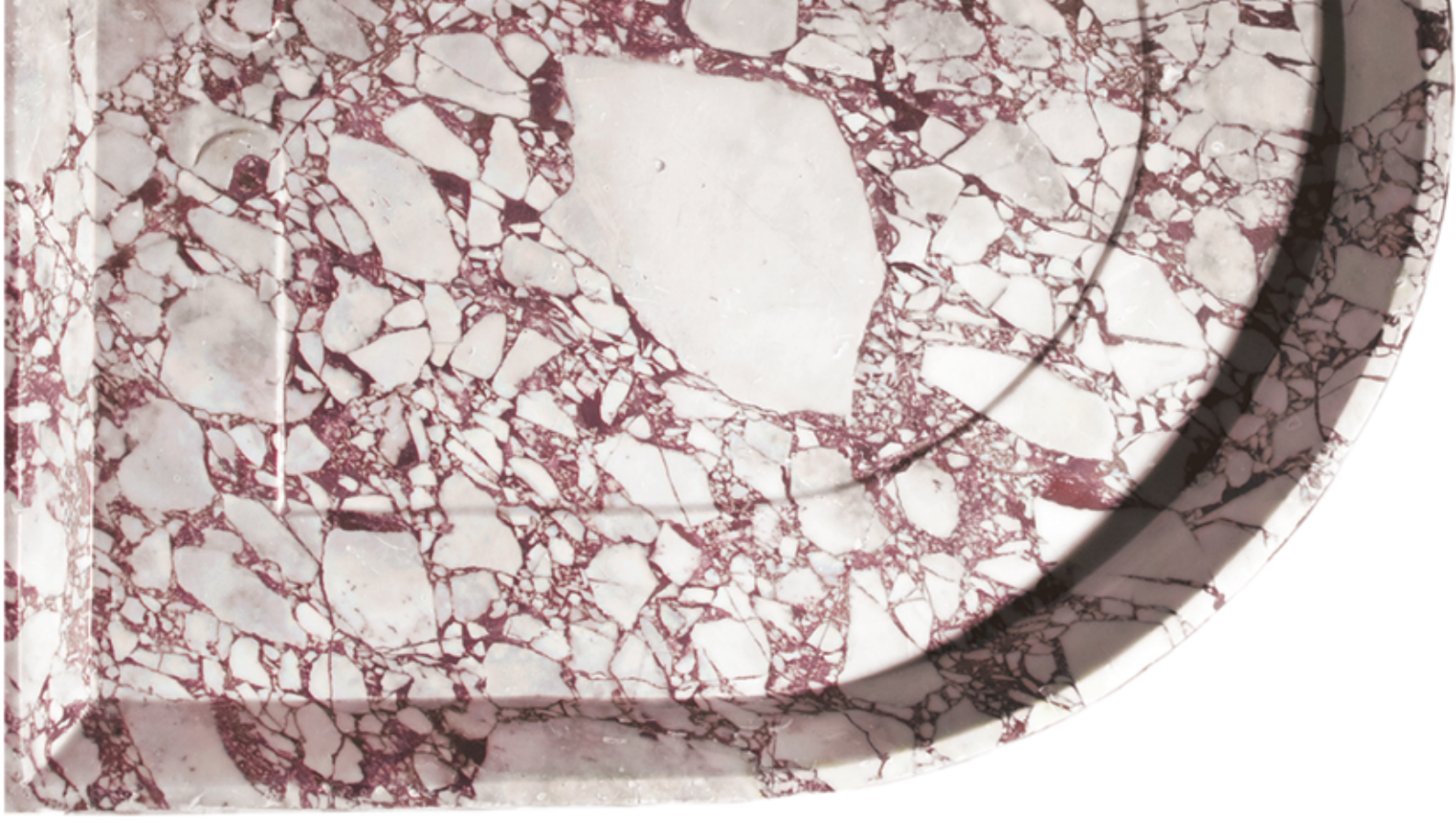
The Pentelic Marble in the Carnegie Museum of Art Hall of Sculpture, Pittsburgh, Pennsylvania

Kollar, Albert D.



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CONTENT

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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 19th and early 20th 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.[1] [2] 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.[3]

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].

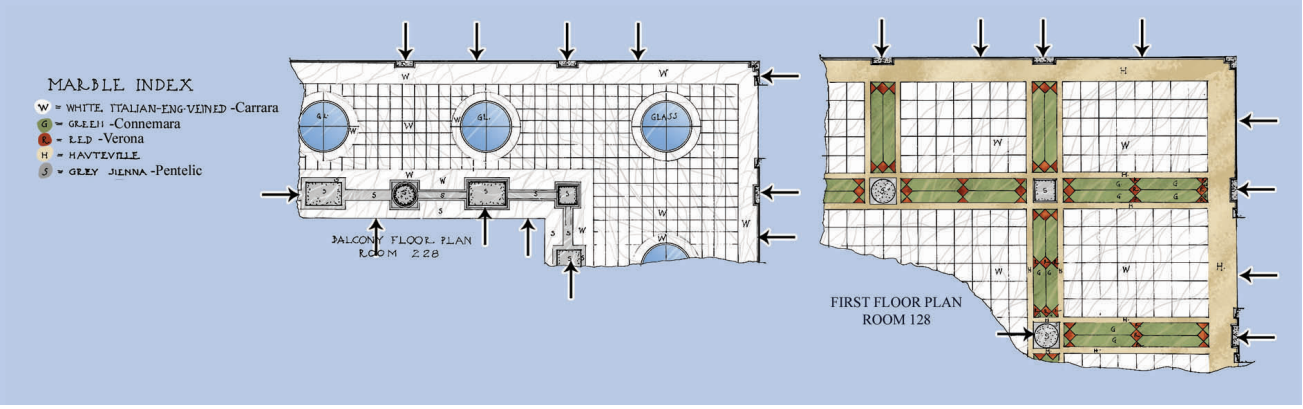

Fig. 1. Modified from Alden & Harlow, Architects, Hall of Sculpture, Balcony Floor Plan Room 228, Main Floor Plan Room 128, May 14, 1904. Includes Marble Index, with colored circles with capital letter, which refers to the common name of a marble with the modern geologic name. Arrows indicate position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

A

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

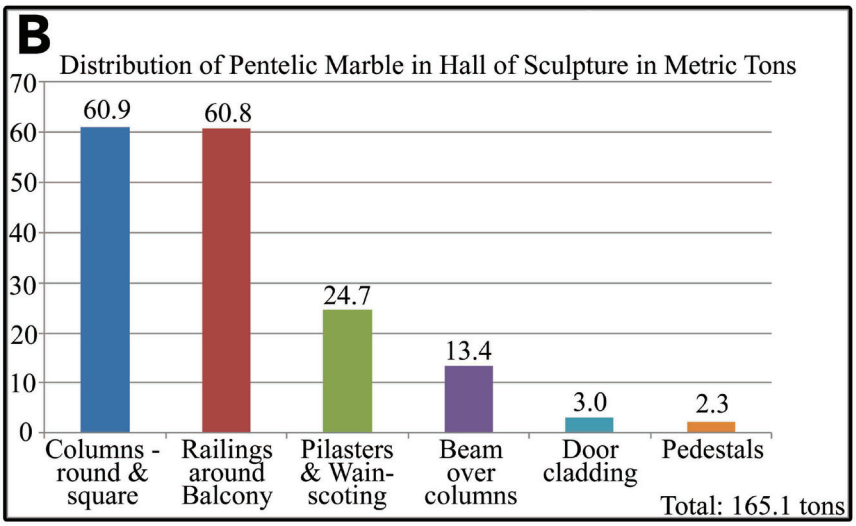

Fig. 2B. Distribution of Pentelic Marble in Hall of Sculpture in metric tons. Includes, columns, balcony, pilasters, wainscoting, beam, door cladding, and pedestals

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,[4] 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.[5] 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.[6 7 8]

Prior to the organization of the Department of Fine Arts in 1895, Andrew Carnegie, the founder of the Carnegie, 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.[9 10] The casts of these sculptures were made by Brucciani and Company, of London, England exclusively for exhibition in the Art Gallery.[11] 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.[12 13] The Parthenon Frieze is part of the well-known Elgin Marbles.[14] 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.

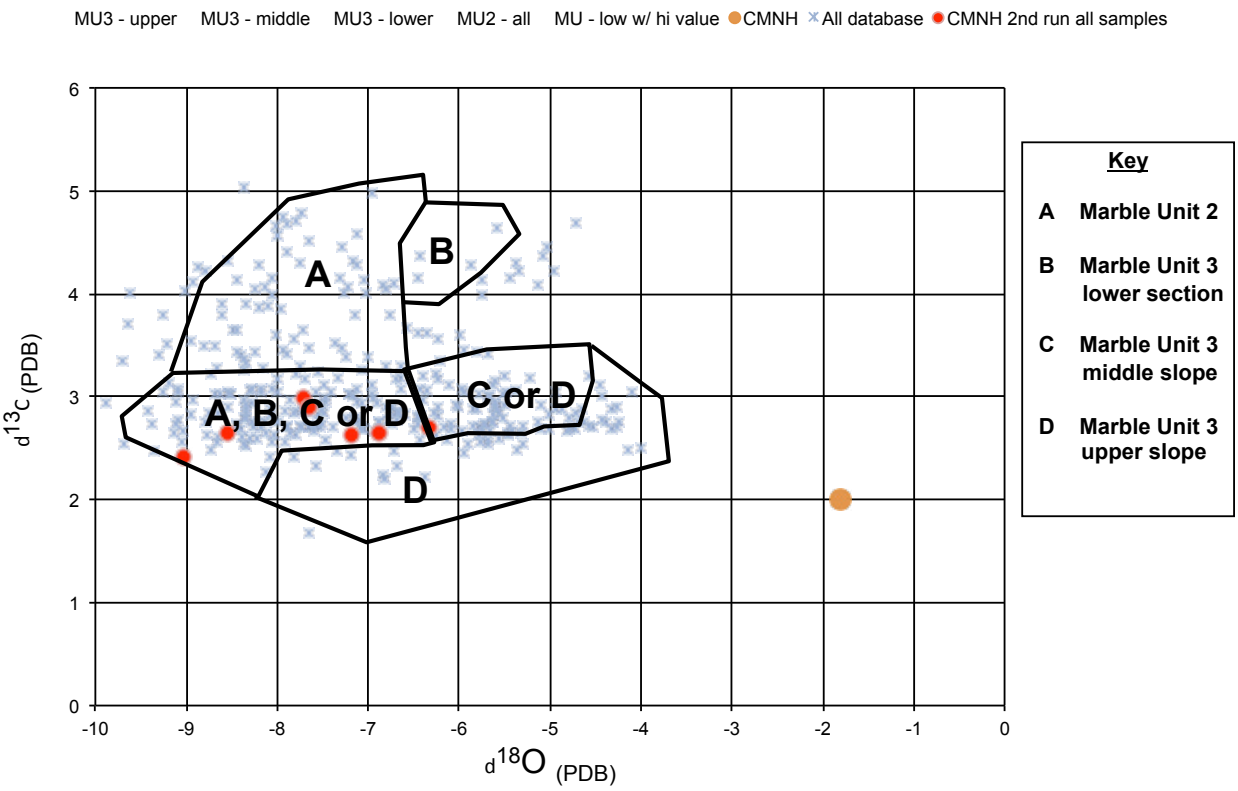

Table 1. Scatterplot distinguishing isotope fields of Pike 2004. Compared to Carnegie Museum of Art Hall of Sculpture marble samples of Carrera (orange dots) and Pentelic marbles (red dots). Scott Pike, Willamette University, Salem, Oregon

and the Parthenon frieze reveal that the marbles were sourced from the classic Greek white marble quarries.[15]

A year after the completion of the Carnegie Library of Pittsburgh in 1895, Longfellow resigned and returned to his Boston practice. [16] 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.[17] When visiting Pittsburgh in 1897, Carnegie recognized the Carnegie Institute needed expansion for the growing fine arts and natural history collections.[18] [19] [20]

By 1898, Carnegie and the Board of Trustees had received estimates for the Carnegie Institute expansion from Alden and Harlow.[21] 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. [22]

The hall of sculpture modeled after the parthenon

The Hall of Sculpture (1907) was built to resemble the 5th 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.[23]

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.[24] 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.[25]

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.[26] 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.[27]

At the end of the 19th 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".[28]

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 20th 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.[29] 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.[30] 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, 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.[31]

The carnegie's pentelic marble provenance?

Prior to 1904, the Carnegie Extension was considered the largest 'marble' building contract undertaken in the United States. [32] 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.[33]

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.[34] 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".[35] "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".[36] "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.[37], "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".[38], "the Hall of Sculpture is made of Pentelic marble from the same quarry used 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".[39]

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

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.[40] [41] 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.

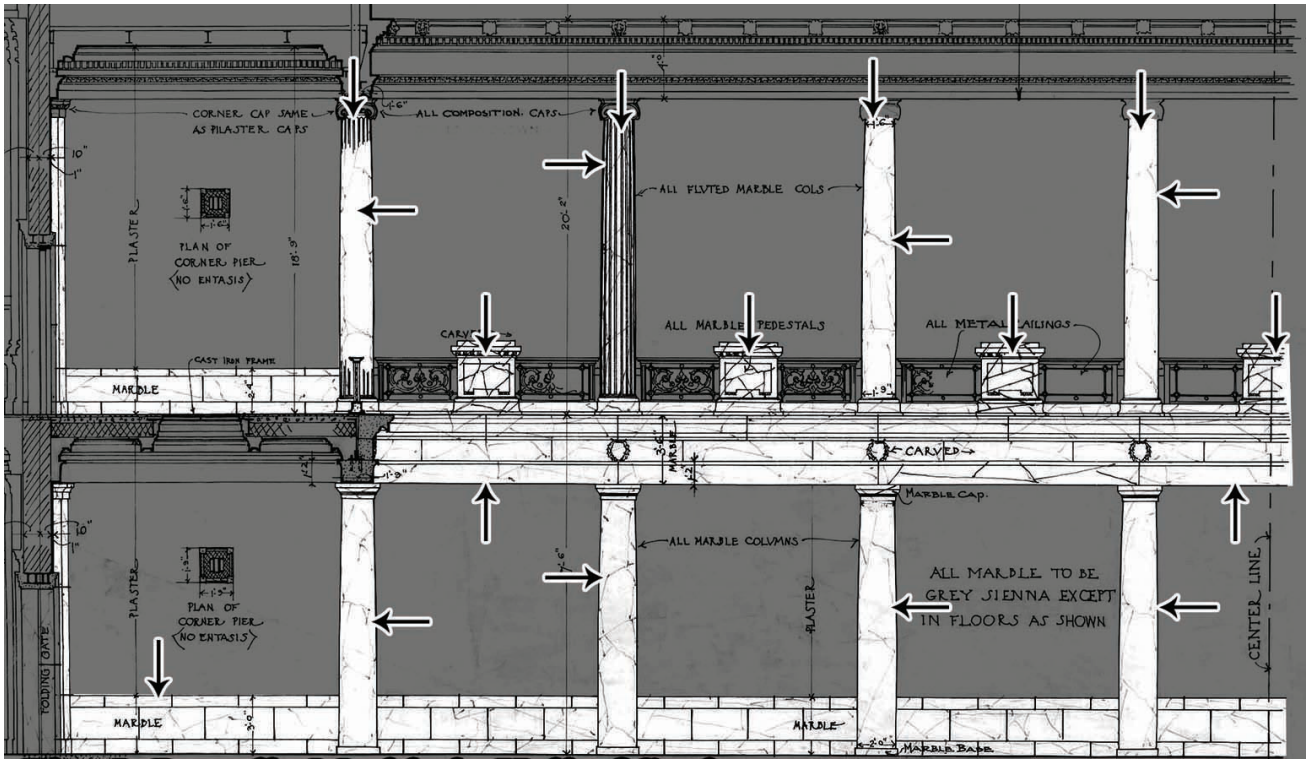

Fig. 5. Modified from Alden & Harlow, Architects, Hall of Sculpture, Long Section Towards Mawhinney St. Rooms 128 and 228. May 14, 1904. Arrows indicate Pentelic marble

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 blueprint's, 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.[42] 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.[43] [44] 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 d180: -1.8
Sample B (WU15-002): d13C: 1.9 d180: -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.[45] [46]

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.[47]

"The δ180 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 Pendeli 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 δ180 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".[48]

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.[49] [50] 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).[51]

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).[52] 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.[53] 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".[54]

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.[55] The blue/grey color marble appears to be what Price described as blue/grey Pentelic, a sought-after color for the international market.[56]

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.

53 PRICE 2007, 62.

54 HITT 1933, 3-12.

55 KOLLAR, HUGHES, FEDOSICK [In press].

56 PRICE 2007, 62.

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BIBLIOGRAPHY

ANONYMOUS 1907: Plenty of Pentelic Marble, 126.

ANONYMOUS 1913: Stonework in the Pittsburgh Library, 528-529.

BEATTY J. W. 1903: The Carnegie Institute Catalogue of Paintings, Sculpture, and other objects in the Department of Fine Arts, 75-77.

CHURCH H. C. 1895: The Statuary. Carnegie Museum, Annual Report of the Director 1898 – 1902, Dedication Souvenir, 58-62.

CLACK J. 1982: The Elgin Marbles. Carnegie Magazine, 32-36.

CROLY H. 1911: The United States Post Office, Custom House and Court House, Cleveland, Ohio, 193-213.

FLOYD M. H. 1994: Architecture After Richardson, Regionalism before Modernism—Longfellow, Alden, and Harlow in Boston and Pittsburgh, 546.

GANGEWERE R. J. 2011: Palace of Culture – Andrew Carnegie's Museums and Library in Pittsburgh, 332.

HITT L. W. 1933: The Parthenon, Carnegie Magazine, 3-12.

KOLLAR A. D. 2016: The Pentelic Marble of the Carnegie Museum of Pittsburgh, Pennsylvania U.S.A, in ASMOSIA XI, Abstract, 275.

KOLLAR A. D., HUGHES K. A., FEDOSICK R.: Sculpture Hall: A Historic Review. Annals of Carnegie Museum [In press].

LONGFELLOW A. W., ALDEN F. E., HARLOW A. B. 1895: The Architectural Plan. Carnegie Museum, Annual Report of the Director 1898 – 1902, Dedication Souvenir, 18-38.

MATTEWS K. J. *et al.* 1992: "The Re-evaluation of the Stable Isotope Data for Pentelic Marble", in M. WAELKENS, N. HERZ, L. MOENS (eds.): Ancient Stones: Quarry, Trade and Provenance, 203-12.

PIKE S. H. 2004: Intra-quarry sourcing of the Parthenon marbles: applications of the Pentelic Marble Stable Isotope Database, in M. COSMOPOULOS (ed.): The Sculptures of the Parthenon, 196-206.

PIKE S. H., LAMBRINOU L. 2015: The Parthenon's Quarry Quandary – Looking inside the Pentelic Source, in ASMOSIA XI, Abstract, 275.

PRICE M. T. 2007: The Sourcebook of Decorative Stone: An Illustrated Identification Guide, 228.

PRIMAVORI, P. 2015: Carrara Marble: a nomination for 'Global Heritage Stone Resource' from Italy, in D. PEREIRA, B. R. MARKER, S. KRAMAR, B. J. COOPER, B. E. SCHOUENBORG (eds.): Global Heritage Stone: Towards International Recognition of Building and Ornamental Stones, 137-154.

STEFFENSEN I. 2003: The New York Public Library: A Beaux-Arts Landmark, The New York Public Library, 64.

SQUITIERI L. 1947: Marble Halls, 16 -21.

UNIVERSITY OF PITTSBURGH NATIONALITY GREEK ROOM. 2017: www.nationalityrooms.pitt.edu.

VAN TRUMP J. D. 1957: The Triumphant Stone, A Study of the Foyer of Carnegie Music Hall, 167-175.

VAN TRUMP J. D. 1970: An American Palace of Culture: The Carnegie Institute and Carnegie Library of Pittsburgh, Pittsburgh, 1-56.

WALKER T. M. 1913: The New Carnegie Library, 19-21.