

Study and Archeometric Analysis of the Marble Elements Found in the Roman Theater at Aeclanum (Mirabella Eclano, Avellino - Italy)

Mesisca, Antonio; Lazzarini, Lorenzo; Cancelliere, Stefano; Salvadori, Monica

Source / Izvornik: **ASMOSIA XI, Interdisciplinary Studies on Ancient Stone, Proceedings of the XI International Conference of ASMOSIA, 2018, 255 - 266**

Conference paper / Rad u zborniku

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

<https://doi.org/10.31534/XI.asmosia.2015/02.09>

Permanent link / Trajna poveznica: <https://um.nsk.hr/um:nbn:hr:123:359955>

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

Download date / Datum preuzimanja: **2025-03-12**



Repository / Repozitorij:

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





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 Ruppiniè 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

STUDY AND ARCHEOMETRIC ANALYSIS OF THE MARBLE ELEMENTS FOUND IN THE ROMAN THEATER AT AECLANUM (MIRABELLA ECLANO, AVELLINO – ITALY)

Antonio Mesisca¹, Lorenzo Lazzarini², Stefano Cancelliere² and Monica Salvadori³

¹ Dipartimento di Scienze dell'Antichità, Università La Sapienza, Rome, Italy (mesisca.antonio@virgilio.it)

² Laboratorio di Analisi dei Materiali Antichi (LAMA), Università IUAV di Venezia, Venice, Italy (lorenzo@iuav.it; stefano@iuav.it)

³ Dipartimento dei Beni Culturali, Università di Padova, Padua, Italy (monica.salvadori@unipd.it)

Abstract

Marble finds relative to the statuary, architectural features and inscriptions unearthed during the archaeological investigation of the public area in the Roman town of *Aeclanum* (Province of Avellino, Campania-Italy), offered an opportunity to undertake an archaeometric study in order to determine their constituent marble species and the sites where they were quarried, so to be able to delineate the socio-economic dynamics closely linked to the circulation of marble and its supply to centres in the hinterland of Campania in Roman times. The techniques used in the study included minero-petrographic (OM on thin section and XRD on powders) and isotopic analyses (SIRA, on powders). The combined petrographic-isotopic analyses showed a clear prevalence of Lunense marble in architectural structures, in floor and wall facings, in inscriptions and in statuary, with the sole exception of the armoured statue of Emperor M. Aurelius, of the corresponding *paludamentum* in Pentelic marble, and finally of the fragment of a female portrait sculpture in Parian marble. The conspicuous presence of Lunense marble is in effect associated with two clear phases, the first linked to building activities carried out in *Aeclanum* in the Augustan Age, after the territory belonging to the town became part of the *patrimonium principis*, and the second linked to its development in the Antonine Age, following the upgrading of the town to *Colonia Aelia Augusta Aeclanensium*.

Keywords

Campania, Aeclanum, (Mirabella Eclano, Avellino-Italy) Roman marbles, archaeometry

Introduction

This contribution reports on the systematic study of stone finds unearthed from the archaeological layers relating to various stages in the life, abandonment and

subsequent despoliation of the theater in the town of *Aeclanum* in ancient Irpinia, now within the municipal area of Mirabella Eclano in the Province of Avellino. The ancient settlement of *Aeclanum* lies on a natural, approximately triangular terrace, pointing S-SE towards the wide Fontanelle valley, at an altitude of around 390 m a.s.l.

The monumental remains that still make up the urban fabric date from the last phase of the town's life, i.e. to the period following the 346 AD earthquake, of which there are clearly visible traces, until the urban area was abandoned, fell into disrepair and suffered complete transformation.

The materials investigated for this research came from the excavations carried out by the archaeologist R. Esposito, which began in August 2006 and continued until December 2009. The campaign documented evidence of an imposing monumental complex close to the forum area, a *scaena frons* built on a rectangular plan with a façade featuring alternately spaced semicircular and rectangular niches faced with marble.

The abundance and variety of marble species found in *Aeclanum* are certainly a consequence of the fact that it lay approximately halfway along the much-used Appian Way and of the high level of wealth achieved by the town's élite.

The evidence gathered from a systematic and global examination of all the marble remains documented for the town of *Aeclanum* and the typological elements that enable the remains to be placed within a precise chronological framework show that the town enjoyed a period of considerable prosperity, especially from the Augustan Age onwards. This was due to several different factors, including its favourable position on a thoroughfare of primary importance, the only made-up road between Rome and the port of Brindisi and therefore inescapably the route to Greece and the Orient, and doubtless also its proximity to the strategic commercial crossroads of *Beneventum* during the Imperial Age.

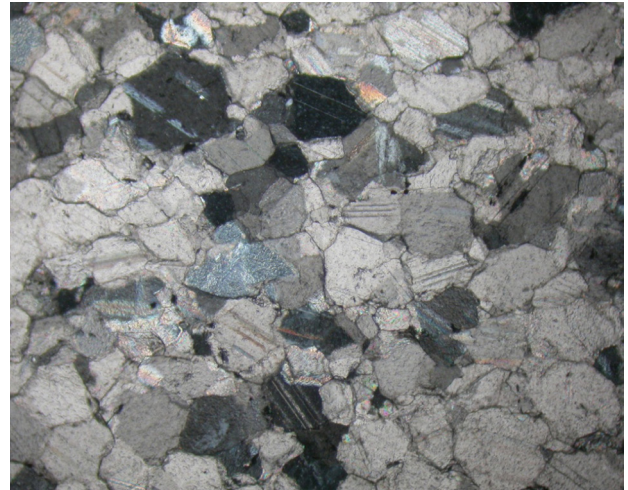


Fig. 1. A portion of curvilinear Ionic sub-cornice

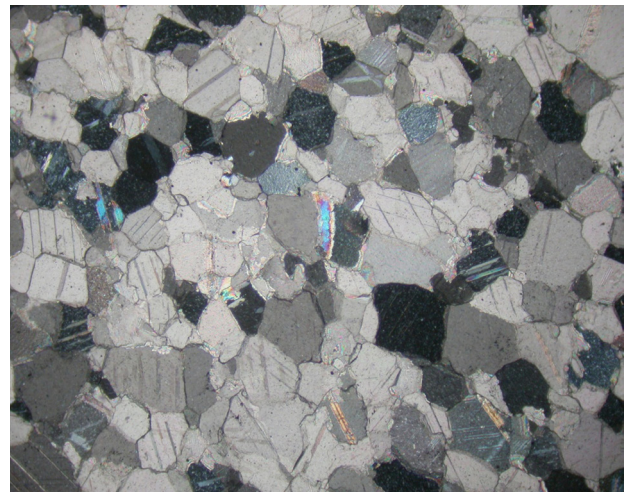


Fig. 2. A fragment of a cornice with a rounded pod-shaped decoration

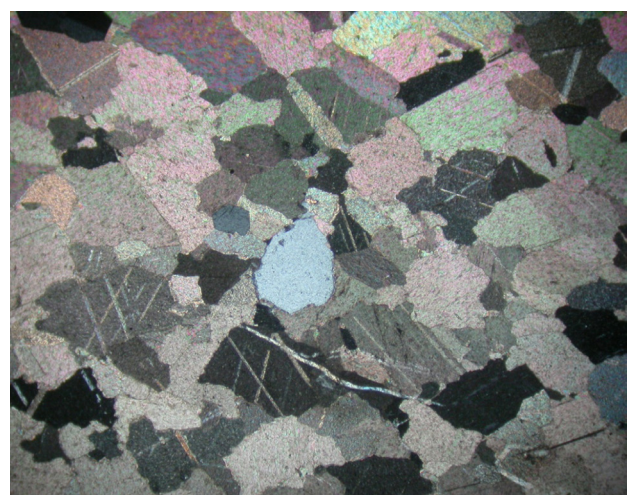


Fig. 3. A Corinthian capital

The materials examined

The systematic archaeological and archaeometric study of the stone remains found in layers pertinent to the site of *Aeclanum* was undertaken not only in order to accumulate as much information as possible about the stones themselves but also in the conviction that the results would contribute to a more general reconstruction of the socio-economic dynamics associated with the trade in stone materials, with the methods for sorting and distributing them and with the symbolic meaning connected with the use of particular lithotypes.

The research took into consideration architectural elements, statuary and stone used to face walls, pave floors and bear inscriptions.

The architectural elements comprise:

- a portion of a curvilinear Ionic sub-cornice (inv. AEC200701) (Fig. 1), the upper band featuring a continuous Ionic cyma containing a succession of egg (ovolo) mouldings set in concave shell elements, alternating with dart-shaped separators; the middle band features a row of dentils which are longer than they are wide and the bottommost moulding has a trilobate Lesbian cyma with viola flowers linked by trilobate arcuate elements containing a lanceolate, single-ribbon leaf; the piece can be dated to the Julio-Claudian period;
- a fragment of a cornice (Fig. 2) with a rounded pod-shaped decoration (inv. AEC200702), composed of adjacent vertical concave arched elements, with an intermediate element separating them from a continuous Lesbian cyma with butterfly-wing mouldings; the piece can again be dated to the Julio-Claudian period;
- a Corinthian capital (inv. AEC200704) with two orders of acanthus leaves (Fig. 3) featuring the typical late-Augustan motif (STRONG 1963; PENSABENE 2007); the acanthus has small ogival leaves, their lobes, like those of the calyxes, separated by elongated drop-shaped hollowed out recesses. The lobes have rounded leaf-ends, the upper ones superimposed on the lower leaves of the inner row. Above these a third row of stems is slightly inclined and surmounted by a convex upper fillet, from which rise the leaves of the calyxes that support the volutes and the helixes. An ogival leaf replaces the calyx of the stem that terminates in the flower of the abacus, which is no longer visible. This type can be dated to the Late Augustan-Tiberian period, 10 – 30 A.D.;
- a cornice bracket (inv. AEC200705) (Fig. 4), with an ogival acanthus leaf, the lobes of which feature elongated drop-shaped hollowed out recesses; the top of the leaf is concave and at its tip there is a

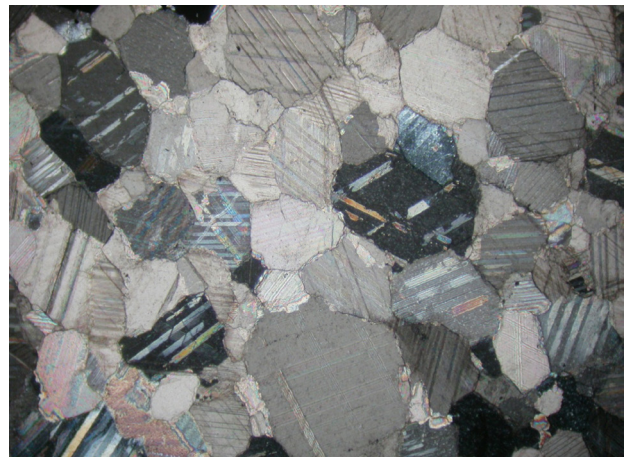


Fig. 4. A cornice bracket

fascies motif carved in relief; the piece can be dated to the Julio-Claudian period.

The facing elements comprise:

- the curved cornice of a niche (inv. AEC200706) (Fig. 5) the front face of which has a smoothly finished cavetto moulding, *cyma recta* terminating with a narrow fillet;
- a fragment from a pilaster (inv. AEC200707) (Fig. 6) framed on both sides by a fillet (MATHEA FÖRTSCH 1999; MESOLELLA 2007), and decorated with clusters of tulips and wreaths of five-petalled lotus flowers and frontal-view open leaves;



Fig. 5. The curved cornice of a niche

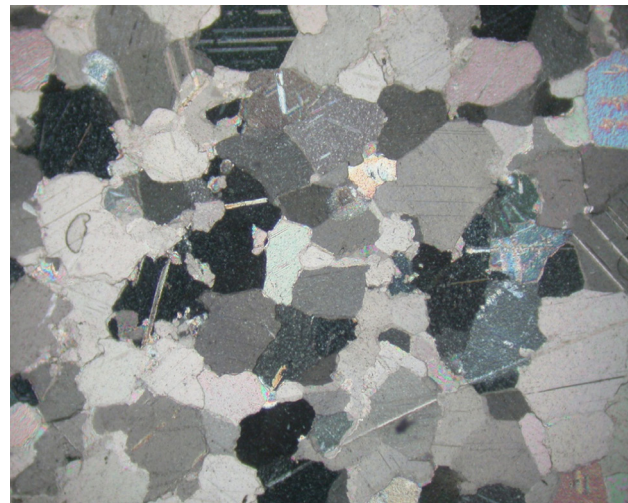
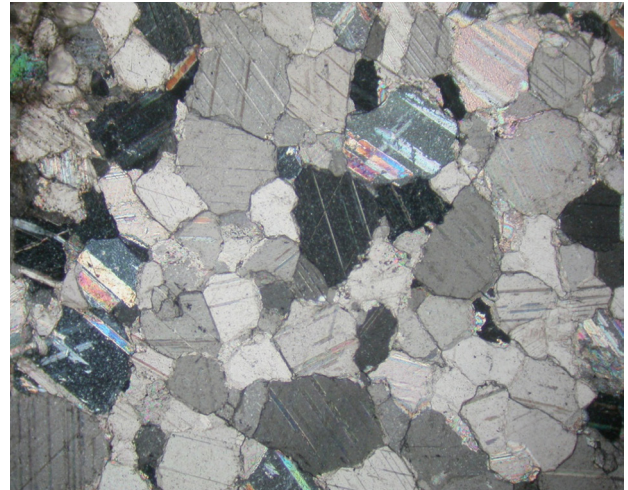


Fig. 6. A fragment from a pilaster

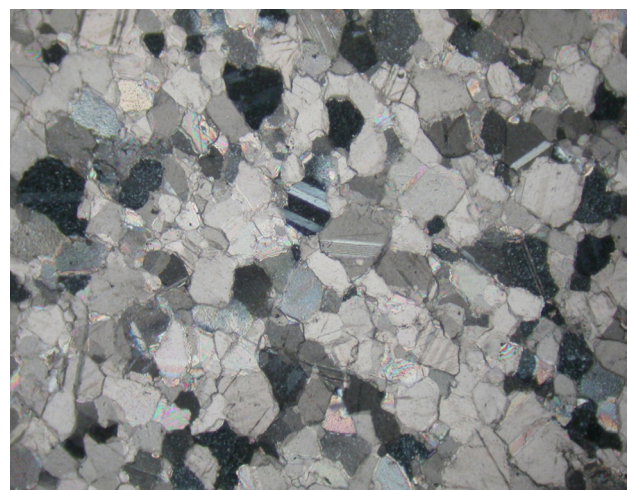
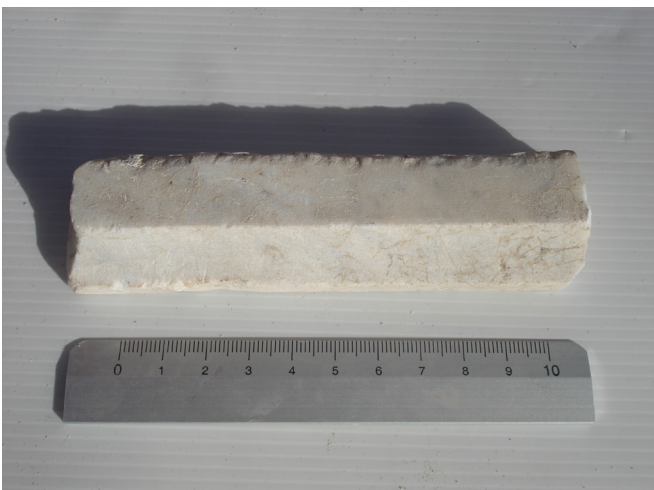


Fig. 7. A fragment of a straight coping element



Fig. 8. A fragmentary portrait

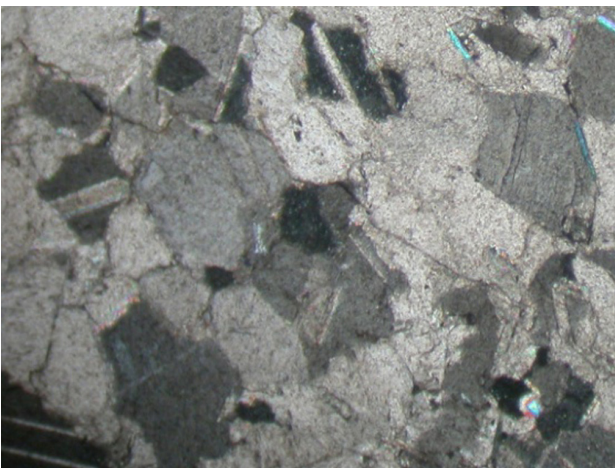
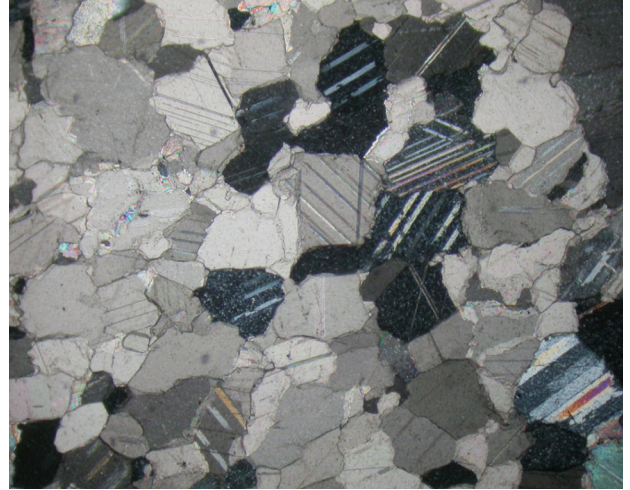


Fig. 9. A headless loricated statue

- a fragment of a straight coping element (inv. AEC200708) (Fig. 7), rectangular in shape but with a square cross-section, with smooth moulding. Samples were also taken from items of statuary, including:
- a fragmentary portrait (inv. AEC200709 - 228288) (Fig. 8) with facial features (nose, chin, lips and part of an ear) associated with typically classicist sculptural styles (STEWART 2003; SCHOLLMMEYER 2007).
- a headless loricated statue (inv. AEC200711) (Fig. 9) with a gorgon decorating the breastplate top centre, shoulder plates and a *paludamentum* cape with well-defined folds (inv. AEC200710) (Fig. 10); the central part of the breastplate features two winged Victories flanking a trophy resting on a reversed palm motif and coils of narrow ribbons; hanging from the breastplate are two rows of elongated, figured pendants with rounded terminations (BABELON 1886; STUART JONES 1912; BERNOULLI 1889-1891; STRONG 1969; STEWART 2003; SCHOLLMMEYER 2007). The statue is attributed to the Emperor M. Aurelius because of the distinctive decoration of the breastplate (*lorica*), which is a frequent feature of coins issued during his reign (BABELON 1886; COHEN 1892);
- a fragment from a portrait of a female figure (inv. AEC200712) (Fig. 11), whose hairstyle and a portion of a heavily marked eyebrow enable the sculpture to be dated to the end of the Flavian or the beginning of the Antonine period (STRONG 1969; STEWART 2003; SCHOLLMMEYER 2007).

The sampled materials subjected to archaeometric analysis also included epigraphic supports, such as a fragment of a public inscription (inv. AEC200713) (Fig. 12) containing a reference to the civic institution of the IIII VIRI. The presence of this mention enables the piece to be placed between the town's designation as a

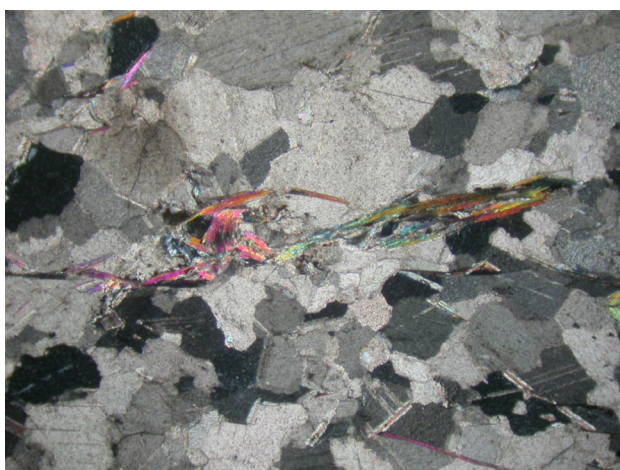


Fig. 10. A *paludamentum* cape

municipium (1st century B.C) and its elevation to *colonia* status (in the course of the 2nd century A.D.). Another fragment of a public inscription bearing a *titulus pictus* or merchant's mark (inv. AEC200714) (Fig. 13) can be dated to the end of the 1st cent. B.C. and the second half of the 1st century A.D.

Mineralogical-petrographic analyses

As is well known, the ability to identify, on the basis of scientifically obtained evidence, the quarry of provenance and the exact nature of the stone used in a sculpture or a building, in facing or as the support for an inscription, can assume various kinds of archaeological importance. It can lead to information about the studio where the piece was produced, it can help in attributing finds to a specific school, and it can provide useful leads in efforts to map the chronological and geographical distribution of a given lithotype, to the reconstruction of land trade routes and thence to information about storage and supply centres, in the present case for the hinterland of Campania.

Thin section of the samples of all the lithotypes found in the roman theater were studied under a polarizing microscope in order to determine their mineralogical composition and petro-fabric to ensure correct petrographic classification. Non-marble items, including both those made of imported ornamental stone and those of locally quarried lithotypes, will be covered in a future publication.

The samples of crystalline marbles were studied in greater detail, and in order to ensure they could be identified with certainty, they were also subjected to analysis of the stable isotopes of carbon and oxygen using dedicated mass spectrometry.

The following characteristics of each marble were noted when it was examined in thin section under the microscope:

- its fabric, an important parameter in that this relates directly to the type and grade of metamorphism undergone by the marble;
- the outline shape of the grains of calcite; this too relates directly to the type of metamorphic genesis undergone by each marble;
- the maximum dimension of the largest grain of calcite (MGS = maximum grain size), given its considerable importance for diagnostic purposes (MOENS *et al.*, 1988);
- the presence and quantity of accessory minerals (other than calcite and/or dolomite).

The quarry from which each marble was sourced was identified by comparing the results obtained with the petrographic-isotopic data bank of reference (LAZZARINI *et al.* 1980; GORGONI *et al.* 2002; LAZZARINI 2004; ANTONELLI, LAZZARINI 2015).

Isotopic analyses were carried out on the CO₂ produced by addition of superpure phosphoric acid at a temperature of 25°C, on a sample quantity of 20-30 mg of sample powder in a special vacuum line according to the procedure suggested by McCrea (McCREA 1950).

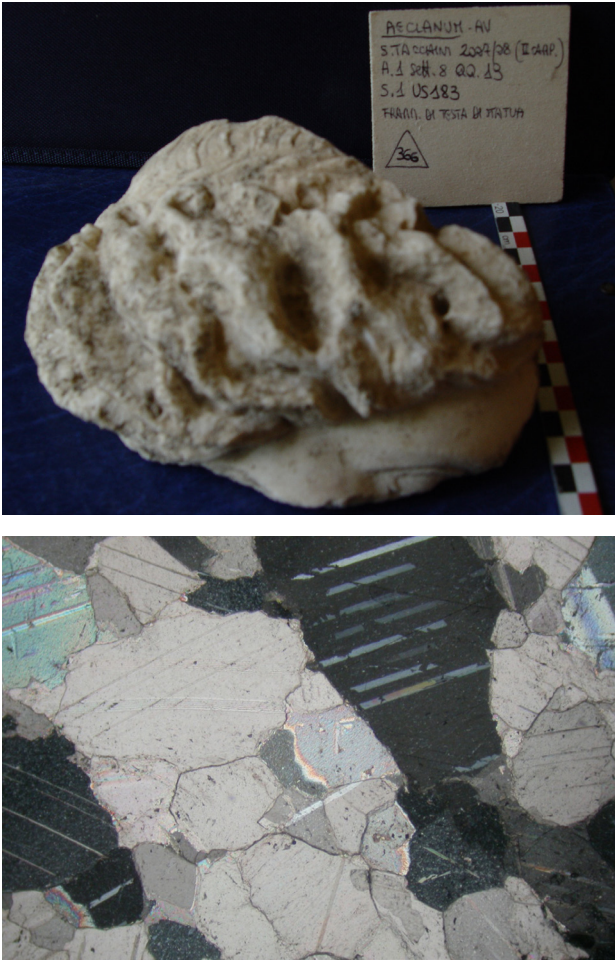


Fig. 11. A fragment from a portrait of a female figure

This CO₂ was then analysed in a mass spectrometer equipped with a triple collector, which enabled simultaneous measurements to be made of the isotopic ratios ¹³C/¹²C and ¹⁸O/¹⁶O.

The results thus obtained were expressed as per convention in δ units (parts per thousand) according to the equation:

$$\delta = \left[\frac{R_{\text{camp}}}{R_{\text{std}}} - 1 \right] \times 1000$$

in which R_{camp} and R_{std} stand respectively for the isotopic ratio of the carbon and the oxygen in the sample and in the reference standard. The standard adopted for both the carbon and the oxygen was PDB (based on the Cretaceous marine fossil, *Belemnitella americana*, from the Pee Dee Formation in South Carolina (CRAIG 1957)). For isotopic identification of the marbles, reference was made to the Herz database and to the isotopic diagram of Gorgoni (GORGONI *et al.* 2002; ATTANASIO *et al.* 2006; ANTONELLI, LAZZARINI 2015).

Finally, the samples were also subjected to a standard diffractometric analysis (radiation CuKα/Ni, at 40 Kv, 20 mA), to ascertain whether they contained any dolomitic fractions.



Fig. 12. A fragment of a public inscription

Results and discussion

This research project focused on a total of 13 samples subjected to archaeometric analysis. The samples were divided into four groups: architectural and facing elements, statuary and inscriptions. As Table 1 shows, the results obtained from the petrographic analyses are in large part sufficient to determine that most of the marbles examined were quarried in the Apuan Alps. The isotopic analyses (Tab. 1) confirmed this clear prevalence of Carrara marble in all four groups; indeed, all the Carrara marble samples seem to have come from the same quarry (Fig.14), with the sole exception of the

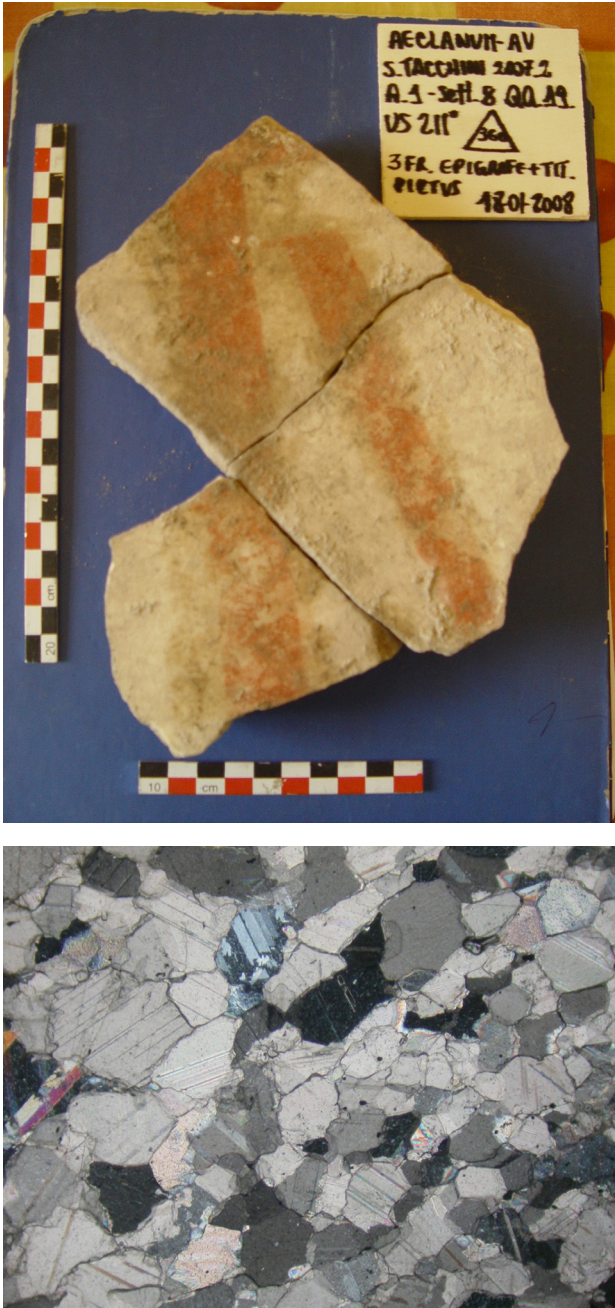


Fig. 13. A public inscription bearing a *titulus pictus*

fragment of decorated pilaster. The only samples shown not to be Carrara marble were the loricated statue and its *paludamentum* cape; these are made of Pentelic marble and the similarity of the relative isotopic readings shows that both were cut from the same block of marble. The fragment of a striking female portrait is made of the famous Parian *lychnites* marble, which came from the cave-quarries in what is now Stephani.

On the basis of the data currently available to us it may reasonably be assumed that a late-Republican phase characterised by the use of local limestones and sandstones quarried locally, or at least in the Campanian area, as is the case with the town walls and their facing

in *opus reticulatum*, was probably succeeded, from the reign of Augustus in the early imperial period, by extensive use of Carrara marble and the probable employment of skilled workers in connection with projects sponsored by the emperor (PENSABENE 2005). This imported labour would appear to be evident, for example, in the fine workmanship seen in the Corinthian capital, and in the sub-cornice with dentils, Ionic *cyma* and trilobite Lesbian *cyma*, though local workshops may also have played a marginal, albeit still undocumented role.

The abundance of Carrara marble must be associated with the urbanization undertaken in the centre of *Aeclanum* in the Augustan period, when the town became part of the *patrimonium principis* and (CIL, IX, 1105; CIL, X, 1117) later in the Antonine period following its elevation to *Colonia Aelia Augusta Aeclanensium* governed by *duoviri*.

The loricated statue with its *paludamentum*, in Pentelic marble, requires separate consideration; the care lavished on the details in the decoration at the centre of the breastplate suggests that the work was not done by local craftsmen but by specialists, probably itinerant, in the representation of imperial power. That the emperor in this case was Marcus Aurelius (CIL, IX, 1111) is clear from the fact, as mentioned earlier, that the motif of two winged victories and a trophy occurs frequently on coins issued during his reign. It is difficult to establish from the meagre data available whether the sculpture was finished *in loco* or whether work on it was already complete when it reached *Aeclanum*.

The female head is also of considerable interest given that it is made of a costly marble and so must have been commissioned by an especially wealthy person.

Supply and circulation of marbles

Many questions still remain to be answered concerning the distribution of marbles in the various centres of the empire, in particular whether they were first transported to Ostia or Rome and stored there before being forwarded to their final destination, or whether they were carried directly from the embarkation port to the end-user. It may well be that both alternatives occurred, depending on historical period, the nature of the commission, the role of the state in sponsoring the construction of certain public buildings and the role of the local aristocracy in the bestowal of private wealth for public good.

Admittedly there is no systematic overall survey of all the documented marble items found in *Aeclanum* and of typological elements allowing us to create a sound chronological framework of reference; but we need only to take account of the town's proximity to the Appian Way, the only route between Rome and the port of Brindisi, and thence to Greece and the Orient, and it

ARTEFACT	Camp N° AEC	FABRIC		Outline of Calcite/ Dolomite crystals	M.G.S.	Quartz	K-mica	Chlorite	Plagioclase	Apatite	Opaque mins.	Carbon./ Graphite Subst.	Dolomite (XRD)	d ¹⁸ O PDB (-)	d ¹³ C PDB (+)	PROBABLE PROVENANCE
Ionic frieze	12	HO	mosaic	Embayed	0,86							++	-	1,61	2,33	Apuan Alps (Carrara, Italy)
Cornice	9	HO	mosaic	Curved	0,64	±	±				± P, Hm	++	-	1,52	2,12	Apuan Alps (Carrara, Italy)
Corinthian capital	3	HO	Mosaic, slightly foliated	Curved	0,96	+						++	-	1,94	2,04	Apuan Alps (Carrara, Italy)
Bracket	6	HO	mosaic	Curved	1,20	±			±		±	++	-	1,96	2,14	Apuan Alps (Carrara, Italy)
Niche cornice	8	HO	mosaic	Curved	0,56							+	-	1,52	2,12	Apuan Alps (Carrara, Italy)
Fragment of pilaster with plant dec.	4	HE	mosaic	Embayed	1,16	+++	±					+++	+	1,52	1,59	Apuan Alps (Carrara, Italy)
Coping element	10	HO	mosaic	Curved	0,58		±				± P	++	-	1,87	2,03	Apuan Alps (Carrara, Italy)
High-relief head	13	HO	mosaic	Embayed	0,86							++	-	1,61	2,23	Apuan Alps (Carrara, Italy)
Paludamentum of a statue	1	HO	Mosaic, well foliated	Embayed	0,80	++	++					++	-	5,87	2,62	Mount Pentelicus (Athens, Greece)
Statue of Marcus Aurelius	2	HO	Mosaic, well foliated	Embayed	1,22	+	++	±				++	-	5,70	2,44	Mount Pentelicus (Athens, Greece)
Female statue	5	HE	mosaic	Curved / Embayed	1,46							++	-	3,97	4,97	Stephani (Island of Paros, Greece)
Inscription III Vir	11	HO	mosaic	Curved	1,04						± P, Hm	++	-	1,60	2,05	Apuan Alps (Carrara, Italy)
Inscription with titulus pictus	14	HO	mosaic	Embayed	0,72						± P, Hm	++	-	1,69	2,13	Apuan Alps (Carrara, Italy)

Table 1. Summary of the results of minero-petrographic and isotopic analyses (HO, homeoblastic; HE, heteroblastic; +++, very abundant; ++, abundant; +, present; ±, traces; P, Pyrite; Hm, Hematite)

becomes possible to speculate that the marbles may have arrived as early as the I century AD, and in any case well before the campaign of rebuilding and renovation undertaken during the rule of the Emperor Hadrian.

In the light of this chronology, we should not exclude the possibility that marble artefacts may have reached *Aeclanum* from both Adriatic and Tyrrhenian ports, together with commodities and fine crockery. In this connection it is important to stress how the advantageous position of Campania compared with the rest of Italy, and even more importantly the direct efforts of the emperor, from the beginning of his reign, in the construction and restoration of monumental works, offer clear pointers to the primary importance the towns and cities of Campania had in the context of the establishment of the empire and

the exceptional economic, commercial and strategic importance of roads, harbours and extensive imperial properties in both ports and hinterland centres.

The economic and political scenario in the internal parts of Campania seems to have changed with Trajan's decision to alter part of the route taken by the Appian Way, which stayed unchanged as far as Benevento but then by-passed the Irpinian section in order to expedite and facilitate the transport of goods from Rome to Brindisi in a period of considerable building activity and military expansionism (JOHANNOWSKY 1994).

The construction of Trajan's new section of the Appian Way - the *via Appia Traiana* - led inevitably to seriously disadvantageous consequences for the town of *Aeclanum*, which now found itself excluded as a trading

centre. So to prevent the marginalization of such areas of the interior a link road was built between *Aeclanum* and *Herdonia* (Ordona) CIL, III, 1456), an important trading post on the Via Appia Trainana in Puglia, whose prosperity received a considerable boost by virtue of its position on this important new road (GOFFREDO, FICCO 2009). The *Via Aurelia Aeclanensis*, as it was called, guaranteed *Aeclanum* and its markets a rapid and efficient link to the centres on the Via Appia Traiana and to the Adriatic coast, especially for goods passing through the port of Brindisi; similarities in style and the use of materials underline that the relationship between the two centres must have been close, and there were instances of *gentes* of *Aeclanum* owning vast estates in *Apulia*.

The work to restructure the *Beneventum-Aeclanum* section, carried out first by Hadrian (CIL, IX, 6072, 6074, 6075) and later by Marcus Aurelius (CIL, IX, 1111), shows that, despite its distance from the Via Appia Traiana, *Aeclanum* tried to ensure that its link with *Beneventum* stayed speedy and straightforward because it was strategically crucial as regards traffic and trade, not only along land routes but also via water (GANGEMI 1987) given the access it provided to a river port at the confluence of the Rivers Sabato and Calore (EBANISTA *et al.* 2006). Precisely because of the presence of facilities relating to a river port, it would be useful to build up a picture of which goods and commodities reached *Beneventum* via the River Calore, which joins the River Volturno at Amorosi and flows on through Capua and finally enters the Tyrrhenian Sea at Castel Volturno.

Just as we know happened for *Minturnae*, where the navigability of the River Liri enabled supplies to reach centres in the interior and links to be maintained with the road system until the Middle Ages, it can be assumed that the River Volturno, considering its size and flow, enabled foodstuffs and other materials (Liv., XXIII, 15, 3, 4; XXIII, 17, 10) to be transported towards the centres of *Capua* and *Allifae* and finally along the River Calore to the important colony of *Beneventum*.

As things stand at the moment, we do not have sufficient evidence to support the theory that the River Calore was wholly navigable beyond *Beneventum*; what does appear indisputable is the role of the Samnite town in the Late-Republican period in the distribution of commodities and other goods, which probably included stone materials, to and from the neighbouring centres including *Aeclanum*, so we may suppose that there was both a land link along the Appian Way and along the River Calore, which was navigable at least as far as Ponte Rotto in the district of Morrone in the town of Apice.

The results of the archaeometric analyses carried out, together with archaeological data concerning style and provenance, enable us to state that the supply of commodities and other goods including stone, by land

or river, was connected with internal factors in the town such as the evergetism and munificence of the ruling classes, but also with external factors including the town's participation in imperial schemes or direct action on the part of the central powers.

In conclusion, it is probable, taking into account the purchasers, the provenance and the logistics of the goods in question, that they were transported overland from the late-Republican period until the rule of Augustus, whereas from the Julio-Claudian period, when the river port at Benevento was created or expanded (GIAMPAOLA 1991; CIPRIANO, DE FABRIZIO 1996; EBANISTA 2006), and with the construction of the Via Traiana in the II century, the River Calore was also used.

BIBLIOGRAPHY

- ANTONELLI F., LAZZARINI L. 2015: "An isotopic reference database for white crystalline marbles used in antiquity", *Rendiconti Lincei Scienze Fisiche e Naturali* 26, 4, 399-413.
- ATTANASIO D., BRILLI M., OGLE N. 2006: The isotopic signature of classical marbles, Todi (PG).
- BABELON E. 1886: *Monnaies de la republique romaine*, *Rolli net Feuardent*, I, 41, 49, 56, 77, 54.
- BERNOULLI 1889-1891: *Röm. Ik.*, II, 2, Stuttgart 1889-1891, 162-187.
- BRUNO M. 2002: "Considerazioni sulle cave, sui metodi di estrazione, di lavorazione e sui trasporti", in M. DE NUCCIO, L. ONGARO (eds.): *concept by P. PENSABENE, L. LAZZARINI: I marmi colorati nella Roma imperiale*, Venezia.
- CERAUDO G. (ed.) 2012: *Lungo l'Appia e la Traiana: le fotografie di Robert Gardner in viaggio con Thomas Ashby nel territorio di Beneventum agli inizi del Novecento*, 2012.
- CIPRIANO M. T., DE FABRIZIO S. 1996: "Benevento. Il quartiere ceramico di Cellarulo: prime osservazioni sulla tipologia ceramica", in M. BATS (ed.): *Les céramiques communes de Campanie et Narbonnaise (I^{er} s. av. J.-C. - II^e s. ap. J.-C.)*. La vaisselle de cuisine et de table, *Actes des Journées d'étude organisées par le Centre Jean Bérard et la Soprintendenza Archeologica per le Province di Napoli e Caserta (Naples 27-28 mai 1994)*, Naples, 201-223.
- COHEN H. 1892: *Monnaies frappées sous l'empire*, Akademische Druck-Verlagsanstalt.
- COLUCCI PESCATORI G. 2005: "Città e centri demici dell'Irpinia: Abellinum, Aeclanum, Aequum Tuticum, Compsa" in G. VITOLO (ed.): *Le città campane fra tarda antichità e alto medioevo*, Salerno, 283-312.
- CRAIG H. 1957: "Isotopic standards for carbon and oxygen and correction factor for mass-spectrometric analyses of carbodioxide", *Geoch. Cosmochim. Acta* 12, 133-149.
- DEMMA F. 2004: "Anfiteatro Flavio di Pozzuoli, la decorazione marmorea nella storia edilizia: tipologia e stile, restauri, officine ed artigiani", in E. C. DE SENA, H. DESSALES (eds.): *Metodi e approcci archeologici: l'industria e il commercio nell'Italia antica (British Archeological Reports International series 1262)*, Oxford, 243-261.
- DI GIOVANNI V. 1996: "Aeclanum romana: le evidenze archeologiche", in F. BARRA (ed.): *L'Irpinia Antica, Storia illustrata di Avellino e dell'Irpinia*, I, Salerno, 241-256.
- EBANISTA C., JACOBELLI L., LAPENTA V., PERRONE M. L. 2006: "Ricognizioni archeologiche", in M. ROTILI (ed.): *Benevento nella Tarda Antichità. Dalla diagnostica archeologica in contrada Cellarulo alla ricostruzione dell'assetto urbano*, Napoli, 131-177.
- EBANISTA C. 2006: "Il complesso dei Santi Quaranta: archeologia e storia", in M. ROTILI (ed.): *Benevento nella Tarda Antichità. Dalla diagnostica archeologica in contrada Cellarulo alla ricostruzione dell'assetto urbano*, Napoli, 179-210.
- EVANGELISTI S. 2002-2003: *Aeclanum, ricerche di prosopografia e storia amministrativo-sociale*. Università degli Studi di Bari. Tesi di dottorato in Storia Antica 2002-2003.
- FANT J. 1993: "Ideology, gift and trade: a distribution model for the Roman imperial marbles", in W. V. HARRIS (ed.): *The inscribed economy: production and distribution in the Roman Empire in the light of instrumentum domesticum. The proceedings of a conference held at the American Academy in Rome (10-11 January 1992)*, 1993.
- GALLINA ZEVI A., TURCHETTI R. (eds.) 2004: "Le strutture dei porti e degli approdi antichi", *Proceedings of the II seminar Rome-Ostia Antica*, 16-17 April 2004.
- GANGEMI G. 1987: "Osservazioni sulla rete viaria antica in Irpinia", in: *L'Irpinia nella società meridionale*. *Annali del Centro Dorso*, 117-123.
- GANS U. W. 1992: *Korinthiesierende Kapitelle der römischen Kaiserzeit, Schmuckkapitelle in Italien und den nordwestlichen Provinzen*, Cologne-Weimar-Vienna.
- GIAMPAOLA D. 1991: "Benevento" in: *La Romanisation du Samnium aux II^e et I^{er} siècles av. J. C.*, *Actes du colloque organisé par le Centre Jean Bérard, Naples 4-5 Novembre 1988*, Naples 1991, 123-131.
- GOFFREDO R., FICCO V. 2009: "Tra Ausculum e Herdonia: i paesaggi di età daunia ed età romana nella valle del Carapelle", in G. VOLPE, M. TURCHIANO (eds.): *Faragola I, Un insediamento rurale nella valle del Carapelle*, *Ricerche e studi*, 26-56.
- GORGONI C., LAZZARINI L., PALLANTE P., TURI B. 2002: "An updated and detailed mineropetrographic and C-O stable isotopic reference database for the main Mediterranean marbles used in antiquity", in *ASMOSIA V*, 115-131.
- GUARINI R. 1812: *Ricerche archeologiche sull'antica città di Eclano*, Napoli.
- HEILMEYER W. D. 1970: *Korinthische Normalkapitelle*, Heidelberg.

- HEINRICH H. 2002: *Subtilitas novarum sculpturarum*. Untersuchungen zur Ornamentik marmorner Bauglieder der späten Republik und frühen Kaiserzeit in Campanien, Munich 2002.
- HERZ N. 2000: "The classical marble quarries of Paros: Paros-2 and Paros-3", in D. U. SCHILARDI, D. KATSONOPOULOU (eds.): *Parìa Lithos*. Parian quarries, marble and workshops of sculpture, Athens. 27-33.
- JOHANNOWSKY W. 1991: "Canali e fiumi per il trasporto del grano", *Le ravitaillement en blé de Rome et des centres urbains des débuts de la République jusqu'au Haut Empire*. Actes du colloque de Naples, 14-16 février 1991.
- LAZZARINI L., MOSCHINI G., STIEVANO B. M. 1980: "A contribution to the identification of Italian, Greek and Anatolian marbles through a petrological study and evaluation of Ca/Sr ratio", *Archaeometry* 22, 1, 173-183.
- LAZZARINI L. 2004: *Pietre e marmi antichi: natura, caratterizzazione, origine, storia d'uso, diffusione, collezionismo*, Padova.
- LAZZARINI L. 2007: *Poikiloi Lithoi, Versicolores Maculae: I marmi colorati nella Grecia antica*, Pisa.
- LO PILATO S. 2013, "La *via Appia* tra *Ponte rotto* ed *Aeclanum*", *Studi di Aereotopografia archeologica* 7, 13, 2013, 44-52.
- MATHEA-FÖRTSCH M. 1999: *Römische Rankenpfeiler und -pilaster, Schmuckstützen mit vegetabilem Dekor, vornehmlich aus Italien und den westlichen Provinzen*, Mainz.
- MC CREA J. M. 1950: "On the isotopic chemistry of carbonates and a paleotemperature scale", *J.Chem. Phys.* 18, 849-857.
- MESOLELLA G. 2007: *Architettura e decorazione architettonica nell'edilizia pubblica dei centri costieri del Lazio meridionale. Minturnae, Formiae e Terracina* (Monografie della Rivista Archeologica Classica 4), Roma.
- MOENS L., ROOS P., DE RUDDER J., DE PAEPE P., VAN HENDE J., WAELKENS M. 1988: "A multi-method approach to the identification of white marbles used in antique artifacts", in HERZ N., WAELKENS M. (eds.): *Classical Marble: geochemistry, technology, trade*, NATO ASI series 153, 243-250.
- ONORATO G. O. 1960: *La ricerca archeologica in Irpinia*, Napoli.
- PENSABENE P. 1990: "Trasporto, diffusione e commercio dei marmi: aggiornamenti e nuove interpretazioni", *Pact* 27, 231-264.
- PENSABENE P. 2005: "Marmi e committenza negli edifici di spettacolo in Campania", *Marmora* 1, 69-143.
- PENSABENE P. 2006: "Marmi e reimpiego nella Campania di età romana", *Acta Apuana* 4-5, 2005-2006, 9-28.
- PENSABENE P. 2007: *Ostiensum marmorum decus et decor*. Studi architettonici, decorativi e archeometrici (Studi Miscellanei, 33), Roma.
- QUILICI L. 1999: "La viabilità dell'Italia tardo antica fra continuità e discontinuità", in M. ROTILI (ed.): *Memoria del passato urgenza del futuro. Il mondo romano fra V e VII secolo*. Atti delle VI giornate di studio sull'età romano-barbarica (Benevento 18-20 giugno 1998), Napoli, 175-194.
- RYBACH L., NISSEN H. U. 1964: "Neutron activation of Mn and Na traces in marbles worked by ancient Greeks", *Proceedings of Radiochemical methods of analysis*, Salzburg, 105-117.
- SAPPELLI M. 2004: "L'acconciatura maschile e femminile in età romana", in D. CANDILIO (ed.): *Moda, Costume e bellezza nella Roma antica*, Milano, Mondadori Electa S.p.A., 18-26.
- SCHOLLMEYER P. 2007: *La scultura romana*, Apeiron Editori.
- SPRY A. 1976: *Metamorphic textures*, Oxford.
- STEWART P. 2003: *Statues in Rome society: Representation and response*, Oxford.
- STRONG D. E. 1963: "Some observations on early Roman Corinthian", *Journal of Roman Studies* 53, 1963, 73-84.
- STRONG D. E. 1969: *Roman sculpture from Augustus to Costantine*, New York.
- STUART JONES H. 1912: *The sculptures of the Museo Capitolino*, Oxford.
- TORELLI M. R. 2002: *Benevento romana*, Roma.
- VOLPE G., MERTENS J. 1995: "Il territorio, la viabilità, la produzione agraria", in J. MERTENS (ed.): *Herdonia, Scoperta di una città*, Bari, 291-320.
- WARD-PERKINS J. B. 1983: "Commercio dei marmi nel mondo romano", in *L'Adriatico tra mediterraneo e penisola balcanica nell'antichità: Lecce-Matera*, 21-27 Ottobre 1973, Taranto, 239-245.