hr:123:076952>

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

*Download date / Datum preuzimanja:* **2024-11-27**



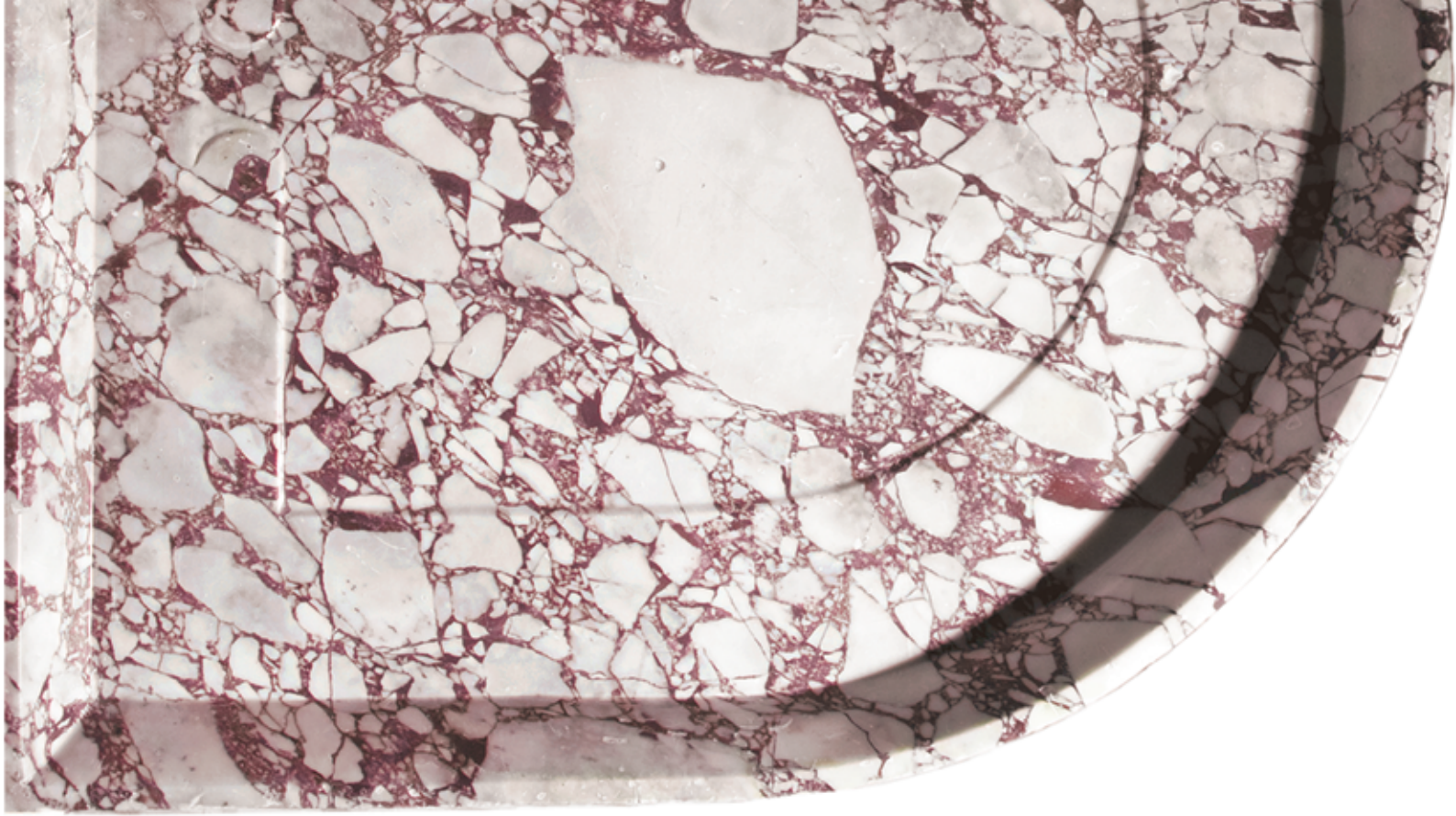
*Repository / Repozitorij:*

[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

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

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



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

|  |     |
|--|-----|
| Grey and Greyish Banded Marbles from the Estremoz Anticline in Lusitania<br><i>Pilar Lapuente, Trinidad Nogales-Basarrate, Hernando Royo Plumed,<br/>Mauro Brilli and Marie-Claire Savin</i> .....                                 | 391 |
| New Data on Spanish Marbles: the Case of <i>Gallaecia</i> (NW Spain)<br><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:<br>Problems of Style, Iconography, and Marble Type in Determining Provenance<br><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<br>(Toledo, Spain) in the Visigothic Necropolis<br><i>Virginia García-Entero, Anna Gutiérrez García-M. and Sergio Vidal Álvarez</i> .....         | 427 |
| Imperial Porphyry in Roman Britain<br><i>David F. Williams</i> .....   | 435 |
| Recycling of Marble: Apollonia/Sozousa/Arsuf (Israel) as a Case Study<br><i>Moshe Fischer, Dimitris Tambakopoulos and Yannis Maniatis</i> .....  | 443 |
| Thasian Connections Overseas: Sculpture in the Cyrene Museum (Libya)<br>Made of Dolomitic Marble from Thasos<br><i>John J. Herrmann and Donato Attanasio</i> .....   | 457 |
| Marble on Rome's Southwestern Frontier: Thamugadi and Lambaesis<br><i>Robert H. Tykot, Ouahiba Bouzidi, John J. Herrmann and Annewies van den Hoek</i> .....   | 467 |
| Marble and Sculpture at Lepcis Magna (Tripolitania, Libya):<br>a Preliminary Study Concerning Origin and Workshops<br><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,<br>Pittsburgh, Pennsylvania<br><i>Albert D. Kollar</i> .....  | 491 |
| Analysis of Classical Marble Sculptures in the Michael C. Carlos Museum,<br>Emory University, Atlanta<br><i>Robert H. Tykot, John J. Herrmann, Renée Stein, Jasper Gaunt,<br/>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<br><i>Natalia Toma</i> .....  | 513 |
| The Stones of Felix Romuliana (Gamzigrad, Serbia)<br><i>Bojan Djurić, Divna Jovanović, Stefan Pop Lazić and Walter Prochaska</i> .....   | 523 |
| Aspects of Characterisation of Stone Monuments from Southern Pannonia<br><i>Branka Migotti</i> .....   | 537 |

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

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

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

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

# THE MARBLE OF ROMAN IMPERIAL PORTRAITS

Donato Attanasio<sup>1</sup>, Matthias Bruno<sup>2</sup>, Walter Prochaska<sup>3</sup> and Ali Bahadır Yavuz<sup>4</sup>

<sup>1</sup> Istituto di Struttura della Materia, Consiglio Nazionale delle Ricerche (ISM-CNR), Rome, Italy (donato.attanasio@ism.cnr.it)

<sup>2</sup> Via dei Vascellari 34, Rome, Italy (matthiasbruno@libero.it)

<sup>3</sup> Department of Geosciences and Geophysics, University of Leoben, Leoben, Austria (walter.prochaska@unileoben.ac.at)

<sup>4</sup> D.E.Ü Engineering Faculty, Geological Engineering Department, Izmir, Turkey (bahadir.yavuz@deu.edu.tr)

## Abstract

The marble provenance of 163 Roman Imperial portraits, stretching approximately over 500 years, has been established with the purpose of obtaining quantitative, diachronic data on the use of sculptural marbles in Roman times. The overall result shows that Göktepe was the most widely used variety (45%) followed at a great distance by the Parian *lychnites* (27.5%), whereas other marbles such as Carrara or Docimium played a more limited role. The use of Göktepe for high quality portraits, already known in Trajanic times, became widespread from the early 2<sup>nd</sup> century AD and apparently reached its apogee under the Severans continuing to be widely used till late antiquity. The significance of these results on the technical and stylistic trends that were popular at Rome in Imperial times is briefly discussed.

## Keywords

imperial portraits, marble provenance, Göktepe quarries

## 1. Introduction

Recent work carried out on the sculptural white and black marbles of Göktepe seems to suggest that they were among the most prized varieties used for fine sculpture, particularly during the middle and late Imperial times. Approximately 500 statues, mostly white but also including many black artifacts, have been tested at Rome, Aphrodisias and in many provincial sites in Italy, North Africa, and other regions of the Empire.<sup>1</sup> The results show that Göktepe is the source of approximately 160 sculptures corresponding almost to 1/3 of the total. With only one exception, the black Canephorae that decorated the house of Augustus and are now in the Palatine Antiquarium, all the black marble sculptures tested proved to be Göktepe *bigio morato* or *nero antico*. The white variety, sporadically used already in Julio-Claudian

times, apparently became, from the early 2<sup>nd</sup> century AD, the most prized marble for manufacturing top-quality portraits and ideal sculptures, largely replacing other marbles such as the Parian *lychnites* that were dominant in earlier periods. The success met by the marbles of Göktepe increased during the mid and late 2<sup>nd</sup> century AD, apparently reaching its apogee in Severan times but continuing to be widely used till late antiquity. Extensive provenance data have been published and the reader is referred to specific publications for details.<sup>2</sup>

Obviously this large amount of unexpected results is drawing increasing attention: recent handbooks on Roman marbles acknowledge the existence and role of Göktepe<sup>3</sup> and a growing number of research groups is taking into account the possibility of Göktepe provenance by including published quarry data<sup>4</sup> into their databases.<sup>5</sup> Despite this, the role and the importance of the site have not yet been fully perceived. Reasons include the novelty of the results and the fact that new provenance data are not easily accommodated within a frame of quarries and provenances that seemed to be well established. In addition, most Göktepe studies have been carried out, up to present, by a single research group lacking the cross-check validation that is much needed for any new scientific achievement. Luckily enough, this problem is being overcome: new groups plan to survey the quarries obtaining and characterizing new quarry samples<sup>6</sup> while the use of existing data is slowly spreading.

There is, however, a different and more important reason that makes it difficult to understand in detail the role played by Göktepe and other sculptural marbles in Roman times. This is the lack of systematic data that would allow precise estimates of the share of each marble

1 BRUNO *et al.* 2015.

2 ATTANASIO *et al.* 2013; 2014; BRUNO *et al.* 2015.

3 RUSSELL 2013, 339-343; PENSABENE 2014, 359-360.

4 ATTANASIO *et al.* 2015.

5 LAPUENTE *et al.* 2012a; 2012b; PENSABENE *et al.* 2015.

6 WIELGOSZ-RONDOLINO 2015.

| Period                           | No. of artefacts | Provenance  |             |             |            |                                |
|----------------------------------|------------------|-------------|-------------|-------------|------------|--------------------------------|
|                                  |                  | Göktepe     | Lychnites   | Carrara     | Afyon      | Other marbles                  |
| Caesar and Julio-Claudian        | 28<br>17%        | 0           | 21<br>75%   | 6<br>21.4%  | 0          | Pa II (1)<br>3.6%              |
| Flavian                          | 9<br>5.5%        | 0           | 2<br>22.2%  | 4<br>44.4%  | 0          | Pe (2); Pro (1)<br>33.3%       |
| Trajanic                         | 9<br>5.5%        | 2<br>22.2%  | 4<br>44.4%  | 2<br>22.2%  | 0          | Pe (1)<br>11%                  |
| Hadrianic                        | 18<br>11.0%      | 11<br>61.1% | 2<br>11.1%  | 3<br>16.7%  | 0          | Aphr (1); Th Vathy (1)<br>11%  |
| Early Antonine<br>ca. 138-162 AD | 15<br>9.2%       | 8<br>53.3%  | 3<br>20%    | 2<br>13.3%  | 1<br>6.7%  | Th Vathy (1)<br>6.7%           |
| Late Antonine<br>ca. 163-192     | 36<br>22.1%      | 19<br>52.8% | 2<br>5.5%   | 0           | 8<br>22.2% | Various marbles (7)<br>19%     |
| Severan                          | 30<br>18.4%      | 24<br>80%   | 1<br>3.3%   | 0           | 3<br>10%   | 1 (Aphr), 1 (Th Vathy)<br>6.7% |
| Late Empire                      | 18<br>11.0%      | 10<br>55.5% | 0           | 1<br>5.5%   | 0          | Various marbles (7)<br>38.9%   |
| Total                            | 163<br>100%      | 74<br>45.4% | 35<br>21.5% | 18<br>11.0% | 12<br>7.4% | 24<br>14.7%                    |

Table 1. Summary marble provenance of the 163 Imperial portraits tested grouped into eight chronological periods

for different types of sculptures within different archaeological contexts and periods of time. The present work is a preliminary attempt to fill the gap by focusing on the analysis of 163 Imperial portrait sculptures, mostly coming from Rome and stretching over several centuries. The artifact choice was suggested by the known fact that portraiture played a major role in Roman art and the sculptures were generally made using carefully selected marble varieties. This is especially true for portraits of Emperors and other members of the imperial family, that, especially when coming from Rome, were top-quality productions and offer the additional advantage of fairly well-known chronologies.<sup>7</sup>

## 2. The sampled artifacts

The 163 portraits discussed in this work extend from Julio-Claudian times to late antiquity. Two portraits of Caesar are included, while the latest artifact is a portrait of Valens or perhaps Honorius (Capitoline Museums, inv. 494) dated to the end of the 4<sup>th</sup> or beginning

of the 5<sup>th</sup> century AD. For the purpose of chronological analysis the portraits, which span a total time lapse of ca. 500 years, were grouped into eight categories (Table 1). Unfortunately the overall time distribution is not as homogeneous as would be desirable. Some groups, such as those of the Flavian or Trajanic periods, include only a limited number of sculptures. The chronological inhomogeneity may obviously bias the distribution results obtained for the less numerous groups and represents a problem that, it is to be hoped, future work will correct.

The selection includes 30 different emperors and 22 members of the imperial families. Many historical figures are represented just by one or few portraits. In other instances, however, several items could be sampled: up to 13 for Antoninus Pius or 14 for Marcus Aurelius. Most artifacts were analyzed specifically for this work, others were tested in the past for different purposes and two were taken from the literature.<sup>8</sup> The portraits, whose original locations were in most cases Rome, come from 16 different museums or archeological sites, among which the National Archaeological Museum at Naples

<sup>7</sup> It is important to note that some of the portraits have been re-worked and therefore their true chronology is earlier than the time of the Emperor that is being portrayed.

<sup>8</sup> They are the so-called Augustus of Prima Porta now in the Vatican Museums and the togatus statue of Caligula in the Virginia Museum of Fine Arts (inv. 71.20) that are both unquestionably made of Parian *lychnites*.



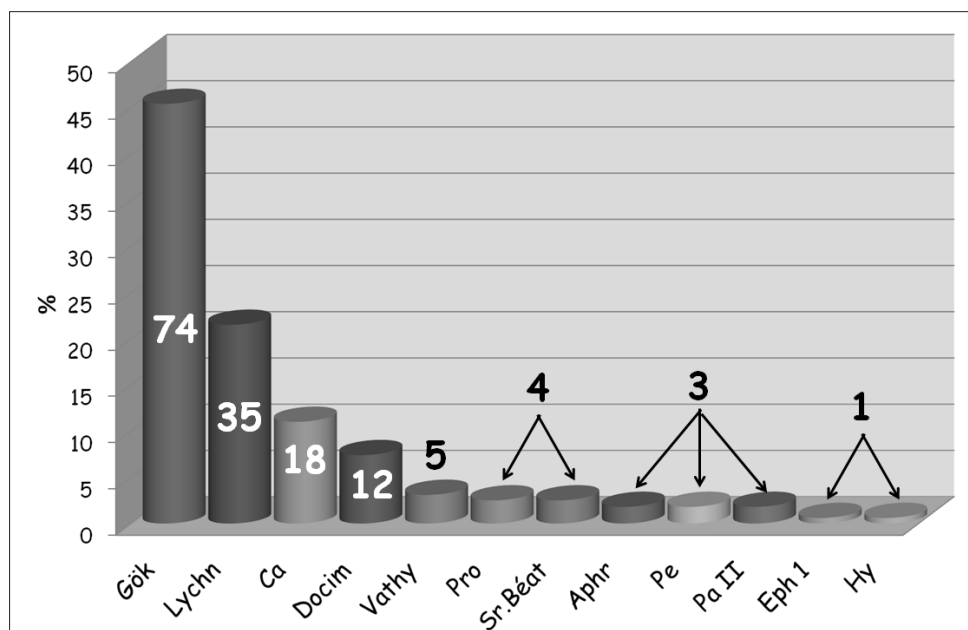


Fig. 1. Distribution histogram of the 12 different marble varieties identified by testing 163 Roman Imperial portraits

(35), the Roman villa of Chiragan (33), Palazzo Massimo in Rome (28), the Uffizi galleries in Florence (19), the Capitoline Museums in Rome (6) and the Louvre (4) can be recalled.

No sample selection, trying to sort out likely Gök-tepe candidates, was attempted. The obvious reason is that the purpose was to obtain an unbiased selection of sculptures capable of reproducing as closely as possible the actual distribution of the marble. Moreover, sampling imperial portraits is a problematic task that, even when possible, allows only extremely small samples to be obtained. Therefore the very simple strategy adopted was that of sampling whatever became available.

It must be added that presenting in detail all the results goes far beyond the limits of a conference paper. Therefore, only a summary account of the work will be given here. However, the marble distribution results and corresponding histograms that are the most important outcome of the work are drawn taking into account the complete set of analyses.

### 3. Experimental methods and marble database

The portrait marbles were characterized by isotopic, EPR, grain size and trace metal analyses, the latter focusing on Mn, Sr, and Fe data. The experimental procedures and the methods of data analysis have been repeatedly discussed in the past and the reader is referred to previous publications for details.<sup>9</sup> Considering that the marbles used for the portraits show a range of different

properties a relatively ample selection of the general marble database had to be used including 12 different marble sites. Many of them are known to produce marbles exhibiting distinctly different properties. For this reason the sites selected as possible provenances correspond to the 20 different marble groups summarized below:

Carrara, Hymettos, Pentelicon, Paros (3 groups), Thasos (2 groups), Altıntaş, Aphrodisias, Afyon, Ephesos (3 groups), Gök-tepe (2 groups), Proconnesos (2 groups), St. Béat (2 groups).

Only purely local varieties or marbles clearly incompatible with the properties of the archaeological samples were neglected. In contrast with this, the quarry selection includes the St. Béat site in the French Pyrenees. This is due to extensive work carried out at Toulouse on sculptures coming from the Roman villa of Chiragan and other locations in the area. Some of these portraits, in fact, particularly the late antique artifacts coming from Chiragan and known as the “dynastic group”<sup>10</sup> proved to be made of local St. Béat marble.

### 4. Results

#### 4.1. General remarks

The histogram of Figure 1 shows that the portraits tested were manufactured using 12 different marbles. It is worth noting, however, that four varieties alone, that is, Gök-tepe, *Lychnites*, Carrara and Docimium, account for the great majority of sculptures (139 examples, 85.3%). Among them Gök-tepe is by far the most frequent (74

<sup>9</sup> ATTANASIO *et al.* 2013; PROCHASKA, GRILLO 2010; PROCHASKA 2013.

<sup>10</sup> BALTY, CAZES 2008, 123-140.

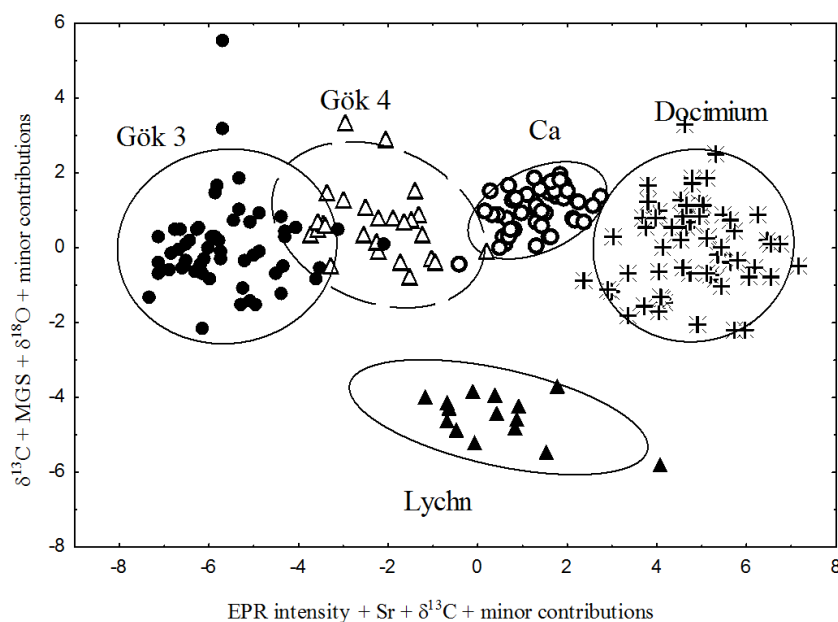


Fig. 2.  
Multi-method  
discrimination of the four  
most used portrait marbles,  
using a combination of  
isotopic, EPR, strontium  
and grain size data

examples, 45.4%) followed at a great distance by Parian *lychnites* (35 samples, 21.5%). On this basis it can be stated that within the whole period of time spanned by the sculptures (ca. 500 years), Göktepe was the marble most commonly used by far. Aside from the four varieties just mentioned, the use of other marbles appears to be sporadic and does not exceed 3%, as demonstrated by five artifacts made of Thasian dolomite, the marble that ranks fifth in the frequency list.

Before proceeding to more detailed analyses, however, it is necessary to consider the question of reliability. Using the quarry selection mentioned in section 3, the rate of success of the method is 75%. This means that 75% of the database samples are re-assigned correctly to their true quarries of provenance leaving non-negligible possibilities of misclassification. However, if the database is more properly tailored, according to specific artifact properties, the rate of success increases considerably. In this way it can be shown that the subset of fine-grained marbles (7 groups, MGS  $\leq$  1.0 mm) can be discriminated approximately at the 95% level. A second point to mention is the fact that individual provenances are based on probability parameters that allow us to distinguish reliable from uncertain assignments quite clearly. In the present case only very few provenances turned out to be statistically uncertain and always refer to the less used marbles. Probably the most problematic example is a portrait identified as Maximianus Herculeus now in the Museum of Fine Arts at Boston (inv. 61.1136). Although statistical analysis indicates that Hymettian marble was used, the probability values are low and this could be, in fact, another Göktepe marble artifact.

None of the assignments involving the four main marbles mentioned above seem to be questionable and

this is clearly demonstrated by the multi analytical graph of Figure 2 that shows that the fields of Göktepe, *Lychnites*, Carrara and Docimium are almost completely separated and allow easy and safe assignments.

#### 4.2. Selected provenance results

Among the many examples that can be mentioned the four portraits of Trajan from the Roman villa of Chiragan shown in Figure 3 are especially important because they represent the earliest use of white Göktepe marble identified for Imperial portraits. Figure 4a shows that samples Ra58b and Ra58c are clear examples of Göktepe marble, whereas Ra58a and Ra117 were made using *lychnites* and Luna marble, respectively. Before Trajanic times no example of a Göktepe portrait could be found. The isotopic graph of Figure 4b shows that *lychnites* was the marble of choice in the Julio-Claudian period, whereas Carrara apparently took the lead in Flavian times. As already noted, however, the nine Flavian portraits tested are too few to obtain conclusive evidence; in addition, none of three marbles identified in this period shows a clear primacy.

A sharp change occurred at the beginning of the 2<sup>nd</sup> century AD when the use of Göktepe marble grew substantially. Obviously the use of other varieties did not disappear but Göktepe became by far the most sought after marble used for sculpture. The famous portrait of Hadrian discovered near the Stazione Termini and now at Palazzo Massimo (inv. 124491), the beautiful posthumous portrait of Trajan in the Museum of Ostia (Fig. 5), the portraits of young Hadrian and Sabine in Hadrian's Villa, two portraits of Lucius Verus (inv. 1131 and 1170) and one of Marcus Aurelius (inv. 1179) found in the villa at Acqua Traversa and now at the Louvre, as well as many



Fig. 3. The four Chiragan Trajan's portraits tested at Toulouse. Ra58b (a) and Ra58c (b) are Göktepe marble; Ra 58a (c) is lychnites and Ra117 (d) is Luna marble from Carrara

other examples are all made using the white marble of Göktepe, whereas a fourth portrait of Lucius Verus also in the Louvre (inv. 1094) proved to be Docimium marble from Iscehisar (Fig. 4c). Additional famous Antonine artifacts are the portrait of Commodus as Herakles in the Capitoline Museums (inv.1120) and the beautiful Getty Museum portrait of Commodus, whose authenticity is still controversial. The two sculptures shown in Figure 6 and commonly considered to be of Carrara marble, are, in fact, further examples of Göktepe marble as clearly shown by the graph of Figure 4c.

The most striking results, however, were obtained analyzing Severan portraits. Ten portraits of Caracalla were tested: nine of them proved to be Göktepe, whereas the last one (Capitoline Museums, inv. 468) is made of the marble from the so-called urban quarries of Aphrodisias (Fig. 4d).<sup>11</sup> All in all, 30 Severan portraits were tested and

24 of them, that is 80%, turned out to be Göktepe marble. During the late Empire the trend did not change. Ten of the 18 portraits tested (55.6%) proved to be Göktepe and the percent rises to 71% if the four Chiragan portraits tested in Toulouse and known as the dynastic group are neglected. They are late provincial artifacts that were manufactured using the local St. B at marble. Figure 4e illustrates the Göktepe provenance of the two latest sculptures: the portraits of Valens in the Uffizi (inv. 273) and in the Capitoline (inv. 494). This latter, in fact, can be even later if the identification as Honorius is accepted.

Beyond the exact number of Göktepe artifacts identified and the diachronic information that they imply, the aim of this brief overview was that of demonstrating the widespread use of Göktepe and the clear evidence with which it can be identified, if proper analyses are carried out. In the past, most of the Göktepe sculptures mentioned above were considered to be Carrara, owing to the fact that the two marbles are very similar not only macroscopically, but also petrographically and

11 In general such homogeneous use of marble for the portraits of a single Emperor is not the rule. For instance five different marbles were identified for the 13 portraits of Antoninus Pius: Göktepe (7), *Lychnites* (2), Carrara

(2), Docimium (1), Thasian dolomite (1).

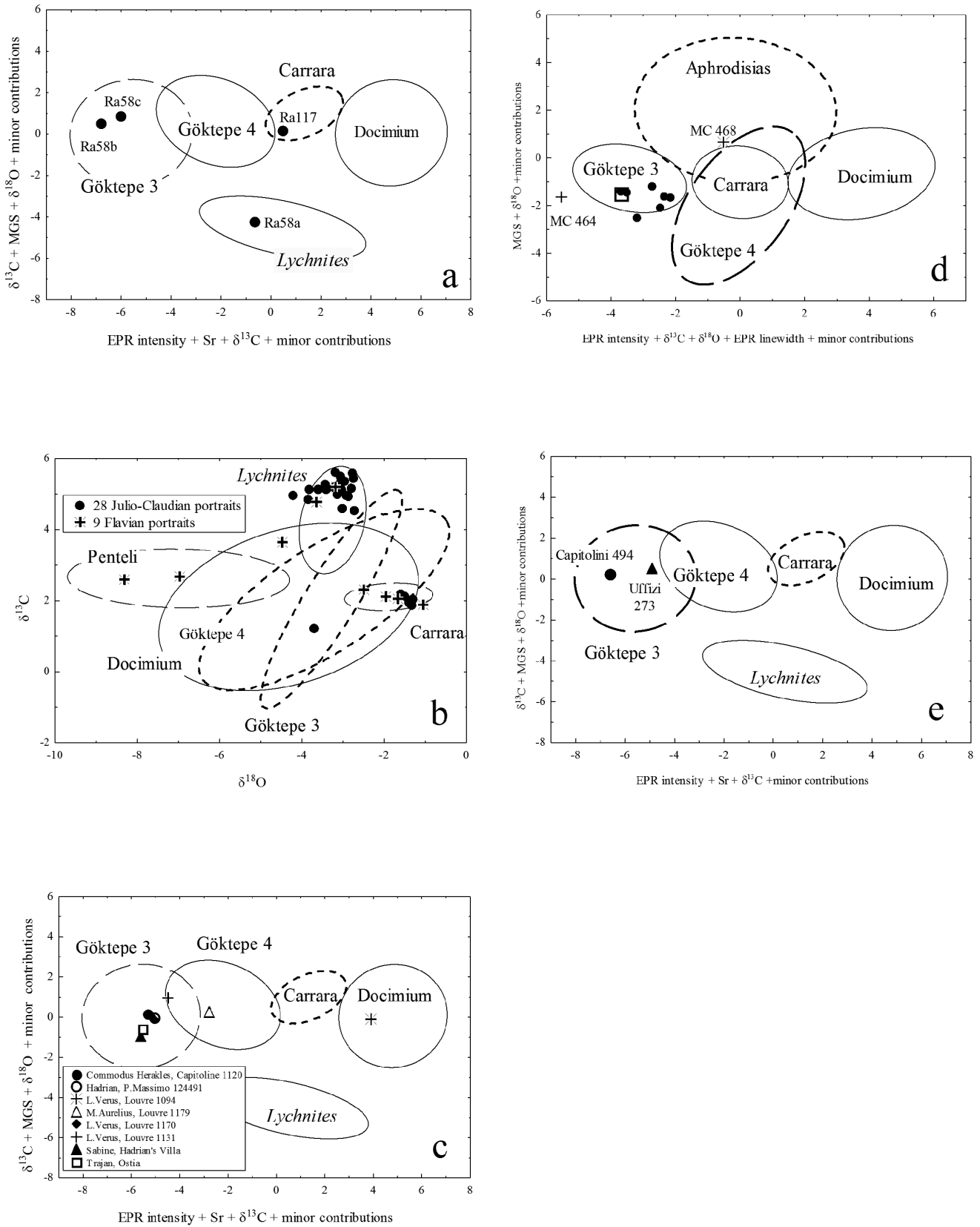


Fig. 4. Provenance of selected artifacts: (a) four Chiragan Trajan's portraits made of Göktepe, lychnites and Carrara marble; (b) overall isotopic graph of 28 Julio-Claudian and 9 Flavian portraits showing the widespread use of lychnites in the 1<sup>st</sup> century AD; (c) selected Hadrianic and Antonine portraits mostly made of Göktepe marble; (d) ten portraits of Caracalla nine of which are Göktepe and one marble from the Aphrodisias city quarries; (e) portraits of Valens in the Uffizi and Valens or perhaps Honorius in the Capitoline Museums both made of Göktepe marble. These are the latest artifacts tested

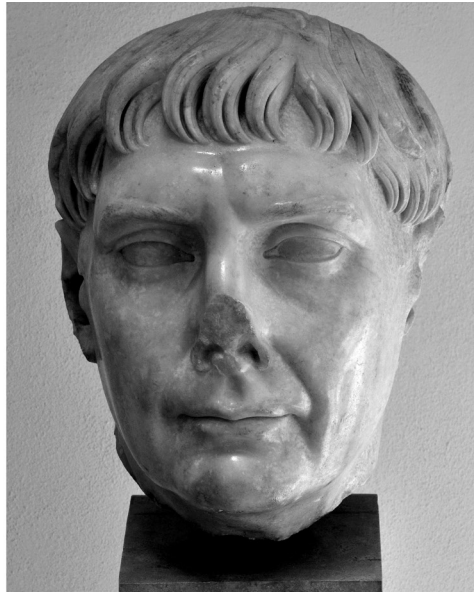


Fig. 5. Göktepe marble portraits of Hadrian (Palazzo Massimo, Rome inv. 124491, so-called Stazione Termini type) to the left and Trajan (posthumous portrait, Museum of Ostia Antica) to the right



Fig. 6. Selected Göktepe marble portraits of Commodus from the Capitoline Museums (Commodus as Herakles, inv. 1120, left) and the Getty Museum (portrait bust, inv. 92SA48, right)

isotopically. However, they differ completely in terms of trace composition. The problem of Carrara/Göktepe discrimination is discussed in detail in another paper in this volume<sup>12</sup> and is based on the very high strontium content and very low concentration of manganese typical of the latter, which unmistakably mark the provenance and allow easy and unquestionable identification.

#### 4.3. Overall distribution and diachronic data

The provenance results obtained in this study deliver important diachronic information, illustrated by the graphs of Figures 7 and 8, which can be summarized as follows:

- Use of the marble of Göktepe for fine portrait sculpture and in particular Imperial portraits started at the turn of the 1<sup>st</sup> and 2<sup>nd</sup> centuries, at the time of Trajan and rapidly spread and became dominant under the reign of Hadrian. The trend continued till late antiquity with percentages that,

12 PROCHASKA, ATTANASIO, BRUNO in this volume.

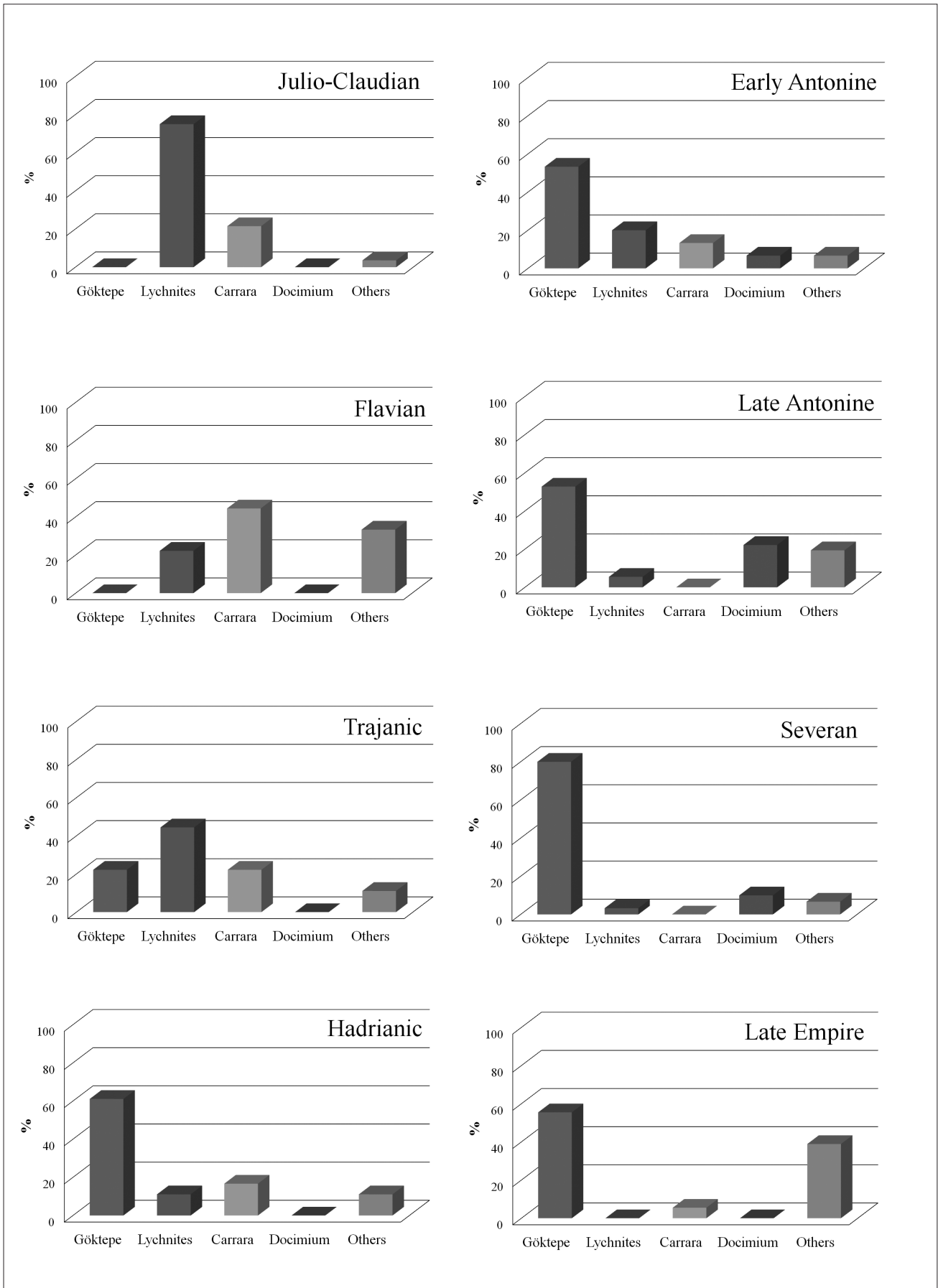


Fig. 7. Histograms of marble distribution during the eight time periods used for chronological portrait classification

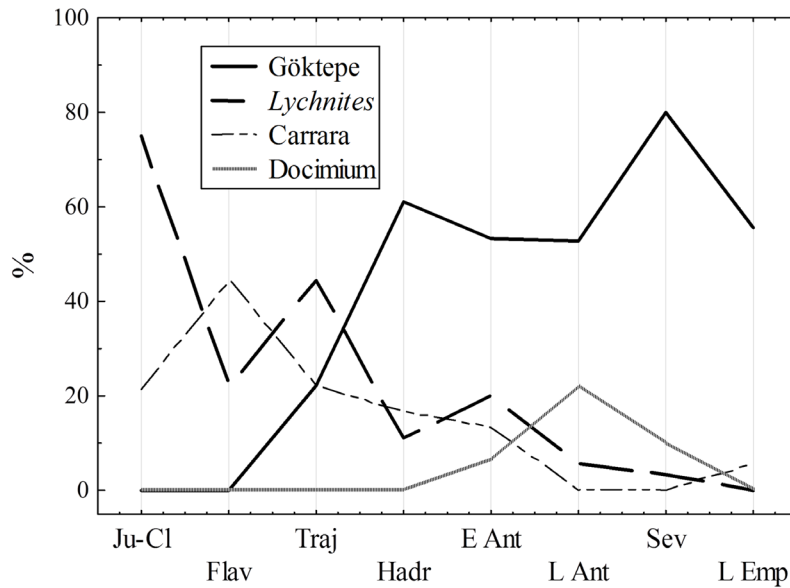


Fig. 8. Scatterplot illustrating diachronically use of the four most important marble varieties employed for Imperial portraiture

using the present data set, rise to 80% in Severan times and never go below the 53% value measured for the late Antonine period.

- Correspondingly the use of other marbles changed substantially. The Parian *lychnites* that till the mid-first century AD were the marble of choice for this type of sculpture (75%) underwent a strong decrease in later periods almost disappearing from the late 2<sup>nd</sup> century onwards.
- The case of Carrara is different. Apart from a slightly decreasing trend that is visible but not fully clear, the novel result is that the role of this marble seems to be greatly reduced with respect to previous results. The reason is that in the past most Göktepe portraits were misclassified as Carrara on the basis of visual inspection or incomplete or unsuitable analyses.
- The use of Docimium is also limited and seems to be restricted to Antonine and Severan times when a wider suite of different marbles was used.
- The presence of other marbles is quite limited and becomes significant only if they are considered as a whole (15%).
- Higher values were obtained only in Flavian (33%) and Later Empire times (39%). The former result is due to the popularity that Pentelicon marble enjoyed in the late 1<sup>st</sup> century AD, suggesting that in this case it should be added to the list of the most important marbles. At variance with this, the 39% value measured for the Late Empire is strongly biased by the analyses of four provincial Chiragan portraits, the “dynastic group” already mentioned, that were made using the local St. Béat marble.

Of course the present data selection is in many ways limited and preliminary. As compared to the total number of surviving portraits, only a tiny fraction was analyzed and it largely reflects the marble use that was trendy in the Imperial capital, whereas comparable studies carried out in provincial contexts have been deferred. Despite this, there are two main reasons that support, to some extent, the general value of the results. The first is that the sculptures were selected entirely by chance and therefore are considered to represent a relatively unbiased set, reproducing fairly well the actual distribution of Imperial portrait marbles. Secondly the change in the marble used, particularly the replacement of *lychnites* by Göktepe, appears to be sharp and pervasive to such an extent that it can hardly be substantially modified by increasing the number of portraits tested in Rome.

## 5. Conclusions

The extraordinary success met by the marble of Göktepe as the material of choice for high quality sculptures including Imperial but also private portraits and ideal sculpture poses a number of problems involving the reasons for this success and the influence that it may have exerted on the sculptural styles that became fashionable in the second century and later. Obviously no conclusive answers can be given here and much more work will certainly be needed to obtain a satisfactory solution. Nevertheless certain questions can be posed and some preliminary and tentative explanations can be attempted.

The decreased use of Parian *lychnites* and the search for alternative sources of fine quality marble may have been fostered by the depletion of Parian quarries that were not able anymore to produce the amount of the best quality varieties that were needed. There are no

quantitative data on this possibility, however, and it must be recalled that the use of *lychnites* continued well into the third century and later, though on a much reduced scale. The Göktepe alternative however, is not immediately obvious: the site is rather small and unfavourably located with the consequence that the production was relatively limited and stone transport difficult and expensive. The excellent quality of the marble, of course, is important and certainly played a key role; still it does not seem to be able by itself to explain the extraordinary success met by this variety. Several alternatives existed and Göktepe does not seem to be so much superior in appearance or carving properties to the best qualities of Docimium or Luna marble. In conclusion it may be argued that the crucial point was the tight connection existing between Göktepe and the Aphrodisian craftsmen who promoted its use and were the most prominent sculptors of their time owing to the stylistic and technical novelties that they introduced. Their signatures, which explicitly mention the ethnicity of the artist, and the marble, that comes predominantly from Göktepe or sometimes from the city quarries of Aphrodisias, were used apparently to certify the Aphrodisian workmanship and to act in some way as a mark of origin.

The Göktepe-Aphrodisias association, however, refers mostly to the introduction and early use of the marble. Later on, the sculptural use of Göktepe became pervasive, implying that it was adopted by the most renowned sculptural ateliers in Rome whether or not they had Aphrodisian origin or connections. Following a reasoning that is certainly hypothetical but also likely and to some extent inescapable it must be admitted that it would be difficult to assume that the urban ateliers borrowed from Aphrodisians only the marble without adopting, at least partly, the technical and stylistic peculiarities that fostered their fame. To conclude it may be stated that marble studies seem to emphasize the role played by the Aphrodisian sculptors in determining the stylistic trends that developed in Rome during the Imperial period, providing a crucial contribution to what is commonly called the urban style of sculpture.

## BIBLIOGRAPHY

- ATTANASIO D., BRUNO M., PROCHASKA W., YAVUZ A. B. 2013: "The Asiatic Marbles of the Hadrian's Villa at Tivoli", *Journal of Archaeological Science* 40, 4358-4368.
- ATTANASIO D., BRUNO M., YAVUZ A. B. 2014: "On the Provenance of Some Sculptural and Decorative Marbles Used at Aphrodisias", *Rend. Mor. Acc. Lincei* 25, 105-151.
- ATTANASIO D., BRUNO M., PROCHASKA W., YAVUZ A. B. 2015: "A Multi-Method Database of the Black and White Marbles of Göktepe Including Isotopic, EPR, Trace and Petrographic Data", *Archaeometry* 57, 217-245.
- BALTY J. C., CAZES D. 2008: *Sculptures antiques de Chiragan, I. Les portraits Romains, I.5 La Tétrarchie*, Musée Saint-Raymond, Toulouse.
- BRUNO M., ATTANASIO D., PROCHASKA W., YAVUZ A. B. 2015: "An Update on the Use and Distribution of White and Black Göktepe Marble from the 1<sup>st</sup> Century AD to Late Antiquity", in *ASMOSIA X*, 461-468.
- LAPUENTE P., LEON P., NOGALES T., ROYO H., PREITE-MARTINEZ M., BLANC Ph. 2012: "White Sculptural Materials from Villa Adriana: Study of Provenance", in *ASMOSIA IX*, 364-375.
- LAPUENTE P., NOGALES T., LEON P., ROYO H., PREITE-MARTINEZ M. 2012b: "Black Sculptural Materials from Villa Adriana: Study of Provenance", in *ASMOSIA IX*, 376-383.
- RUSSEL B. 2013: *The Economics of the Roman Stone Trade*, Oxford University Press, Oxford.
- PENSABENE P. 2014: *I Marmi nella Roma Antica*, Carocci Editore, Roma.
- PENSABENE P., ANTONELLI F., CANCELLIERE S., LAZZARINI L. 2015: "Archaeology and Achaometry of the Marble Sculptures Found in the Villa di Poppea at Oplontis (Torre Annunziata, Naples)", in *ASMOSIA X*, 615-628.
- PROCHASKA W. 2013: "A Sculptural Marble of Prime Quality in Antiquity—the Dolomitic Marble of the Sivec Mountains in Macedonia", *Archaeometry* 55, 179-97.
- PROCHASKA W., GRILLO S. M. 2010: "A New Method for the Determination of the Provenance of White Marbles by Chemical Analysis of Inclusion Fluids: the Marbles of the Mausoleum of Belevi/Turkey", *Archaeometry* 52, 59-82.
- WIELGOSZ-RONDOLINO D. 2015: "Marmora Asiatica 1. Polish Archaeopetrologists in Turkey or the First Season of Fieldwork in Göktepe and Dokimeion" in 37<sup>th</sup> Intern. Symp. of Excavations, Surveys and Archaeometry, Erzurum, May 2015 (abstract).