

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 Bahadir 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 Silentary, Hagia Sophia, Onyx, Lydia, and Breccia Corallina <i>John J. Herrmann and Annewies van den Hoek</i>	345
Incrustations from Colonia Ulpia Traiana (Near Modern Xanten, Germany) <i>Vilma 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>Marmora</i> from the Late Roman Palatial Building at Carranque (Toledo, Spain) in the Visigothic Necropolis <i>Virginia García-Entero, Anna Gutiérrez García-M. and Sergio Vidal Álvarez</i>	427
Imperial Porphyry in Roman Britain <i>David F. Williams</i>	435
Recycling of Marble: Apollonia/Sozousa/Arsuf (Israel) as a Case Study <i>Moshe Fischer, Dimitris Tambakopoulos and Yannis Maniatis</i>	443
Thasian Connections Overseas: Sculpture in the Cyrene Museum (Libya) Made of Dolomitic Marble from Thasos <i>John J. Herrmann and Donato Attanasio</i>	457
Marble on Rome's Southwestern Frontier: Thamugadi and Lambaesis <i>Robert H. Tykot, Ouahiba Bouzidi, John J. Herrmann and Annewies van den Hoek</i>	467
Marble and Sculpture at Lepcis Magna (Tripolitania, Libya): a Preliminary Study Concerning Origin and Workshops <i>Luisa Musso, Laura Buccino, Matthias Bruno, Donato Attanasio and Walter Prochaska</i>	481
The Pentelic Marble in the Carnegie Museum of Art Hall of Sculpture, Pittsburgh, Pennsylvania <i>Albert D. Kollar</i>	491
Analysis of Classical Marble Sculptures in the Michael C. Carlos Museum, Emory University, Atlanta <i>Robert H. Tykot, John J. Herrmann, Renée Stein, Jasper Gaunt, Susan Blevins and Anne R. Skinner</i>	501
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

NEW DATA ON SPANISH MARBLES: THE CASE OF *GALLAECIA* (NW SPAIN)Anna Gutiérrez Garcia-M.¹, Hernando Royo Plumed² and Silvia González Soutelo³¹ Institut de Recherche sur les ArchéoMATériaux (IRAMAT) - Centre de Recherche en Physique Appliquée à l'Archéologie (CRP2A), Université de Bordeaux Montaigne, Bordeaux, France (anna.gutierrez@u-bordeaux-montaigne.fr)² Institut Català d'Arqueologia Clàssica (ICAC), Tarragona, Spain (hroyo@icac.cat)³ GEAAT. Universidad de Vigo (UVigo), Ourense, Spain (silviagonzalez@uvigo.es)**Abstract**

This paper presents the first results of an ongoing provenance study of some objects aiming to determine which marbles were employed in an area as far apart from the Mediterranean Sea as Roman *Gallaecia* (in the NW of Spain) from an interdisciplinary perspective. These first results help us to understand the trade routes and other mechanisms of the economy and society that produced or enjoyed these objects.

A multimethod analysis (POM, CL and IRMS for C-O isotopic determination) has been applied and compared to our reference collection including well-known Classical as well as most of the Iberian marbles. The results so far show a picture much more complex than anticipated, where the local marble from the area of O Incio (in the south of Lugo province) and other local varieties from the NW region were also exploited and used by the Romans.

Keywords

ancient marbles, provenance study, Roman Galicia

Roman *Gallaecia* (NW Spain): a little-known territory

During the last decades, the understanding of the use of marble in Roman Spain has leapt forward. The works undertaken by some Spanish research teams working on the NE, the Ebro valley, the south (ancient *Baetica* province and modern Murcia) and some central regions have provided a more complete picture of the use of marbles and decorative stones in Hispania. As a result of this, the data about the volume, use and areas of arrival of foreign marbles, such as, for example, the marble of Carrara¹, has significantly increased. Likewise, these studies have revealed the importance and scope of the use of

some high quality Iberian stones that were also used in wider-than-merely-local areas².

Nevertheless, there are still significant gaps regarding some other Iberian territories such as the northwesternmost part (modern Galicia), where no significant work had been done on this subject since the late 70s-80s³. Even though the number of objects made in marble found there is somewhat smaller than in other regions of Spain, they are nonetheless very interesting evidence of the economic mechanisms of the society that produced or consumed them. Besides, the lack of in-depth studies in *Gallaecia* has hindered the capacity not only to grasp the overall historical aspects related to the economic structure and social complexity developed in Roman times in this region but also to complete a global picture of marble use in Roman Spain.

The characterization of such materials⁴ has been addressed as a first and essential step to establish what marbles were used in this territory, for what purpose,

2 Most of their work has been presented in the Proceedings of several scientific meetings in Spain (BELTRÁN, NOGALES 2009; GARCÍA-ENTERO 2014; GUTIÉRREZ GARCIA-M, ROUILLARD 2018) as well as the last ASMOSIA Conferences (GUTIÉRREZ GARCIA-M. *et al.* 2012; PENSABENE, GASPARINI 2015).

3 When A.M. CANTO's ground-breaking paper on marble quarrying in Roman Spain (CANTO 1978), F. BRAEMER (1986) and M. CISNEROS CUNCHILLOS (1988) briefly mentioned the use of the marble from O Incio in Antiquity.

4 This is part of the wider *Marmora Galicia* project, an on-going collaboration between the GEAAT of the University of Vigo, the Catalan Institute of Classical Archaeology-ICAC, in Spain, and the IRAMAT-CRP2A, in France (within the projects HAR2011-25011 and HAR2015-65319-P funded by the MICINN-FEDER as well as the projects "*Marmora et Lapidés Hispaniae...*" and "Graver dans le marbre... (ROMAE)" projects funded by the LaScArBx, a research programme supported by the ANR (ANR-10-LABX-52).

1 GUTIÉRREZ GARCIA-M., RODÀ 2012.

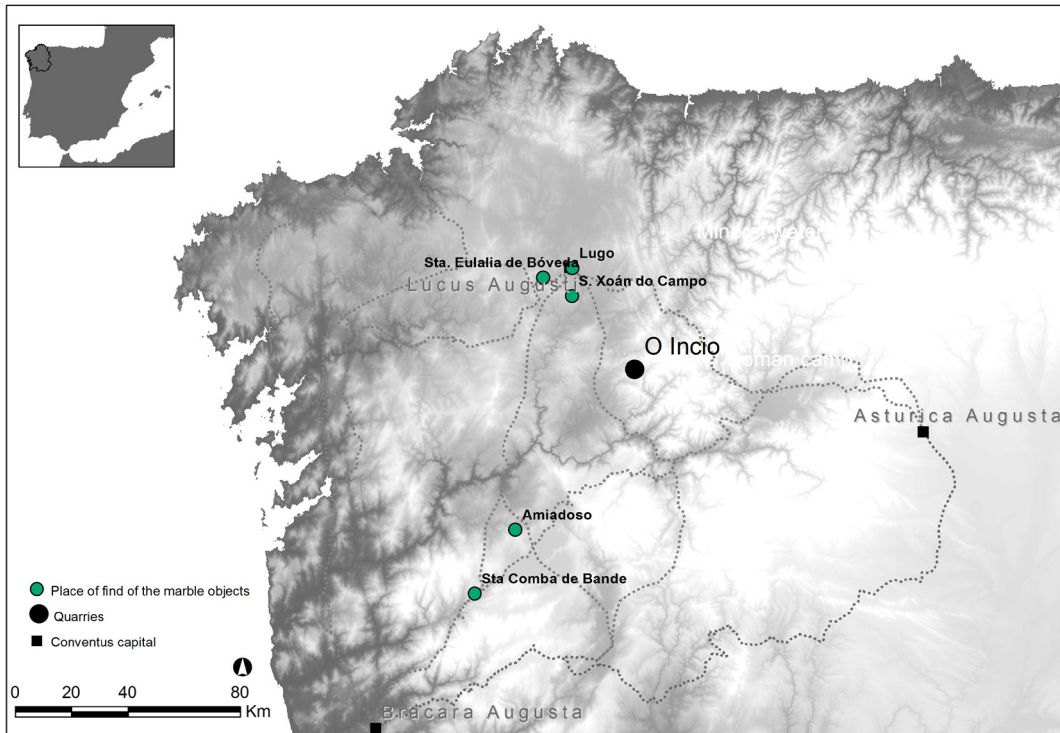


Fig. 1. Location of O Incio and finding place of the archaeological objects included in this work

where they came from, how they arrived at their place of use and the dating of their exploitation or presence in this region, so far away from the Mediterranean and from the most common marble trade networks.

Aware of the difficulties in answering all these broad questions, we considered it to be essential to develop two main, strongly interrelated, lines of study:

- The location of marble archaeological remains. An in-depth search in the literature and museum catalogues has provided data about 150 Roman and Late Roman marble objects found in modern Galicia⁵. They are architectural elements (capitals, columns, etc.), sculpture and carving fragments, inscriptions, altars and sarcophagi, currently in museums, other heritage institutions or still *in situ*, usually reused in pre-Romanesque and Romanesque churches. In order to check or complete the written information, several field trips in this territory were undertaken to locate and visually inspect as many of them as possible.
- The location of the Roman quarries. The identification of the outcrops providing local marble that could have been exploited in Antiquity is key to obtain a reference core of geological samples

5 Which corresponds approximately to the northwest part of ancient *Gallaecia*.

required to undertake provenance studies and to explore the possible existence of a marble industry in Roman *Gallaecia*. Indeed, despite granite being the main stone resource exploited in Galicia, the existence of small marble outcrops has been known and some of them, located near the village of O Incio (Fig. 1), have been traditionally considered as being employed since Antiquity. Nevertheless, most of these outcrops have not yet been archaeometrically characterised⁶.

A comprehensive approach to the study of the marble objects

All aspects of the objects –archaeological, stylistic and archaeometric – have been taken into account in order to achieve a better understanding of the materials and techniques employed to manufacture them, as well as of the agents involved in their production and use.

6 With the exception of the O Incio marble, the subject of a recent publication (GUTIÉRREZ GARCIA-M. *et al.* 2016), and a few outcrops on the Bierzo region in the framework of the provenance study of marble elements from Astorga, province of León (CISNEROS CUNCHILLOS *et al.* 2010-2011). The location and archaeometric characterization of other quarries is in progress, within the *Marmora Galicia* and the on-going PhD thesis by M.-C. Savin (IRAMAT-CRP2A UMR 5060 CNRS - Université Bordeaux Montaigne).

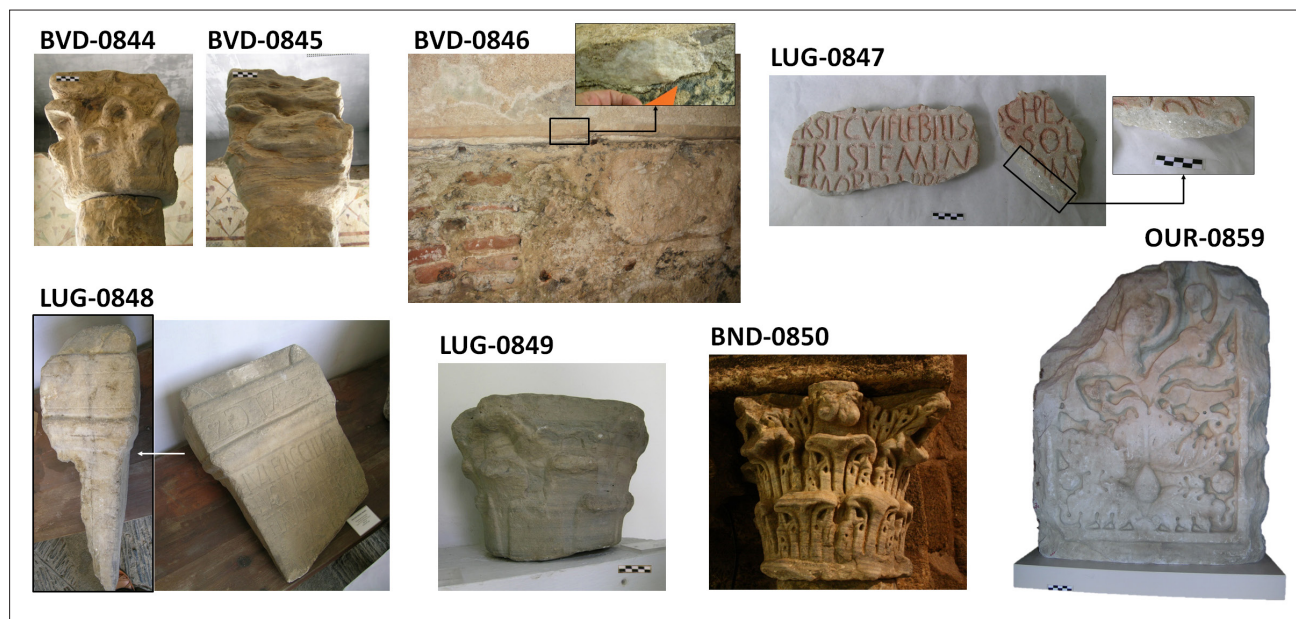


Fig. 2. Studied archaeological objects and detail of the marble of a selection of them

Archaeological data, both from the objects of study when available (original finding context, stratigraphic dating, etc) or from the territory itself (roads or navigable river networks, general socio-economic structure) is key in locating and contextualizing them. Unfortunately, many of those pieces were found out of stratigraphic context or reused in later buildings so, for most of them, the stylistic analysis (and/or epigraphic analysis, in the case of inscriptions) is the only way to estimate an approximate date. Yet, it can also lead to identifying possible workshops, and the correlation between their stylistic features and the use of a particular marble can help to understand whether the artisans were local or if they arrived from somewhere else.

The archaeometric analysis of the objects is essential to source the origin of the marbles used to produce them. It consisted of a multimethod analysis including three main analytical techniques: thin section/petrographic optical microscopy (POM), cathodoluminescence (CL) and stable isotope analysis ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$). The polarizing light microscope (NIKON Eclipse50iPOL)⁷ was systematically used for studying mineralogy and texture parameters. Particular attention was paid to fabric and grain size, measuring maximum grain size (MGS) and describing grain boundary shape (GBS). Cathodoluminescence analysis (CL) was carried out by using CL8200 Mk5-1 coupled to the previous microscope. The electron energy applied to the thin sections was 15-20 Kv and the

beam current was operated at 250-300 μA . The observed luminescence colours, intensity and distribution of each sample were registered onto digital photographs using an automatic digital camera (NIKON Coolpix5400). Oxygen and carbon stable isotopes were determined on calcite samples by isotope ratio mass spectrometry (IRMS) with FINNIGAN Gasbench II equipment⁸. The results were expressed in terms of usual delta notation ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) in ‰ relative to the international reference standard PDB (Pee Dee Belemnite). This multi-method approach is based on a well-established method (LAZZARINI *et al.* 1980; BARBIN *et al.* 1992; LAPUENTE *et al.* 2000; 2014; GORGONI *et al.* 2002; ATTANASIO *et al.* 2006 and others).

The studied artefacts

A first group of archaeological objects archaeometrically analysed was selected so as to be as comprehensive as possible in spite of its reduced size. The eight sampled objects present marbles that can be separated into two main groups according to their main diagnostic traits. Five of them are fine-grained marbles with a very particular appearance due to the almost parallel, white and grey centimetric to millimetric banding that has traditionally been considered a distinguishing feature of the local O Incio marble. The other three objects are made with singularly coarse white, homogeneous marbles whose possible origin was more difficult to anticipate and, therefore, a foreign provenance seemed also possible. The precise identification of these materials could make it possible to

7 At the Institut Català d'Arqueologia Clàssica - ICAC, (Tarragona, Spain).

8 At the Istituto di Geologia Ambientale et Geoingegneria - IGAG/CNR (Monterotondo (Roma), Italy).

confirm or dismiss the previous assumptions on marble use in *Gallaecia*. Moreover, these artefacts are representative of the array of types of marble objects (epigraphic inscriptions, architectural and decorative elements) as well as the geographical distribution in the territory (Figs. 1 and 2, Table 1).

Unfortunately, none of them had been discovered in its original location or in stratigraphic context. They were re-used in Late Antiquity or post-Roman times and are currently preserved in museum collections or as part of archaeological structures and pre-Romanesque or Romanesque buildings. Additionally, in most cases it is extremely difficult to date them on the basis of their stylistic features.

The sampled objects are:

- a) From Santa Eulalia de Bóveda (Lugo province)⁹:
- Two capitals made with a white and light grey, fine-grained marble with very thin (mostly millimetric and occasionally centimetric) subparallel bands. One of them¹⁰ presents also ferroan veins obliquely arranged to the banding while the other does not¹¹. Both capitals are strongly weathered and the marble presents a powdery and disaggregated state¹² that hinders the evaluation of its translucency. According to DOMINGO MAGAÑA (2011, 91), they are Corinthian capitals with acanthus foliage covering most of the kalathos with helix and scrolls on top and a neck piece, which is common in the Late Roman productions of NW Hispania.
 - A very simple moulding, which marks the beginning of the painted vault. It consists of several white marble listels that were probably made from recutting previous elements. A sample was taken from a homogeneously coarse-grained white marble that, despite the humid conditions of the chamber and unlike the capitals, had kept a quite compact quality¹³.
 - One of the two fragments from a large funerary inscription found during restoration works in the 50s-60s and currently preserved at the Museo

Provincial de Lugo¹⁴ (fragment on the right in Fig. 2). This slab is made in a white, very coarse-grained marble with a light grey/bluish tinge, occasional grey veins where larger crystals are visible. This marble presents a low translucency. Its chronological framework is still under debate: HOYO (2005, 882) proposes a 3rd century AD date but MONTENEGRO RÚA (2010, 157) dates it back to the first half of the 2nd century AD.

- b) Also from the collection of the Museo Provincial de Lugo:
- An inscribed altar dedicated to Iulia Flaccilla by her mother Flavia Paterna¹⁵. It is made with a white, coarse-grained marble which, despite the dust patina, shows a subtle light grey shade, occasional, irregular, dark grey veins and low translucency. It was probably reused at the Late Roman wall of Lugo, as it was found next to it. Unfortunately, only its upper part has been preserved, but here the epigraphic analysis allows an Early Imperial dating.
 - A capital made with a white/grey banded, very fine-grained marble¹⁶. It is a non-compact, non-translucent marble whose most distinctive trait is the very fine (millimetric), parallel grey bands. It was found out of context, next to San Xoán do Campo church (Lugo) and, as in Santa Eulalia de Boveda's capitals, most of the carved decoration has been lost. Nevertheless, it is of Corinthian style with slightly marked leaves, neck piece and caulicole, which suggests a 3th - 4th century AD date (DOMINGO MAGAÑA 2011: 234).
- c) From Santa Comba de Bande (Ourense province)¹⁷, one of the four capitals from the church apse¹⁸. It is made of a white/grey banded, fine-grained marble. Again, it is a most singular marble due to the fine (millimetric), parallel bands

9 They come from the building beneath the current church, whose function is still unknown. The capitals were preserved on the top of the 3 columns that were identified surrounding the paved, shallow pool in the center of a room accessed by a portico and a narthex. Three building phases have been distinguished (ABAD CASAL 1978, 917-921; FONTAINE 1992, 101; BLANCO-ROTEA *et al.* 2009), but its chronology is still the object of much debate (MONTENEGRO *et al.* 2008).

10 Sample BVD-0844.

11 Sample BVD-0845.

12 Due to the highly humid conditions of the chamber where they were preserved.

13 Sample BVD-0846.

14 IRLu 88a = HEp 11, 2001, 346 = HEp 12, 2002, 342. There is some discussion among the scholars about whether the two fragments are part of the same inscription, but since the two fragments present exactly the same type of marble and analogous lettering, only one sample (LUG-0847) was taken.

15 CIL II 2586 = IRLu 30 = IRG II, 35. Sample LUG-0848.

16 Sample LUG-0849.

17 It is a small Visigothic or pre-Romanesque church considered a 7th century AD building by some scholars while others believe it was built in the 9th-10th century (with the possible existence of a previous church or mausoleum on the site together with a nearby Roman road, *mansio* and military camp) (RODRÍGUEZ COLMENERO 1993, 403). For a summary of this site's complexity, see SÁNCHEZ PARDO 2015, 100.

18 Sample BND-0850.

Sample	Artefact	Museum Inv. Num.	Site of find	Date	Main macroscopic traits of the marble
BVD-0844	Capital (NE)	-	Sta. Eulalia de Boveda church	Late Roman?	White/light grey banded, fine-grained, ferruginous veins
BVD-0845	Capital (SE)	-	Sta. Eulalia de Boveda church	Late Roman?	White/grey banded, fine-grained
BVD-0846	Moulding	-	Sta. Eulalia de Boveda church	Late Roman?	White, coarse-grained
LUG-0847	Inscription (slab)	EPI-73	Sta. Eulalia de Boveda church	2 nd - 3 th cent. AD	White, very coarse-grained, occasional grey veins
LUG-0848	Inscribed altar	EPI-45	Roman wall of Lugo ?	2 nd - 3 rd cent. AD	Greyish white, coarse-grained
LUG-0849	Capital	961	S. Xoán do Campo	3 rd - 4 th cent. AD	White/grey banded, fine-grained
BND-0850	Capital (SW)	-	Sta. Comba de Bande church	4 th - 6 th cent. AD	White/grey banded, fine-grained
OUR-0859	Ornamental plaque	CE002761	S. Adrián de Amiadozo church	4 th cent. AD (1 st phase)	White/grey banded, fine-grained

Table 1. List of samples, archaeological artefact, finding site, possible date and main macroscopic features after visual inspection of the object

Sample	Main Min.	Acc. Min.	Texture	Fabric	MGS (mm)	GBS	Stress	CL (Main Min.)	$\delta^{13}\text{C}$ (‰)	$\delta^{18}\text{O}$ (‰)	PROVENANCE
BVD-0844	Cal	Qtz,(Kfs),(Mc),(Op)	HEBL	Lineated-	2.0	Sutured	Twins, UE	HOM / MED [GB, AM: Qtz, Kfs]	-	-	Unknown (Local)
BVD-0845	Cal	Qtz, Kfs, Mc, (Op)	HEBL	Lineated	1.5	Sutured, (Curved)	Twins, UE	HET / MED-(STR) [GB, AM: Qtz, Kfs]	1.6	-9.2	Unknown (Local)
BVD-0846	Cal	Qtz, Mc	HEBL	Isotropic*	3.9	Sutured	Twins	HOM / STR [GB, AM: Qtz, Mc]	2.1	-10.0	Unknown (Local)
LUG-0847	Cal	Qtz, (Kfs), Mc	HEBL	Lineated -	6.5	Sutured, (Embayed)	Twins, UE	HOM / STR [GB, AM: Qtz, Mc]	1.9	-11.2	Unknown (Local)
LUG-0848	Cal	Qtz,(Kfs),(Mc),(Op)	GRBL*	Isotropic*	2.7	Sutured	Twins, UE	HOM / STR [GB, AM: Qtz, Mc]	2.0	-8.9	Unknown (Local)
LUG-0849	Cal, (Dol)	(Qtz), (Mc)	HEBL	Lineated, Banded	0.6	Sutured	No	HET / FNT-(MED) [SM: Dol]	1.1	-10.6	O Incio-2
BND-0850	Cal	(Qtz)	GRBL*	Isotropic* Mosaic-	0.8	Sutured, (Curved)	No	HET / FNT-(MED)	0.4	-13.2	O Incio-2
OUR-0859	Cal	(Qtz)	HEBL	Lineated-	1.3	Sutured	Twins	HOM / MED [GB, AM: Qtz]	0.3	-15.2	Unknown (Local)

Table 2. Mineralogical-petrographical and cathodoluminescence features and isotopic signature of the archaeological samples and provenance. Main Mineral (Cal: calcite. Dol: dolomite). Accessory Mineral (Qtz: quartz. Kfs: potassium feldspar. Mc: mica. Op: opaque minerals). Texture (GRBL: granoblastic. HEBL: Heteroblastic). Stress (UE: undulose extinction). CL (HOM: homogeneous. HET: heterogeneous. FNT: faint intensity and dark orange hue. MED: medium intensity and orange hue. STR: strong intensity and light orange hue). []: CL irregularities (GB: grain boundary. SM: subordinate mineral. AM: accessory mineral). (:): subordinate or occasionally. -: faintly. *: Possible anomalous texture or fabric due to an unrepresentative small sample chip

although in this case the white ones are slightly thicker than in the previous capitals and the marble is slightly translucent. Again, its dating is under discussion, as either being Late Roman (NÚÑEZ 1978: 91) or the 6th century AD product of a local workshop (DOMINGO MAGAÑA 2011: 93, 232).

d) From San Adrián de Amiadozo (Allariz, Ourense province)¹⁹, an ornamental plaque with high quality

reliefs that stands out for its artistic relevance²⁰. It is carved in a white/light grey banded, fine-grained marble. It is a well-crystallized, slightly translucent marble with a “lamination” appearance due to the alternation of thick (centimetric) white bands and finer (millimetric) light grey ones. This

¹⁹ It is a small chapel where some pre-Romanesque remains are still visible (SÁNCHEZ PARDO 2015, 98-

99) and where several reused objects were found since 1945 (FARIÑA BUSTO 1997, 313).

²⁰ It is currently on display at the Museo Arqueológico Provincial de Ourense. Sample OUR-0859.

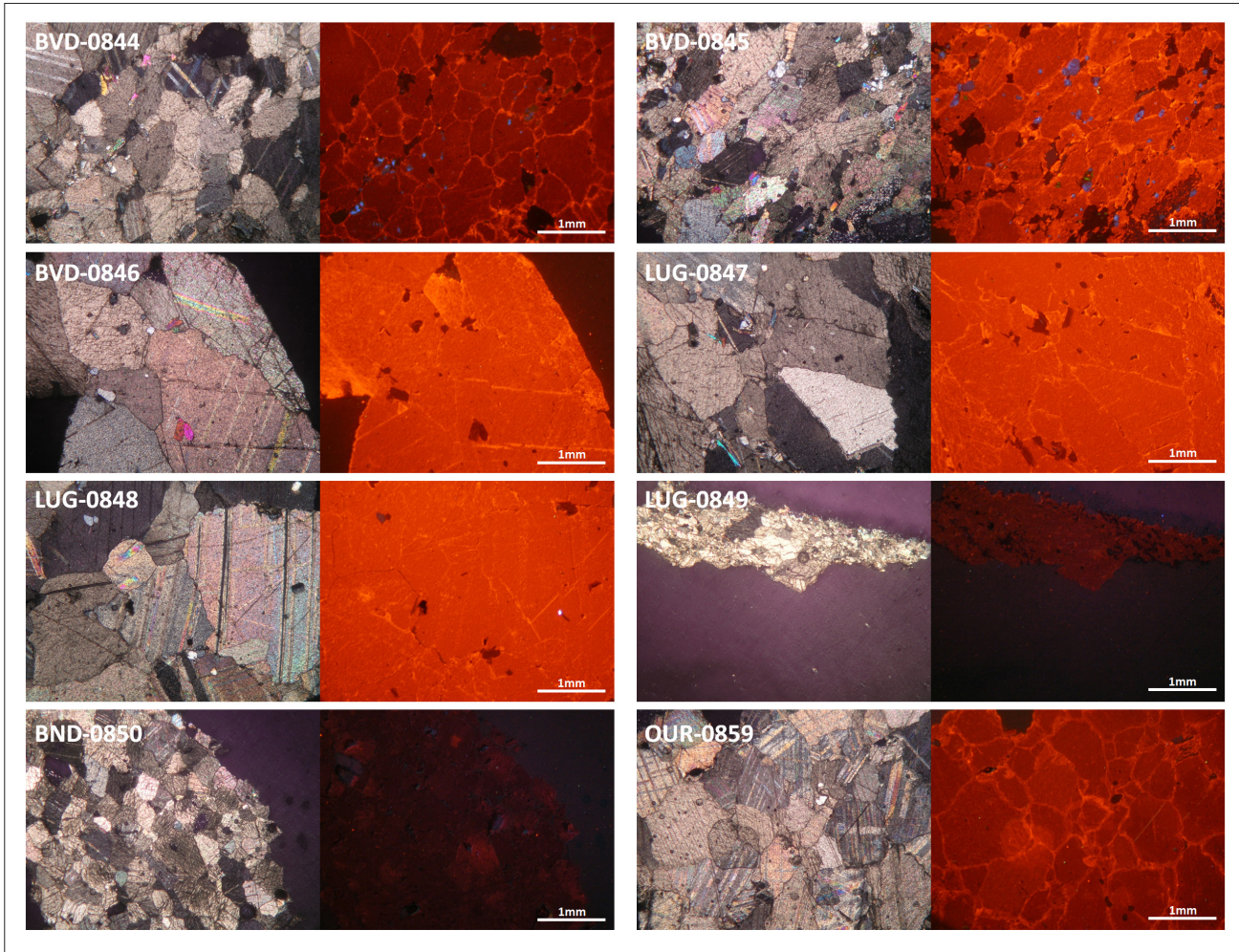


Fig. 3. Cross-polarized light and cathodoluminescence photomicrographs

piece of art is the result of the work of at least two different periods: Roman or Late Roman and then pre-Romanesque or Romanesque²¹. The two earliest faces show a large acanthus leaf with scrolls and a krater showing scrolls with leaves and a human mask.

Results and discussion

The results of the mineralogical-petrographic analysis, cathodoluminescence traits and $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ (PDB) values are presented in Table 2. The microscopic appearance under cross-polarized light and the response to the cathodoluminescence analysis of each sample are

21 This plaque has been the object of several studies (VIDAL ALVAREZ 2005; VALLE PÉREZ 2012) and a recent interdisciplinary discussion in which a 4th century date for its earliest phase has been proposed (GONZÁLEZ SOUTELO *et al.* 2016).

shown in Figure 3 and their position in the C-O stable isotope diagram in Figure 4.

It is important to point out the difficulty involved in the characterization of marble microstructure when it is not possible to choose the orientation of the thin section and when the sample is extremely small in size, usually the case when chips taken from archaeological objects. This inconvenience has recently been highlighted concerning banded marbles, such as those of Estremoz Anticline (LAPUENTE *et al.*, in this volume), and it also applies to the Galician O Incio marble. Three lithotypes have been identified in the O Incio, a white marble with few orangish veins (O Incio-1), a white and grey marble showing the banding traditionally considered the distinguishing mark of O Incio marble (O Incio-2) and a light and dark grey banded one (O Incio-3)²² (Fig. 5). The results of their study have been included in our reference

22 See GUTIÉRREZ GARCIA-M. *et al.* 2016 for a detailed description of each lithotype and the O Incio quarries.

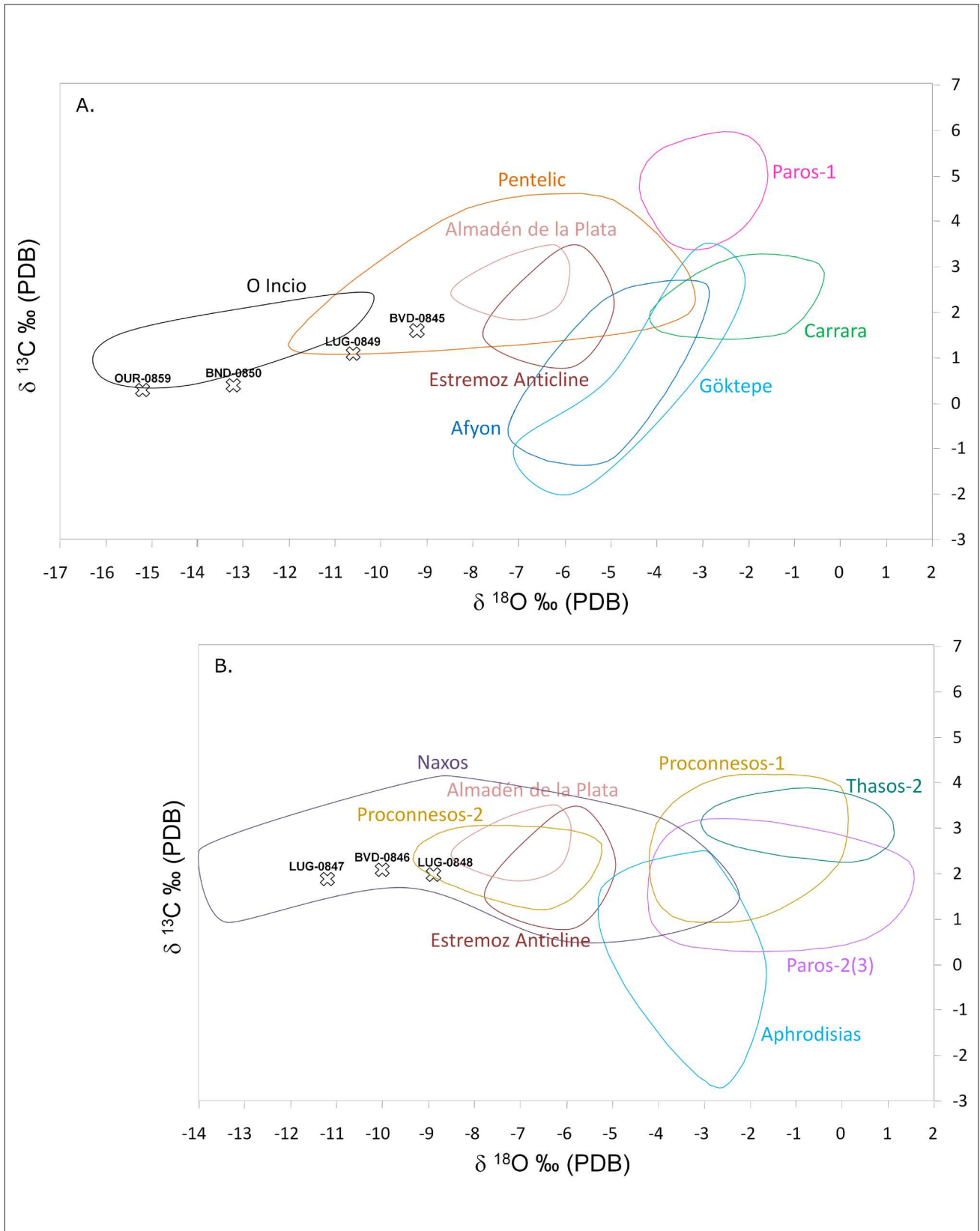


Fig. 4. Stable isotope diagram showing the signature data of the marble samples and the fields of Classical and Iberian marbles with similar grain sizes (GORGONI *et al.* 2002; LAPUENTE *et al.* 2014, in this volume; ATTANASIO *et al.* 2015). A: fine-grained (average MGS < 2 mm), showing also the values of O Incio marble (GUTIÉRREZ GARCIA-M. *et al.* 2016). B: medium to coarse-grained marbles (average MGS > 2 mm). As the knowledge of gray and banded marbles used in Antiquity is still incomplete and, therefore, their isotopic fields are not available, those of the white marbles are used as reference

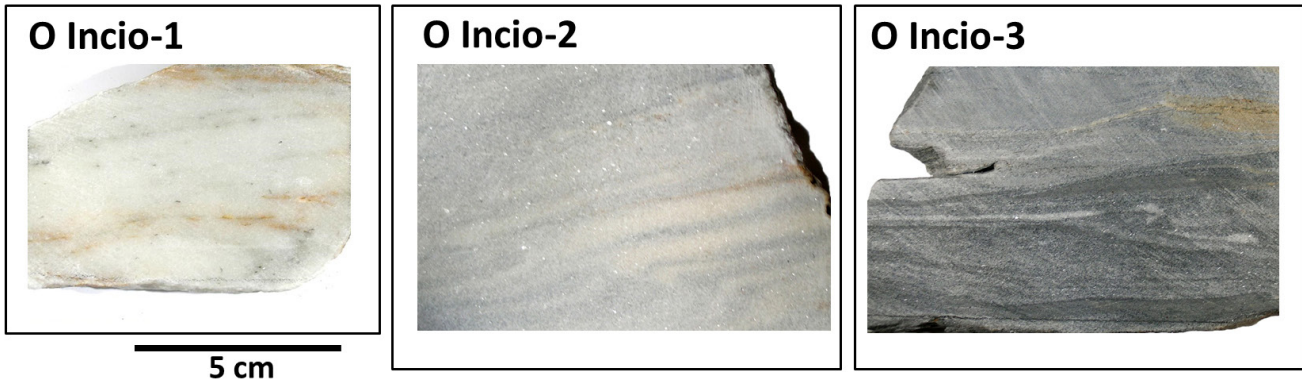


Fig. 5. Macroscopic appearance of the three O Incio marble varieties

collection to enable comparison with the archaeological samples under study.

All eight pieces are calcitic marbles and only in one case, LUG-0849, subordinate dolomite has been identified (always in relation with the darkest grey bands). This same sample shows a heteroblastic texture with lineated and banded fabric. Its MGS is 0.6 mm and the GBS are sutured, with accessory quartz and mica flakes. It presents a heterogeneous, faint-medium intensity with reddish orange calcitic luminescence (with the occasional dark red typical of the dolomite related with the darkest bands). BND-0850 shows these same CL traits – except for the dolomitic dark red – and together with LUG-0849, they have an isotopic signature significantly close to the values given by the O Incio quarry samples. BND-0850 also presents a fine MGS (0.8 mm) and mainly sutured GBS although some curved grain boundaries are also visible. The granoblastic texture and mosaic fabric of this sample can be presumed to be unrepresentative as is the result from the different orientation of the chip since all the other petrographic and CL traits are, as for LUG-0849, very similar to those of the typical fine-grained, white and grey banded O Incio-2 lithotype (GUTIÉRREZ GARCIA-M. *et al.* 2016). This identification is reinforced by their isotopic values, since despite not falling within the O Incio field, they are significantly near and their macroscopic, petrographic and CL features do not match at all those of any other known marble.

OUR-0859 is a fine grained marble with a MGS of 1.3 mm. Its texture is a slightly lineated fabric, clearly heteroblastic with sutured GBS. It presents some quartz as accessory mineral. Most of its petrographic features and its medium intensity luminescence resemble those presented by the reference samples of the O Incio quarries. Moreover, its isotopic values also point in this direction. Nevertheless, it does not match them entirely, as this sample shows a slightly stressed texture and a homogeneous CL. Therefore, a local provenance for this

sample is confirmed although, despite its undeniable similarities with the fine-grained O Incio marble, its exact provenance has not been yet identified²³.

The two samples from Sta. Eulalia de Boveda's capitals (BVD-0844 and BVD-0845) also present a heteroblastic texture and lineated or faintly lineated fabric, but they have slightly higher MGS (not to exceed 2.0 mm), a characteristic stressed texture and a wider range of accessory minerals, among which the presence of tiny feldspar stands out. Additionally, BDV-0845 shows a particular negative $\delta^{18}\text{O}$ value. Their visual appearance, so close to the fine-grained, banded O Incio marble, and their petrographic and CL features rule out all Classical and Iberian marbles. Therefore, a local origin seems the most plausible hypothesis. Nevertheless, these samples also show features difficult to match with the reference samples currently available, which are in fact closer to the very coarse-grained marbles also included in this paper.

The very coarse-grained samples (BVD-0846, LUG-0847 and LUG-0848) are white, homogeneous marbles with thin, isolated grey bands that hint at a possible structural orientation that has been confirmed under the microscope. They show a relative variability in some of their characteristics, but this can be a consequence of the small sample chip which limits their representativeness. This is especially manifest in coarse-grained samples. Therefore, the occasional absence of some accessory minerals, the difference in MGS or the variation of their texture and fabric are acceptable and the differences in the microtexture and fabric can be attributed to a different orientation of the sample chip. LUG-0847 is the most representative sample of the three due to its larger size and adequate orientation. It presents

23 For a more detailed description of this plaque's traits and a discussion of its provenance, see GONZÁLEZ SOUTELO *et al.* 2016, 111-114.

a relatively heteroblastic texture, slightly lineated fabric, occasional stressed crystals and an extremely high MGS, comparable only to that of the marbles from Trigaches (southern Portugal) and Naxos (Greece). The presence of feldspars in LUG-0847 and also LUG-0848 would seem to link them to Santa Eulalia de Boveda's marbles (BVD-0844 and BVD-0845) but they are much rarer and smaller. Yet the particularly strong (in calcitic light orange), homogeneous CL shown by these three samples is very different from the one shown by the BVD samples and, most interestingly, it is not compatible either with the coarse-grained Iberian marbles such as Trigaches or with the other Portuguese, smaller coarse-grain marbles from the Estremoz Anticline. Finally, although it is the only isotopically coincident (Fig. 3B), their strong CL also discards the well-known Naxos marble as possible provenance while their very negative isotopic O values point towards a Galician origin. Therefore, its attribution remains undetermined pending improvement of the reference database with other local marbles from the NW of Spain.

Conclusions

Even in this initial stage and with such small assemblage, two very important contributions emerge from this study. First of all, the use of O Incio marble in Roman times is analytically corroborated in two capitals, thus confirming for the first time the already mentioned previous assumptions. But at the same time, the results show a more complex picture than what was anticipated of the marble industry in *Gallaecia*, as other presumably local marbles were also exploited and used during Roman times. Not only were the ornamental plaque of Amidoso and the two capitals from Santa Eulalia de Bóveda also made with fine-grained marbles of very likely local origin, but the use in Antiquity of very-coarse grained marbles whose source is presumably somewhere in the NW of the Iberian Peninsula has also been detected, for the first time.

The variability of the petrographic and CL reference traits of the Galician fine-grained banded marbles is compensated for with quite distinctive negative $\delta^{18}\text{O}$ isotopic values. These isotopic values set them apart from most of the white and white/grey Mediterranean marbles known so far, as well as from the only fine-grained Iberian marbles known so far, outcropping in Estremoz Anticline (southern Portugal), which can also appear as dark grey banded materials²⁴. The coarse-grained, white

marble objects studied in this work share these low $\delta^{18}\text{O}$ isotopic values, while presenting petrographic and CL features that distinguish them from the Classical ones.

Although these other marbles are still to be sourced and archaeometrically characterized, the quarrying of local marbles emerges as a key aspect. These local marbles were mostly used for architectural elements (capitals, carved plaques and mouldings) but also for inscriptions. Only the fine-grained varieties allowed a highly skilled working while the inscribed elements so far analysed were carved on the coarse-grained white marble. Concerning the chronology, local marble was exploited since the 3rd century AD without doubt and maybe from a century earlier, as suggested by the two inscriptions. The O Incio marble in particular seems to have been in use basically from at least the Late Roman period onwards, but it reached places as far as 100 km from the quarry. Thus we can assume that a region-wide distribution network existed, either at the time or later on, with the distribution of old elements to be reused in early medieval churches. Indeed, it is difficult to precise a chronological framework for their distribution. Besides the strong weathering of many of the out-of-context pieces, reuse became part of the building practices in Late Roman and Visigothic times – including the transport of elements from relatively distant places – sometimes even with symbolic connotations (UTRERO AGUDO, SASTRE DE DIEGO 2012).

This first provenance study provided the essential basis upon which to pursue further research. Some of it is already in progress and focuses on locating and characterizing other marble outcrops in this territory. Only in this way will it be possible to identify the unresolved provenances and to advance on the characterisation of the local marbles, thus confirming or completing what these first results enable us to glimpse about the exploitation and use of marble in Roman *Gallaecia*.

24 Although the published isotopic diagram (see fig. 4) reflects only the white lithotypes (LAPUENTE *et al.* 2000, 2014), according to the results presented by P.

LAPUENTE *et al.* in this same volume, the isotopic values of the white/grey lithotypes do not significantly vary. Our most sincere gratitude goes to her for sharing this information and other considerations with us.

ACKNOWLEDGMENTS

Our gratitude goes to the Servizo de Arqueoloxía (Subdirección Xeral de Conservación e Restauración de Bens Culturais, Dirección Xeral de Patrimonio, Xunta de Galicia), the Museo Arqueológico Provincial de Lugo, the Museo Arqueológico Provincial de Ourense, and the ecclesiastic authorities of Galicia. We also like to acknowledge the contribution of M. Brilli (Istituto de Geologia Ambientale e Geoingegneria, CNR). Finally, we also wish to express our most sincere gratitude to the anonymous referees whose comments and suggestions have certainly improved the final version of this paper.

REFERENCES

- ABAD CASAL L. 1978: "Aportación al estudio de Santa Eulalia de Bóveda", XV Congreso Nacional de Arqueología (Lugo 1977), Universidad de Zaragoza, 917-922.
- ATTANASIO D., BRILLI M., OGLE N. 2006: The isotope signature of Classical marbles. *L'Erma di Bretschneider*, Roma.
- BARBIN V., RAMSEYER K., DÉCROUEZ D., BURNS S. J., CHAMAY J., MAIER J. L. 1992: "Cathodoluminescence of white marbles: an overview", *Archaeometry* 34, 175-183.
- BLANCO-ROTEA R., BENAVIDES GARCÍA R., SANJURJO SÁNCHEZ J., FERNÁNDEZ MOSQUERA D. 2009: "Evolución constructiva de Santa Eulalia de Bóveda (Lugo, Galicia)", *Arqueología de la arquitectura* 6, 149-198.
- BRAEMER F., 1986: "Répertoire des gisements de pierres ayant exporté leur production à l'époque romaine", in F. BRAEMER (ed.): *Les ressources minérales et l'histoire de leur exploitation. Colloque international tenu dans le cadre du 108^e Congrès national des Sociétés savantes*, Grenoble 5-9 avril 1983, Paris, 287-328.
- CANTO A. M. 1978: "Avances sobre la explotación del mármol en la España romana", *Archivo Español de Arqueología* 50-51, 165-189.
- CIL II = E. Hübner, *Corpus Inscriptionum Latinarum II. Inscriptiones Hispaniae Latinae*, Berlin, 1869; *Inscriptionum Hispaniae Latinarum Supplementum*, Berlin, 1892.
- CISNEROS CUNCHILLOS M. 1988: *Mármoles hispanos: su empleo en la España romana*. Universidad de Zaragoza, Zaragoza.
- CISNEROS CUNCHILLOS M., GISBERT AGUILAR J., SOMOVILLA DE MIGUELI. A. 2010-2011: "El uso del mármol en la arquitectura de *Asturica Augusta*", *Anales de Arqueología Cordobesa* 21-22, 93-126.
- DOMINGO MAGAÑA J. 2011: *Capiteles tardorromanos y visigodos en la península ibérica (siglos IV-VIII d.C.)*. Institut Català d'Arqueologia Clàssica, Tarragona.
- FARIÑA BUSTO F. 1997: "Amiadoso". *Galicia castrexa e romana*. Galicia Terra Única. Xunta de Galicia, Lugo, 313-316.
- FONTAINE J. 1992: *El Prerrománico*. La España Románica, vol. 8, Madrid.
- GARCÍA-ENTERO V. (ed.) 2012: *El marmor en Hispania: explotación, uso y difusión en época romana*. Universidad Nacional de Educación a Distancia, Madrid.
- GONZALEZ SOUTELO S., GUTIÉRREZ GARCIA-M. A., ROYO PLUMED H. 2014: "El mármol de O Incio: proyecto de caracterización y estudio de la explotación y uso de un marmor local en la Galicia romana", in J. M. ÁLVAREZ MARTÍNEZ, T. NOGALES BASARRATE, I. RODÀ DE LLANZA (eds.): *Actas del XVIII Congreso Internacional de Arqueología Clásica: Centro y periferia en el mundo clásico*, Mérida, 323-326.
- GONZÁLEZ SOUTELO S., VIDAL ÁLVAREZ S., GUTIÉRREZ GARCIA-M. A., ROYO PLUMED H. 2016: "La placa de Amiadoso (Allariz, Ourense): Nuevos datos sobre el uso del mármol local en el noroeste de Hispania a partir de un estudio interdisciplinar", *Espacio, tiempo y forma (serie I. Prehistoria y Arqueología)* 9, 99-121.
- 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.
- GUTIÉRREZ GARCIA-M. A., LAPUENTE P., RODÀ I. (eds.) 2012: *Interdisciplinary Studies on Ancient Stone*. Proceedings of the IX ASMOSIA Conference (Tarragona 2009). Institut Català d'Arqueologia Clàssica, Tarragona.
- GUTIÉRREZ GARCIA-M. A., RODÀ I. 2012. "El mármol de Luni-Carrara en la fachada mediterránea de Hispania", in S. KEAY (ed.): *Rome, Portus and the Mediterranean*, London, 293-312.
- GUTIÉRREZ GARCIA-M. A., ROUILLARD P. (ed.) 2018: *Lapidum natura restat. Canteras antiguas de la península ibérica en su contexto (cronología, técnicas y organización de la explotación)*, Institut Català d'Arqueologia Clàssica / Casa de Velázquez, Tarragona.
- GUTIÉRREZ GARCIA-M. A., ROYO PLUMED H., GONZÁLEZ SOUTELO S., SAVIN M.-C., LAPUENTE P., CHAPOULIE R. 2016: "The marble of O Incio (Galicia, Spain): Quarries and first archaeometric characterisation of a material used since Roman times", *Archeosciences, Revue d'archéométrie* 40, 103-117.

Hep = *Hispania Epigraphica*

- HOYO J. del 2005: "Carmina Latina Epigraphica del noroeste hispano", in A. ALVAR (coord.): *Actas del XI Congreso Español de Estudios Clásicos*. Santiago de Compostela 200, Madrid, 877-886.
- IGME (Instituto Geológico y Minero de España): Mapa geológico de España 1:50000, hoja 156 – Monforte de Lemos, reim. 2002.
- IRG II = VÁZQUEZ SACO F., VÁZQUEZ SEIJAS M. 1954: *Inscripciones romanas de Galicia II*. Provincia de Lugo, CSIC-Instituto Padre Sarmiento de Estudios Gallegos, Santiago de Compostela.
- IRLu = ARIAS F., LE ROUX P., TRANOY A. 1979: *Inscriptions romaines de la province de Lugo*. Diffusion de Boccard, Paris.
- LAPUENTE P., TURI B., BLANC PH. 2000: "Marbles from Roman Hispania: stable isotope and cathodoluminescence characterization", *Applied Geochemistry* 15, 1469-1493.
- LAPUENTE P., NOGALES-BASARRATE T., ROYO H., BRILLI M. 2014: "White marble sculptures from the National Museum of Roman Art (Mérida, Spain): sources of local and imported marbles", *European Journal of Mineralogy* 26, 333-354.
- LAPUENTE P., NOGALES BASARRATE T., ROYO H., BRILLI M., SAVIN M.-C. in this volume: "Grey and greyish banded marbles from the Estremoz Anticline in Lusitania"
- LAZZARINI L., MOSCHINI G., STIEVANO B. M. 1980: "A contribution to the identification of Italian, Greek and Anatolian marbles through a petrological study and the evaluation of the Ca/Sr ratio", *Archaeometry* 22, 173-183.
- MONTENEGRO RÚA J. 2010: "El carmen epigraphicum de Santa Eulalia de Bóveda (Lugo) y los loci similares virgilianos: una aportación al CIL XVIII/2", *Espacio, Tiempo y Forma* 1/3, 145-160.
- MONTENEGRO RÚA E. J., BLANCO-ROTEA R., BENAVIDES R., PORTELA C. 2008: *Santa Eulalia de Bóveda*, Xunta de Galicia, Santiago de Compostela.
- NOGALES T., BELTRÁN J. (eds.) 2009: *Marmora Hispania: Explotación y uso de los materiales pétreos en Hispania Romana*, L'Erma di Bretschneider, Roma.
- NÚÑEZ RODRÍGUEZ M. 1978: *Arquitectura prerrománica*. Colegio Oficial de Arquitectos, Santiago de Compostela.
- PENSABENE P., GASPARINI E. (eds.) 2015: *ASMOSIA X. Proceedings of the Tenth International Conference Interdisciplinary Studies on Ancient Stone*. L'Erma di Bretschneider, Rome.
- SÁNCHEZ PARDO J. C. 2015: "El reuso de materiales y estructuras antiguas en las iglesias altomedievales de Galicia. Casos, problemas y motivaciones", *Estudios do Quaternário* 12, 95-110.
- VALLE PÉREZ X. C. 2012: "De la Gallaecia antigua a la Gallaecia moderna: la piedra como marco, como soporte y como ornato durante la Edad Media (siglos IV al XVI)", *Gallaecia Pétrea*, Xunta de Galicia, Santiago de Compostela, 330-339.
- VIDAL ÁLVAREZ S. 2005: *La escultura hispánica figurada de la Antigüedad Tardía (siglos IV-VII)*, Universidad de Murcia, Murcia.
- UTRERO AGUDO M. A., SASTRE DE DIEGO I. 2012: "Reutilizando materiales en las construcciones de los siglos VII-X. ¿Una posibilidad o una necesidad?", *Anales de Historia del Arte* 22 (II), 309-323.