

# The Pentelic Marble in the Carnegie Museum of Art Hall of Sculpture, Pittsburgh, Pennsylvania

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# CONTENT

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

Thassos, Known Inscriptions with New Data <i>Tony Kozelj and Manuela Wurch-Kozelj</i> .....	131
The Value of Marble in Roman <i>Hispalis</i> : Contextual, Typological and Lithological Analysis of an Assemblage of Large Architectural Elements Recovered at N° 17 Goyeneta Street (Seville, Spain) <i>Ruth Taylor, Oliva Rodríguez, Esther Ontiveros, María Luisa Loza, José Beltrán and Araceli Rodríguez</i> .....	143
<i>Giallo Antico</i> in Context. Distribution, Use and Commercial Actors According to New Stratigraphic Data from the Western Mediterranean (2 <sup>nd</sup> C. Bc – Late 1 <sup>st</sup> C. Ad) <i>Stefan Ardeleanu</i> .....	155
<i>Amethystus</i> : Ancient Properties and Iconographic Selection <i>Luigi Pedroni</i> .....	167
<b>2. PROVENANCE IDENTIFICATION I: (MARBLE)</b>	
Unraveling the Carrara – Göktepe Entanglement <i>Walter Prochaska, Donato Attanasio and Matthias Bruno</i> .....	175
The Marble of Roman Imperial Portraits <i>Donato Attanasio, Matthias Bruno, Walter Prochaska and Ali 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 <sup>th</sup> And 17 <sup>th</sup> Centuries): the Church of <i>Santi Severino e Sossio</i> <i>Roberto Bugini, Luisa Folli and Martino Solito</i> .....	275
Roman and Early Byzantine Sarcophagi of Calcitic Marble from Thasos in Italy: Ostia and Siracusa <i>Donato Attanasio, John J. Herrmann, Robert H. Tykot and Annewies van den Hoek</i> .....	281
Revisiting the Origin and Destination of the Late Antique Marzamemi 'Church Wreck' Cargo <i>Justin Leidwanger, Scott H. Pike and Andrew Donnelly</i> .....	291
The Marbles of the Sculptures of Felix Romuliana in Serbia <i>Walter Prochaska and Maja Živić</i> .....	301
Calcitic Marble from Thasos and Proconnesos in Nea Anchialos (Thessaly) and Thessaloniki (Macedonia) <i>Vincent Barbin, John J. Herrmann, Aristotle Mentzos and Annewies van den Hoek</i> .....	311
Architectural Decoration of the Imperial Agora's Porticoes at Iasos <i>Fulvia Bianchi, Donato Attanasio and Walter Prochaska</i> .....	321
The Winged Victory of Samothrace - New Data on the Different Marbles Used for the Monument from the Sanctuary of the Great Gods <i>Annie Blanc, Philippe Blanc and Ludovic Laugier</i> .....	331
Polychrome Marbles from the Theatre of the Sanctuary of Apollo Pythios in Gortyna (Crete) <i>Jacopo Bonetto, Nicolò Mareso and Michele Bueno</i> .....	337
Paul the Silentary, Hagia Sophia, Onyx, Lydia, and Breccia Corallina <i>John J. Herrmann and Annewies van den Hoek</i> .....	345
Incrustations from Colonia Ulpia Traiana (Near Modern Xanten, Germany) <i>Vilma Ruppinić and Ulrich Schüssler</i> .....	351
Stone Objects from Vindobona (Austria) – Petrological Characterization and Provenance of Local Stone in a Historico-Economical Setting <i>Andreas Rohatsch, Michaela Kronberger, Sophie Insulander, Martin Mosser and Barbara Hodits</i> .....	363
Marbles Discovered on the Site of the Forum of Vaison-la-Romaine (Vaucluse, France): Preliminary Results <i>Elsa Roux, Jean-Marc Mignon, Philippe Blanc and Annie Blanc</i> .....	373
Updated Characterisation of White Saint-Béat Marble. Discrimination Parameters from Classical Marbles <i>Hernando Royo Plumed, Pilar Lapeunte, José Antonio Cuchí, Mauro Brillì and Marie-Claire Savin</i> .....	379

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

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

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

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

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

# THE PENTELIC MARBLE IN THE CARNEGIE MUSEUM OF ART HALL OF SCULPTURE, PITTSBURGH, PENNSYLVANIA

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## Abstract

The Hall of Sculpture of the Carnegie Museum of Art is part of the multi-cultural Carnegie Institute built in 1895 and 1907 in Pittsburgh, Pennsylvania. The Carnegie building complex is recognized as a historic landmark for its architecture design by the United States Department of the Interior and the Pittsburgh History & Landmarks Foundation.

The neo-classical design of the Hall of Sculpture resemble the cella of the classical Greek Parthenon built in honor of the Greek goddess Athena. The classic white/grey Pentelic marble is the primary architectural stone used in the hall's columns, balcony, wainscoting, pilasters, cladding, and pedestals.

This review is to determine the provenance of the Pentelic marble. The geochemical isotopic data analysis of the Carnegie Pentelic marble samples suggests there were several quarries within the classic Marble Unit 2 and Marble 3 on Mount Pentelikon, Athens, Greece.

## Keywords

Carnegie, Pentelic marble, Hall of Sculpture

## Introduction

In the late 19<sup>th</sup> and early 20<sup>th</sup> century Pittsburgh, Pennsylvania, Andrew Carnegie built a consortium of buildings for art, science, music and literature. The Carnegie complex includes the Carnegie Library of Pittsburgh, the Carnegie Music Hall, the Carnegie Museum of Art, and the Carnegie Museum of Natural History. The Carnegie complex was recognized in 1979 as a National Historic Landmark for its architecture by the United States Department of the Interior. The Carnegie architects utilized an array of unique decorative architectural dimension stones. Many of these stones were the material of choice of architects and artists of antiquity in their historical buildings, statuary, and monuments. In my research on the Carnegie stones, there are thirty varieties of dimension stones of marbles and fossil limestones, imported from Algeria, Croatia, France, Greece,

Ireland, and Italy. Additional stone types include fossil limestone, sandstones, and granite from quarries in the United States and Larvikite from Norway.<sup>1 2</sup> The white and grey Pentelic marble is the primary marble for the Hall of Sculpture and the Greek Temple on the Acropolis.

The Carnegie dimension stones represent three major rock types – igneous, metamorphic, and sedimentary. The Carnegie building stones record some 600 million years of geologic history. For example, limestone is a sedimentary rock composed of ancient marine sediments, fossils, carbonate mud, algae and dolomite. When limestone is subjected to the process of metamorphism, temperature and heat, marble is formed. Marble is a wonderful stone often used in classical and neoclassical architecture, decorative monuments, and sculptures.

There are seven marble varieties in the exhibit halls and office spaces in the interior of the Carnegie Museums, Carnegie Music Hall and Carnegie Library of Pittsburgh. The dominant white marbles are the white/grey Pentelic marble of Greece and the white/grey Carrara marble of Italy. The Connemara is a green serpentine marble from Ireland. The breccia marbles include, the yellow and dark Siena marbles of Italy, Tinos green and Verde Antico marbles of Greece and Breche sanguine or Numidian marble of Algeria. The spectrum of marbles ranges from a mixture of white and grey, blood red, egg yolk yellow, dark yellow, and serpentine.<sup>3</sup>

The Hall of Sculpture is a large rectangular neo-classical design built to resemble the cella of the Parthenon in Athens, Greece. Approximately eighty-six percent of the hall's architecture units are marble. Forty-six percent of the columns, balcony, pilasters, wainscoting, cladding, and pedestals, are white/grey Pentelic marble. Forty percent of the floor is identified as 'Marmo Venato' (Veined) Carrara marble (Fig. 2A). On sunny days, the rectangular skylight allows plenty of sunlight to reflect off more than one thousand square meters of marble, creating a luminously whitish hall. In contrast, on overcast

1 KOLLAR 2016, 147.

2 KOLLAR, HUGHES, FEDOSICK [In press].

3 KOLLAR, HUGHES, FEDOSICK [In press].



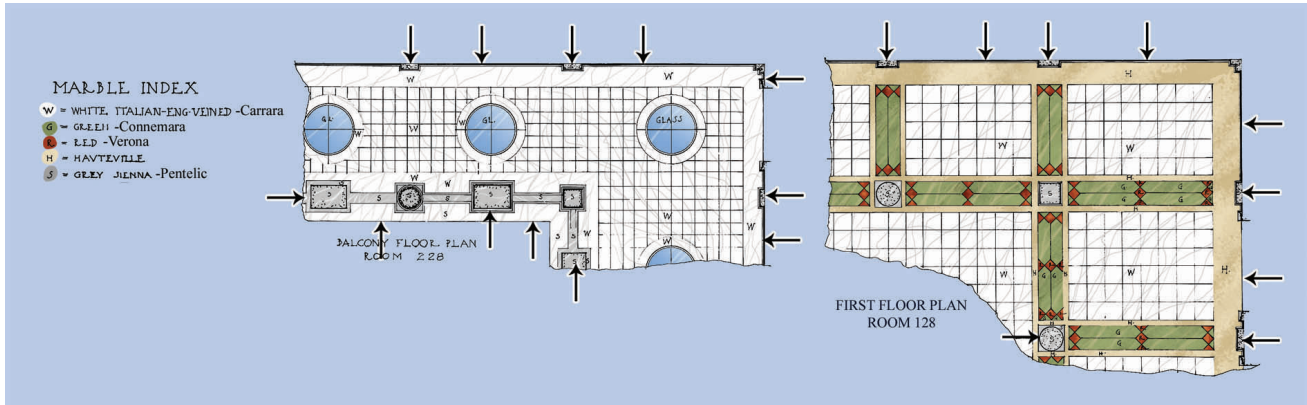


Fig. 1. Modified from Alden & Harlow, Architects, Hall of Sculpture, Balcony Floor Plan Room 228, Main Floor Plan Room 128, May 14, 1904. Includes Marble Index, with colored circles with capital letter, which refers to the common name of a marble with the modern geologic name. Arrows indicate position of Pentelic marble on First Floor and Balcony Floor Plan

<b>A</b> HALL OF SCULPTURE ARCHITECTURE STONE DISTRIBUTION			
TYPE	COLOR	% TOTAL	SQ. METERS
Pentelic	White/Grey	46%	542.9
Carrara	Venato	40%	480.1
Hauteville	Beige	8%	95.6
Connemara	Banded	5%	61.0
Verona	Light red/orange	1%	8.5
Verona	Dark red/orange	0%	0.3
		100%	1188.32

Fig. 2A. Hall of Sculpture Architecture Stone Distribution. Includes, type, color, percent of total, square meters

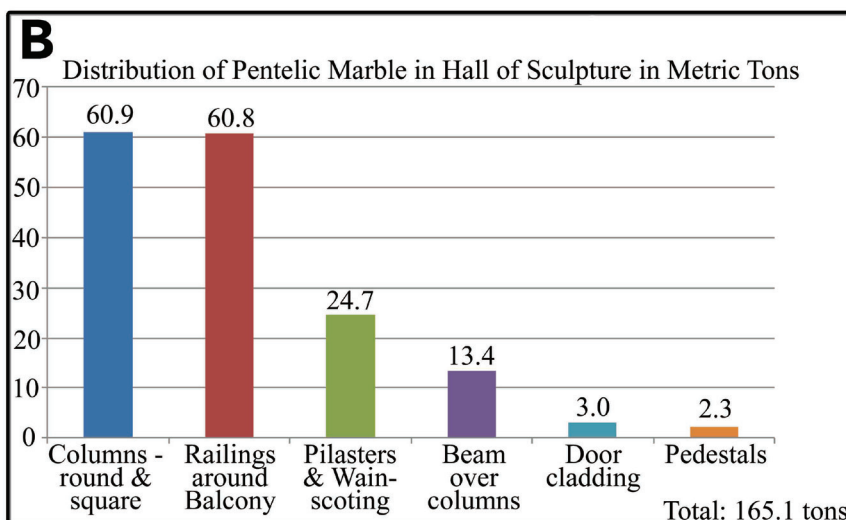


Fig. 2B. Distribution of Pentelic Marble in Hall of Sculpture in metric tons. Includes, columns, balcony, pilasters, wainscoting, beam, door cladding, and pedestals





1907 Hall of Sculpture Image

Fig. 3

Fig. 3. Hall of Sculpture, 1907 black and white photograph, taken by Alden & Harlow, Architects

days the interior of the hall is less illuminated and reflective of sunlight off the marble, which tends to make the hall appear greyer. A plaster reproduction of the original Panathenaic Frieze of the Parthenon, purchased by Andrew Carnegie in 1898, was installed around the interior of the room at the cornice line,<sup>4</sup> unlike the original frieze on the Acropolis, which covered the exterior of the building. When the hall opened, a collection of sixty-nine classical sculpture plaster casts occupied the first floor (Fig. 3). The story of classic buildings is often romanticized by the use of marbles in architecture. The showcase of the Hall of Sculpture with Pentelic marble columns, balcony pedestals, and the Parthenon Frieze is often viewed by museum visitors as an expression of the classic Greek world.

### Development of the Carnegie Museum of Art's Hall of Sculpture

The first building phase of the Carnegie complex by Longfellow, Alden, and Harlow, architects, was the construction of the Carnegie Library of Pittsburgh and Carnegie Music Hall.<sup>5</sup> The architects drew up plans for three gallery spaces on the second floor of the north wing of the library. The gallery would be the temporary home for the Department of Fine Arts collection of paintings

and sculpture casts, until the new building extension with the Hall of Sculpture was built in 1907.<sup>6,7,8</sup>

Prior to the organization of the Department of Fine Arts in 1895, Andrew Carnegie, the founder of the Carnegie Library, presented to the Trustees of the Carnegie Library, a series of absolutely perfect reproductions, of sixteen of the greatest pieces of sculpture in the world.<sup>9</sup> The casts of these sculptures were made by Brucciani and Company, of London, England exclusively for exhibition in the Art Gallery.<sup>11</sup> One of the great pieces of this collection acquired from the British Museum in London, England, is a plaster copy of the famous Parthenon Frieze made of Pentelic marble.<sup>12,13</sup> The Parthenon Frieze is part of the well-known Elgin Marbles.<sup>14</sup> Pike reported that geochemical isotopic analysis of the Elgin Marbles

4 GANGEWERE 2011, 39.

5 FLOYD 1994, 203-231.

6 VAN TRUMP 1970, 8.

7 GANGEWERE 2011, 50.

8 KOLLAR, HUGHES, FEDOSICK [In press].

9 BEATTY 1903, 75-77.

10 CHURCH 1895, 58-62.

11 CHURCH 1895, 58-62.

12 GANGEWERE 2011, 39.

13 BEATTY 1903, 77.

14 CLACK 1982, 32-36.

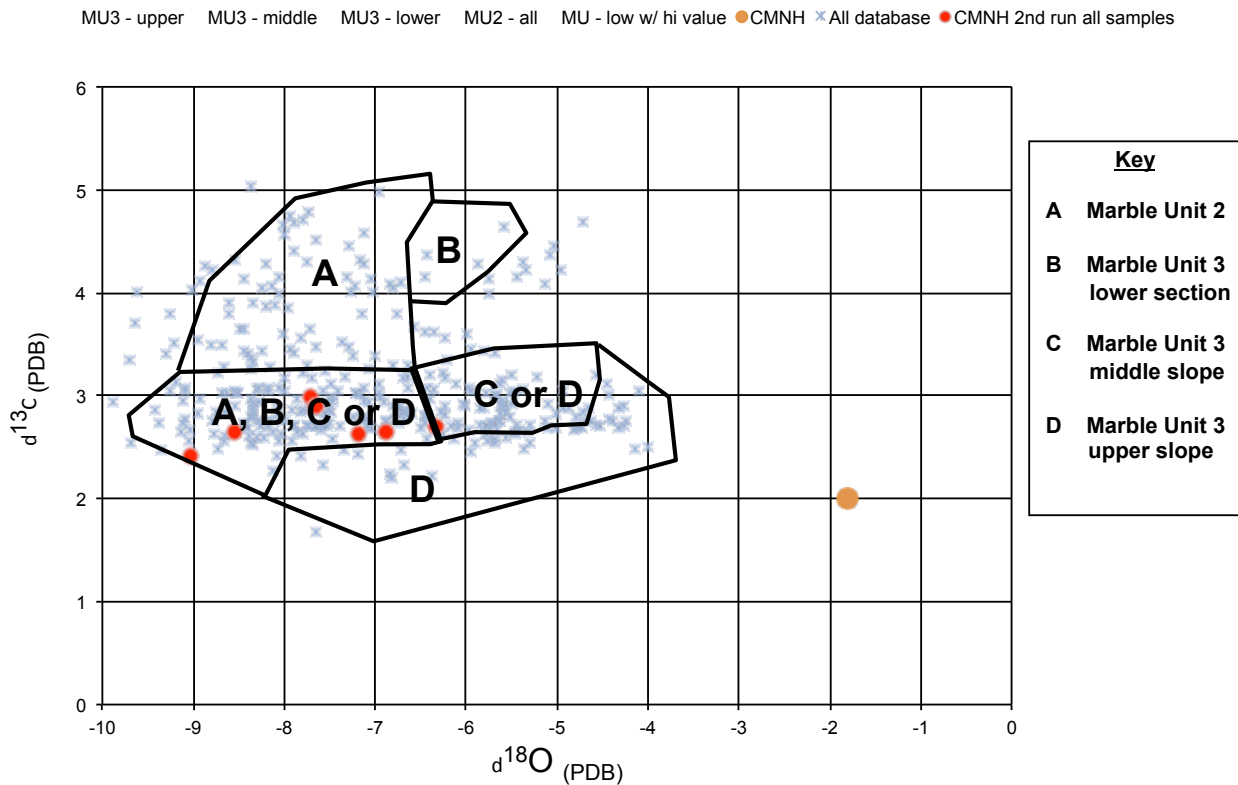


Table 1. Scatterplot distinguishing isotope fields of Pike 2004. Compared to Carnegie Museum of Art Hall of Sculpture marble samples of Carrera (orange dots) and Pentelic marbles (red dots). Scott Pike, Willamette University, Salem, Oregon

and the Parthenon frieze reveal that the marbles were sourced from the classic Greek white marble quarries.<sup>15</sup>

A year after the completion of the Carnegie Library of Pittsburgh in 1895, Longfellow resigned and returned to his Boston practice.<sup>16</sup> That same year, Alden and Harlow formed their Pittsburgh architecture firm and continued to serve as the architects for regional Carnegie Libraries. From 1897 to 1901, Andrew Carnegie continued to purchase fine arts reproductions including sixty-nine plaster casts of significant works of Egyptian, Middle Eastern, classic Greek, and antique Roman sculptures.<sup>17</sup> When visiting Pittsburgh in 1897, Carnegie recognized the Carnegie Institute needed expansion for the growing fine arts and natural history collections.<sup>18 19 20</sup>

By 1898, Carnegie and the Board of Trustees had received estimates for the Carnegie Institute expansion

from Alden and Harlow.<sup>21</sup> In 1900, the architect's preliminary sketches for the new Carnegie Extension received its first public viewing at the Pittsburgh Architectural Club. The group of drawings that was approved by Andrew Carnegie in April of 1901 included the design for the new Hall of Sculpture.<sup>22</sup>

**The hall of sculpture modeled after the parthenon**

The Hall of Sculpture (1907) was built to resemble the 5<sup>th</sup> century Greek Parthenon (447 to 438 B.C.). The cella or inner sanctuary honored the goddess Pallas Athena whom the Athenians worshipped as the guardian of their city. The Hall of Sculpture dimensions mimic what is historically interpreted as the dimensions of the original structure. The height of the room extends two stories or 14 m from the first floor to the top of the plaster frieze that is attached at the cornice line just below the rectangular skylight glass ceiling. The interior room dimensions are 38.4 m in length and 17.6 m in width. The hall's colonnade has sixteen smooth Pentelic marble Doric columns and four Pentelic marble pillars on the first floor supporting the balcony and second floor (Fig. 5). There are sixteen fluted Ionic

15 PIKE 2004, 196-206.

16 FLOYD 1994, 216.

17 BEATTY 1903, 59.

18 FLOYD 1994, 216.

19 VAN TRUMP 1970, 8.

20 GANGEWERE 2011, 32.

21 FLOYD 1994, 216.

22 VAN TRUMP 1970, 8.

Pentelic marble columns and four Pentelic marble pillars on the balcony supporting the top-lit glass ceiling and roof. The hall's architectural units (e.g., columns, balcony railings, pillars, cladding, wainscoting, and pedestals), (Fig. 5), are constructed of solid white/grey Pentelic marble from the classic Greek marble quarries on Mount Pentelikon, (Fig. 2B), table 1. Pike's geologic map of the ancient quarry region on the south slope of Mount Pentelikon, Attica, Greece, locates the majority of the ancient quarries within Marble Units 3, with several recognized in Marble Unit 2.<sup>23</sup>

The architects' 1904 blueprints for the Hall of Sculpture depict the placement of the sixty-nine plaster casts and the famous Elgin marble casts from the east pediment of the Parthenon. Many of the sixty-nine casts on the first floor room 128 are seen in the 1907 black and white photograph taken shortly after the hall's grand opening, (Fig. 3). The eight original sculpture casts exhibited at the first Carnegie International in 1896 are now placed on the hall's balcony pedestals (Fig. 5). The remaining sculpture casts from the 1907 opening are in the adjoining Hall of Architecture.

To educate museum visitors about Greek history, a scale model of the Parthenon was built in 1933 for public exhibition in the Hall of Architecture.<sup>24</sup> The model measures approximately 3.3 m long by 1.7 m wide by 1 m in height, one twentieth of the original size of the Parthenon in Athens. The model's interior space with the miniature statue of Athena inside is illuminated.<sup>25</sup>

### The export of pentelic marble from greece in modern time

During the Hellenistic period, the ancient Greeks valued the white Pentelic marble for buildings, monuments, and statuary. An example of the classic white marble is in the Parthenon sculptural pieces at the British Museum in London, England.<sup>26</sup> After the fall of the Roman Empire, the quarries used for architecture purposes were essentially abandoned until the 1830s. In 1832, the newly formed independent Greek government renewed efforts to rebuild Greek buildings, and the infrastructure of Athens. With the reestablishment of the Olympic Games in their first modern version in 1896, classic Pentelic marble was used in the restoration of the Panathenaic Stadium, in Athens.<sup>27</sup>

At the end of the 19<sup>th</sup> century, rumors circulating throughout the international architectural society that Pentelic marble from Greece might not be available for market. A review in *STONE* suggested the Greek government contemplated taking action to prohibit the exportation of the marble. Mr. A.E. Bockman, a major Pentelic marble importer at the time, denied this rumor, "An English company holds a concession from the Greek government of the whole of the Pentelikon Mountain, it has now fifteen quarries opened in full working order. It is filling Greek, English, German, French, and Indian contracts amounting to many thousand tons. Bockman continues, "the deposit of marble in the Pentelikon Mountain is inexhaustible, and there is no restriction whatsoever upon shipping the marble to any part of the world"<sup>28</sup>

In the 1970s, the Pentelic quarries were expanding to meet the demand for marble as the modern city of Athens developed. Soon thereafter, the Greek preservationists declared these classic quarries part of the National Forest and therefore protected from further destruction, PIKE, personal communication.

The author knows of five 20<sup>th</sup> century buildings in the United States that incorporate Pentelic marble in their architecture. The Carnegie's Hall of Sculpture, Pittsburgh, Pennsylvania (1907), the Dime Savings Bank of Brooklyn, New York (1908), the New York Public Library, New York City, New York (1911) the Old Federal Building, Cleveland, Ohio (1911), and the Greek Nationality Room on the campus of the University of Pittsburgh, Pittsburgh, Pennsylvania (1941).

Mowbray & Uffinger, architects of the Classical Revival style of the Dime Savings Bank of New York, originally the Dime Savings Bank of Brooklyn, ordered 2,000 tons of Pentelic marble for the exterior of the building.<sup>29</sup> Carrère & Hastings, architects of the Beaux-Art landmark, the New York Public Library, used white/grey Pentelic marble on the second floor wainscoting in the hallway just beyond Astor Hall.<sup>30</sup> The University of Pittsburgh Cathedral of Learning, an historic Gothic architecture building, was constructed from 1926 to 1936. Shortly thereafter, the Greek Nationality Room was installed in 1941 as part of the university's Nationality Rooms. The Greek Room wall plaque and oral recording on the Nationality Rooms web site [www.nationalityrooms.pitt.edu](http://www.nationalityrooms.pitt.edu), verify the authenticity of the Room's Pentelic marble, "marble quarried prior to the outbreak of the Second World War and [which] is the same marble that built the Parthenon in Athens". The white/grey

23 PIKE 2004, 200.

24 HITT 1933, 3.

25 KOLLAR, HUGHES, FEDOSICK [In press].

26 PIKE 2004, 203.

27 PRICE 2007, 62.

28 ANONYMOUS 1907, 126.

29 ANONYMOUS 1907, 126.

30 STEFFENSEN 2003, 37.

marble floor tile, Ionic columns, and pilasters are similar to the Pentelic marble in the Carnegie's Hall of Sculpture. The Greek Room's wainscoting architecture unit is grey. PRICE described the inclusion of grey coloring in Pentelic marble as the mineral graphite. This occurs when the organics within the original limestone are carbonized during the metamorphism phase forming the mineral graphite.<sup>31</sup>

### The Carnegie's Pentelic marble provenance?

Prior to 1904, the Carnegie Extension was considered the largest 'marble' building contract undertaken in the United States.<sup>32</sup> The Pittsburgh construction firm of William F. Miller and Sons was the building contractor. The task of marble and stone fabrication was beyond a single company's capacity. As primary contractor, Miller and Sons established subcontracts and secondary fabrication companies in nearby cities of Philadelphia, Baltimore, Chicago, and Buffalo.<sup>33</sup>

Mr. B.P. Young, an employee of Miller and Sons, was assigned as agent to travel to Athens, Greece, to secure and arrange marble shipments to Pittsburgh from Athens, Isle of Tinos, and Larisa, Greece.<sup>34</sup> The author's review of the archives in the Carnegie Museum of Art and the architecture archives of the Pittsburgh History and Landmarks Foundation, was unable to document a specific quarry from which the Carnegie's Pentelic marble was sourced.

A review of the cited references, suggest the source of the Carnegie's Pentelic marble quarry was Mount Pentelikon. "Carnegie marble is from the classic quarries of Mount Pentelikon, near Athens, Greece".<sup>35</sup> "The Hall of Sculpture used Pentelic marble, one of the most perfect of marbles and is the same stone of which the Parthenon was built".<sup>36</sup> "The Hall of Sculpture marble columns quarried at Mount Pentelikon between Athens and Marathon, in Greece, the same marble that was used in the Parthenon".<sup>37</sup> "The Carnegie court was built to resemble the cella of the Parthenon and constructed of Pentelic marble from the actual quarries that supplied the stone for that great Temple of Athena on the Acropolis".<sup>38</sup> "the Hall of Sculpture is made of Pentelic marble from the same quarry used



Fig. 4. 2017 image of Carnegie Museum Hall of Sculpture. Pentelic marble outlined in red

by ancient Greek architects to construct the buildings on the Acropolis in Athens, "the museum's Hall of Sculpture was constructed with brilliant white marble from the same Greek quarries that provided the stone for the Parthenon".<sup>39</sup>

These references cast the Carnegie's Pentelic as the same white marble that built the Parthenon. But what is white marble to architects and architecture historians is not necessarily true to geologists. PIKE's research indicates that the high quality pure white *Aspra Marmara* marbles are exclusive for much of the sculptural program on the Parthenon and for the Elgin Marbles of the British Museum, London, England.<sup>40 41</sup> The Carnegie's Pentelic marble is white with thin grey bands (Fig. 2A), (Fig. 3) and white incorporating streaks of reddish-brown, and greens colors. The isotopic geochemical analysis of the Carnegie's Pentelic is plotted in the isotopic red dot field, Table 1.

31 PRICE 2007, 62.

32 VAN TRUMP 1957, 171.

33 VAN TRUMP 1957, 171.

34 VAN TRUMP 1957, 171.

35 ANONYMOUS 1913, 34, 528-529.

36 WALKER 1913, 19-21.

37 SQUITIERI 1947, 19.

38 VAN TRUMP 1970, 42.

39 GANGEWERE 2011, 39.

40 PIKE 2004, 203.

41 PIKE 2015, 207.



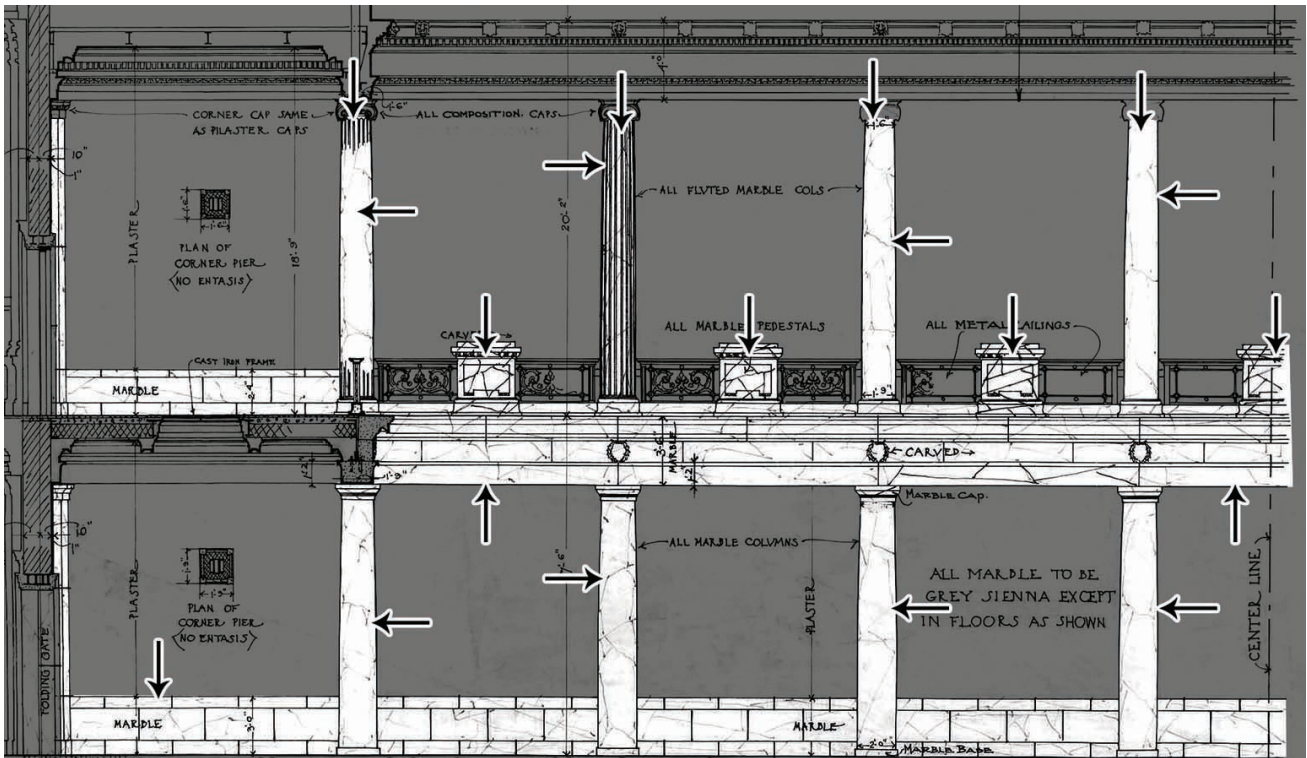


Fig. 5. Modified from Alden & Harlow, Architects, Hall of Sculpture, Long Section Towards Mawhinney St. Rooms 128 and 228. May 14, 1904. Arrows indicate Pentelic marble

### Geochemical isotopic analysis and provenance of the carnegie pentelic marble

The purpose of this study is to specify the Pentelic quarry site for the marble used in the Hall of Sculpture. In the summer of 2014, Dr. Scott Pike of Willamette University, recommended I send him two small samples of the marble floor tile from the Hall of Sculpture for isotopic analysis. The ratios result of the floor tile suggest the marble source is identical to that of Carrara marble of Italy and not of the Pentelic marble, as suggested by the cited literature in the previous section. The Carrara isotope ratios are represented by the orange dot and is outside the range for the Pentelic Database Field, Table 1.

Prior to the ASMOSIA XI meeting in Split, Croatia, digital copies of the architects' 1904 blueprints for the Hall of Sculpture became available to me courtesy of the Carnegie Museum of Art's Architecture Department. On one of the blueprints, the handwritten script said, "all marble to be Grey Sienna except in floor as shown" (Fig. 5). A second blueprint for Room 128 & 228 order the architects' marble index for the hall's floor plan. The marble called Grey Sienna is listed as one of five 'marbles' used in the hall (Fig. 1). There is no mention of Pentelic in the marble index. This creates a conflict with the previous cited references that refer to the Hall of Sculpture marble as Pentelic. So how to address the Grey Sienna handwritten script?

I reached out to Sarah Minnaert, Deputy Director, Carnegie Museum of Art, to procure an additional seven marble sample chips from the Hall of Sculpture architecture units (e.g., the balcony Ionic columns, wall wainscoting, pilasters, door cladding and pedestals), (Fig. 2B). Each sample bag was labeled with a digital image of the sampled architecture unit. All samples were sent to Professor Pike in Salem, Oregon for additional isotopic analysis in the summer of 2015.

In the records of antiquity and current research by art historians, architects, archaeologists, geologists and archaeometrists have verified the Pentelic marble source.<sup>42</sup> PIKE identified 172 discrete quarries within the ancient quarry area. Each quarry samples reveal a unique chemical signature known for its oxygen-18 ratios. Once known these ratios can be correlated to the Pentelic marble ratios with the values secured from the Parthenon Elgin marbles.<sup>43 44</sup> Therefore, the Carnegie's Pentelic marble isotopes ratios can now be compared to the established Pentelic marble database.

Sample A (WU15-001): d13C: 2.0 d18O: -1.8

Sample B (WU15-002): d13C: 1.9 d18O: -1.8

42 PIKE 2004, 198.

43 MATTEWS *et al.* 1992, 203-212.

44 PIKE 2004, 198.

A total of nine ‘white’ marble samples were analyzed and compared to the established isotopic Pentelic and Carrara databases. It’s been established that Carrara marble is the main floor tile in the Hall of Sculpture. The architecture drawings (Fig. 1) with a capital letter W (white), Italian English Veined and is recognized as the Carrara marble throughout the Carnegie Museum.<sup>45-46</sup>

The next challenge is to confirm the seven marble samples identified in the architect’s blueprint as Gray Sienna (Fig. 1) is indeed Pentelic marble. From Dr. Pike’s lab, the isotopic ratios of three of the seven samples suggest a low stream flow. Pike plotted all seven samples ratios against the first two Carrara marble Samples A & B. “The isotopic ratios are dissimilar and are represented by the Orange dots” in Table 1. “The seven data points in red, plot squarely in the center of the Penteli isotope field figured on table 1. This designates the probability that Carnegie Pentelic marble was sourced from Marble Unit 2 and Marble Unit 3.<sup>47</sup>

“The  $\delta 180$  values are fairly widely spread from a low-value of -9.0 to a high value of -6.3 is common in many of the quarries at Penteli and does not necessarily mean the marble came from different quarry pits. It is quite possible that the Carnegie material may have come from multiple quarries. The data simply can’t distinguish between the two possibilities. The spread in  $\delta 180$  values does suggest, though, that multiple blocks were used. If the Carnegie samples were from the same quarry blocks, we would probably see similar ratios. Unfortunately, the data cannot distinguish a particular quarry or set of quarries used for exploration.”<sup>48</sup>

The ratios of the Carnegie marbles used in the Hall of Sculpture probably had their origin from Marble Unit 2 and Marble Unit 3. But not from the *Aspra Marmara* quarries in the upper portion of Marble Unit 3, table 1. The *Aspra Marmara* marbles were high quality pure white and used for much of the sculptural program on the Parthenon as compared with the Lord Elgin Marbles of the British Museum and the Propylaea on the Acropolis.<sup>49-50</sup> Many architecture historians interpret the Carnegie Pentelic marble as a white marble, the provenance of the isotopic ratios in the marble quarry fields as shown in Table 1 suggest it is not.

45 PRIMAVORI 2015, 137-154.

46 KOLLAR, HUGHES, FEDOSICK [In press].

47 PIKE 2004, 201-203.

48 PIKE Personal Communication, 2015.

49 PIKE 2004, 198.

50 PIKE 2015, 207.

### The pentelic marble and other decorative stone varieties in the neoclassical Hall of Sculpture

The Carnegie Pentelic marble is characterized by grey banding in the marble columns, balcony, railings, pillars, cladding, wainscoting, and pedestals. The banding is noticeable on the first-floor Doric marble columns and on the second-floor marble balcony and marble pedestals. Grey banding stand’s out against the white in the 1907 black and white image of the Hall of Sculpture (Fig. 3) and in the Hall of Sculpture color image (Fig. 5).

The 1904 architectural drawings of the Hall of Sculpture include the First Floor Plan 128 and Balcony Floor Plan Room 228. Under the heading, “Marble Index” are the lists of the architecture stones indicated by a capital letter placed in a circle. To illustrate what the letter designates, each circle is filled with a corresponding stone reference color. For example, S represents Grey Sienna and R represents Red, (Fig.1). The Carnegie architects referred to all stones as marbles. I identified and labeled three marbles in the Hall of Sculpture marble index: Grey Sienna as Pentelic marble, white Italian English Veined as Carrara marble, and Green as Connemara marble. The marble index also lists two limestones, Red Verona and Hauteville (Fig. 1).<sup>51</sup>

The decorative stones in the Hall of Sculpture is an architecture contrast of color. The stone distribution is summarized by the total square meters and percentages amounts for the hall (Fig. 2A). The dominant stone is the Pentelic marble. It makes up forty-six percent of the total stones in the hall and covers five hundred forty-two square meters in the hall’s columns, wainscoting, pilasters, door cladding, balcony, and railings. The second dominant stone is the Venato Carrara marble at forty percent. Four hundred and eighty square meters of tile was used on the first floor and second floor balcony. Lesser stone coverage but colorful are the Hauteville limestone at eight percent and ninety-five square meters of floor tile on the first floor. The green banded Connemara marble at five percent and sixty-one square meters of floor tile is shown on the first floor. Lastly, at one percent and covering nine square meters on the first floor are two varieties of light and dark red fossiliferous Verona limestone, (Fig. 2A).

We estimate approximately one hundred and sixty-five metric tons of Pentelic marble was used in the Hall of Sculpture construction (Fig. 2B).<sup>52</sup> We also infer that approximately four hundred and ninety-five tones of marble were extracted from Mount Pentelikon for the Carnegie marble contract. The number of tons inferred

51 KOLLAR, HUGHES, FEDOSICK [In press].

52 KOLLAR, HUGHES, FEDOSICK [In press].

is based on the mode of fabrication, loss in cutting and shaping of pedestals, wainscoting, pilasters, door cladding and railings, and the challenge of cutting and shaping the thirty-two, 4.57-meter-high columns, (Fig. 2B).

The Pentelic marble on display in the Hall of Sculpture, includes a variety of colors, white and grey, grey/white red, and grey/white/green. White marble once exposed to the elements of weathering can oxidize the iron oxides and trace minerals, creating reddish-brown and green stain variations in the stone.<sup>53</sup> Hitt speculated, “fresh cut Pentelic marble exposed to the natural forces of nature, the marble did not retain the extreme whiteness color but exposed minerals that colored the marble with soft tones of yellow and green”.<sup>54</sup>

In an attached building to the Carnegie Museum is the main entrance of the Carnegie Library of Pittsburgh. A blue and grey color marble was observed at the main entrance.<sup>55</sup> The blue/grey color marble appears to be what Price described as blue/grey Pentelic, a sought-after color for the international market.<sup>56</sup>

## Conclusions

The Pentelic marble makes up forty-six percent of the architectural stones used to build the Carnegie Museum of Art Hall of Sculpture. Nine marble sample chips were analyzed from the Hall of Sculpture architecture units (e.g., floor tile, columns, pilasters, door cladding, wall wainscoting, and pedestals). The two-initial floor tile sample chips are confirmed as Carrara marble from Italy. The seven sample chips designated in the architect’s blueprints as Grey Sienna marble are confirmed as Pentelic marble. It was not possible to ascertain from the isotopic data whether the Carnegie Pentelic marble is exclusive to a single classic quarry or more likely, from multiple classic quarries on Mount Pentelikon. The isotopic data suggest the Carnegie Pentelic marble are within Marble Unit 2 and Marble Unit 3. But not of the classic *Aspra Marmara* (white marble quarry) known to be the source for Greek sculptures.

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53 PRICE 2007, 62.

54 HITT 1933, 3-12.

55 KOLLAR, HUGHES, FEDOSICK [In press].

56 PRICE 2007, 62.

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