Seneca sandstone: A heritage stone from the United States

C. Grissom[1]*, E. Aloiz[2], E. Vicenzi[1], and R. Livingston[3]

[1]Smithsonian Museum Conservation Institute, 4210 Silver Hill Rd., Suitland, MD 20746, U.S.A.

[2]4047 Argyle Avenue, Erie, PA 16505, U.S.A.

[3]Material Science and Engineering Dept., University of Maryland, College Park, MD 20742, U.S.A.

*Corresponding author (email: grissomc@si.edu)

Abstract: Seneca sandstone is a fine-grained arkosic sandstone of dark-red coloration used primarily during the nineteenth century in Washington, DC. The quarries, which are not active, are located along the Potomac River 34 kilometers northwest of Washington near Poolesville, Maryland. Seneca sandstone is from the Poolesville Member of the Upper-Triassic Manassas Formation, which is in turn a Member of the Newark Supergroup that crops out in eastern North America. Its first major public use is associated with George Washington, the first president of the Potomac Company founded in 1785 to improve the navigability of the Potomac River, with the goal of opening transportation to the west for shipping. The subsequent Chesapeake and Ohio Canal parallel to the river made major use of Seneca sandstone in its construction and then facilitated the stone's transport to the capital for the construction industry. The most significant building for which the stone was used is the Smithsonian Institution Building or 'Castle' (1847–1855), the first building of the institution and still its administrative center. Many churches, school buildings, and homes in the city were built wholly or partially with the stone during the 'brown decades' of the latter half of the nineteenth century.

Seneca sandstone is a fine-grained, dark-red arkosic sandstone formerly quarried along the Potomac River 34 kilometers northwest of the United States capital, Washington, DC, near Poolesville, Maryland. Its first major public use is associated with the nation's first president, George Washington, during the late eighteenth century, but the sandstone was used primarily for construction of major buildings in Washington in the nineteenth century. Geologically, the stone is from the Poolesville Member of the Upper-Triassic Manassas Formation found in the states of Maryland and Virginia; this Formation is in turn a Member of the Newark Supergroup, which crops out in eastern North America from Nova Scotia in Canada to South Carolina in the U.S. (Olsen 1980, Lee & Froelich 1989); see Figure 1. Other Members of the Newark Supergroup are well known for providing building stones that dominated domestic construction in New York and other major east coast cities during the latter half of the nineteenth century, especially Portland brownstone from the Connecticut River valley, New Jersey brownstone, and Pennsylvania's Hummelstown brownstone, all of which are also Upper-Triassic arkosic sandstones (Matero & Teutonico 1982). Operations at the Seneca quarries ceased at the beginning of the twentieth

century, but in contrast to other quarries of the Newark Supergroup, the land is untouched by further development. Located entirely on public parkland today, the quarries have potential for interpretation as an industrial quarry site.

This contribution nominates Seneca sandstone for international recognition as a 'Global Heritage Stone Resource' (GHSR). The GHSR nomination results from recognition that Seneca sandstone has a significant place in human culture. The nomination follows the Terms of Reference that have been accepted for the International Union of Geological Sciences (IUGS) Heritage Stone Task Group (HSTG) and published in Global Heritage Stone Circular 4 (see www.globalheritagestone.org).

Seneca sandstone: an introductory summary

Quarrying operations at Seneca, which have been inactive since the early twentieth century, began in the late eighteenth century. George Washington is associated with the sandstone's first major public use before he became the first U.S. President and Washington, DC, the nation's capital. In 1785 he became the first president of the Potomac Company, whose goal was to improve the navigability of the Potomac River: short systems of locks and canals were built near the river to allow rapids to be bypassed. Seneca sandstone was obtained close by across the river for lining five locks of the Great Falls Skirting Canal, still visible on the Virginia side of the river in Great Falls Park, part of the National Park Service's George Washington Memorial Parkway. The successor to the Potomac Company's efforts was the Chesapeake and Ohio Canal (C&O) begun in 1828 on the opposite bank parallel to the Potomac. The work was supervised by chief engineer Benjamin Wright, who had served in that capacity on the recently completed and highly successful Erie Canal. Ultimately running from Washington to Cumberland, Maryland, the C&O Canal made major use of Seneca sandstone for 25 locks (Southworth *et al*. 2008, 25), lock houses, and other structures of the canal in the vicinity of the quarries (Fig. 2). After the canal had reached Seneca Creek in 1831, Seneca sandstone could be readily transported to the city after it was loaded onto canal boats from a canal basin in the Peter Quarry. Later, canal water was supplied to a sandstone cutting building conveniently constructed near the basin.

Major buildings that used the stone were designed by well-known architects. These included the Smithsonian Institution Building, better known as the 'Castle' (1847–1855), designed by James Renwick, Jr. (1818–1895); see Figure 3. Significant buildings constructed of other stones by Renwick include Grace Church (1846–1847) and St. Patrick's Cathedral (1879) in New York City, both National Historic Landmarks. Other major buildings built with Seneca sandstone in Washington include the District of Columbia (DC) Jail (1872) designed by the supervising architect of the U.S. Treasury Department, Alfred B. Mullett (1834–1890); shown in Figure 4. Many churches, school buildings, city markets, and homes in the city were built or trimmed with Seneca sandstone during the 'brown decades' of the latter half of the nineteenth century (Mumford 1955).

The Smithsonian Castle was the first building of the Smithsonian Institution and remains the administrative center for the institution's 19 museums and galleries. When it opened, the Castle housed all activities of the Smithsonian Institution, accommodating the storage and display of an extensive natural history collection, laboratories for scientific study, halls for lectures, and living quarters for Joseph Henry, the first Secretary (Ewing & Ballard 2009, 30–39). The Romanesque style of the Castle was

a deliberate departure from the classical style selected for earlier public buildings in Washington, such as the U.S. Capitol, and the new building was promoted as a prototype for a 'National Style of Architecture for America' by Robert Dale Owen, an Indiana congressman, Smithsonian regent, and chairman of the building committee (Owen 1849, 109). The use of a dark-red stone occurred at the beginning of the 'brown decades,' when dark colors were fashionable. However, it was also selected by the building committee over the white stones previously used for important federal buildings (Inwood Marble and Cockeysville Marble, as well as the tan-colored Aquia Creek sandstone, which was painted white) because of its durability and especially its cost, which was by far the lowest of available options. Use of African-American slave labor for quarrying was alleged to have contributed to the low cost of the stone (Report 1847, 113). It is known for certain that African Americans established a community near the quarries, and many worked there after the Civil War.Seneca sandstone quarries have individual names associated with owners, buildings, or locations, although they were essentially contiguous as the outcrop was quarried along exposures facing the river or feeder streams (Figs. 5, 6). The most popular color of the sandstone was dark red, but, as the prominent geologist David Dale Owen (Robert Dale Owen's brother) noted after his survey of the quarries in 1847, stones were 'various colors, from a light, greenish-gray, or dove color, to a deep red or brown' (Report 1847, 36). Owen described sandstone from the Bull Run Quarry that was chosen for the Smithsonian Castle as lilac gray or purplish gray in color when quarried, turning deep red upon exposure (Owen 1849, 115; Report 1847, 36–39). Stone from the Lee/Government Quarry used for the Union Arch aqueduct is referred to as grey blue (Peck 2013).

The land on which the Seneca sandstone quarries are found was originally part of a royal British land grant called Conclusion, given in 1731 to Daniel Delany, the elder. During the American Revolutionary War (1775–1783), the land was confiscated by the State of Maryland from its then-owner, Daniel Delany, Jr., because of his loyalty to the British. Robert Peter, a Georgetown tobacco merchant, acquired the Delany land at auction in 1781. At the time of construction of the C&O Canal, the quarries were owned by Peter's grandson, John Parke Custis Peter (1799–1848). To supply the sandstone to the canal company, he requested that it extend the north bank of the canal inland as far as possible to facilitate loading stone between Bull Run and Seneca Creek. Since it would not cost additional funds, a canal basin adjacent to his quarry was made that remains today. Peter was a country gentleman, notably a great grandson of Martha Custis Washington (wife of George Washington), and he used proceeds from sale of Seneca sandstone for the canal to build Montevideo (1828–1830) on his nearby plantation. This historic mansion, also built of Seneca sandstone, was a copy of his father's home in Georgetown, Tudor Place (1816), designed by William Thornton, who is credited as one of the designers of the initial U.S. Capitol building. In 1847, Peter provided quotes for sandstone from his Bull Run Quarry for the Smithsonian Castle's construction (Report 1847, 18–19).

Peter died suddenly from lockjaw in 1848, and a few years later his Seneca quarries were acquired by the Seneca Sandstone Company (1850–1866), followed by the Maryland Freestone Mining and Manufacturing Company (1867–1873), which was reorganized as the Maryland Freestone Mining and Manufacturing Company (1873–1882). The latter two companies greatly developed the quarries and marketed a large amount of the stone, principally in Washington (Mathews 1898, 199–206). It was probably they that erected a large cutting building made out of the sandstone near the canal basin (Figs.

7–9), since it is not mentioned in the early accounts of visits to the quarries, notably those by Benjamin H. Latrobe (1764–1830) in regard to reconstruction of the U.S. Capitol and Owen prior to the construction of the Smithsonian Castle. A scandal involving President Ulysses S. Grant and the Freedman's Bank, however, led to the closure of the quarries from between 1876 and 1882 (Peck 2013, 76–86, 107). From 1883 to 1891 the property was owned by the Potomac Red Sand Stone Company, although in June 1889 the C&O Canal washed out, temporarily halting transport of stone to Washington. In 1891 George Mann of Baltimore purchased the property and founded the Seneca Stone Company (1891–1905). Figure 10 shows the quarry during later years. By the end of the nineteenth century the quality of the stone had begun to decline as well as the taste for dark-colored stone (Mathews 1898, 241); the death knell for brownstones was almost certainly the popularity of the 'white city' at the 1893 Chicago Exposition (Kidney 1974, 19). The last quarrying is said to have been done around 1904 for decoration shown in figure 11 on the Crown Cork and Seal headquarters building in Baltimore (Peck 2013, 114). A 1924 flood closed the C&O Canal definitively, precluding cost-effective transportation to Washington. The Baltimore & Ohio Railroad, begun the same day as the canal, had also made the canal obsolete, but its route did not go near the quarries. In 1938 the federal government acquired the canal and surrounding lands, which were placed under the National Park Service and named the C&O Canal National Historical Park. In 1972 the State of Maryland acquired 270 acres that included most of the quarries and several buildings, which became part of Seneca Creek State Park.

Scientific study of Seneca sandstone began in 1847 in anticipation of the construction of the Castle (Report 1847, 20–22; Owen 1849, Appendices A & B, 113–119). To simulate frost damage, sodium-sulfate testing was done by a chemist, Dr. Charles G. Page, based on the work of the French chemist, Cyprien Brard; this was one of the earliest North American examples of such testing. Samples were tested from 13 quarries submitted as part of bids for supplying stone for the Castle as well as nine other building stones. Results for the Seneca sandstone were among the best and vastly superior to other sandstones, such as the Connecticut River sandstone often used for New York City buildings and the local Aquia Creek sandstone used for the earliest federal buildings in Washington. Benjamin Latrobe, who visited the quarries in 1815, found the stone harder than the Aquia Creek sandstone, so that it 'will cost a little more in working, which additional expense is amply compensated by its superior quality' (Latrobe 1815, 683). He further noted that the stone was easily got as 'a very moderate head of Earth and Rubbish upon it . . . is easily thrown down the Cliff out of the way.' David Dale Owen wrote at some length about his visit to the Seneca sandstone quarries as well as other local quarries in preparation for selection of stone for the Smithsonian Castle (Report 1847, 36–39). Just before acceptance of stone for the Castle, Owen and Renwick visited the Seneca quarries together and selected the Bull Run quarry stone because of its color, quality, and sufficient quantity (Report 1847, 105–107). Owen also reported that the stone had the valuable property that it was soft enough to be easily cut when first quarried but hardened upon exposure (Report 1847, 39). This hardening was later confirmed when Adolf Cluss (1825–1905), one of the most important architects in Washington during the late nineteenth century, repaired the Castle after an 1865 fire. Stone leftover from the original construction proved so hard that it had to be worked by granite masons to implement repairs (Seneca 1872, 15–17). In the 1850s U.S. Army engineer Montgomery Meigs opened the Government Quarry at Seneca for construction of an aqueduct for the new Washington water system: the Union Arch aqueduct (1857–1864), also known as

Cabin John Bridge and the Washington aqueduct bridge. Prior to selecting the Seneca sandstone, Meigs had it tested for strength by the U.S. Army Corps of Engineers, who found it superior. Geologists George Merrill (1889; 1910) and Edward Mathews (1898, 199–206) described the quarries at some length at the end of the century. Mathews noted that workable beds of fine grained and uniform stone (separated by inferior material) varied in thickness from 46 cm to about two meters.

In recent years, Lee and Froelich (1989) detailed the stratigraphy of the Culpeper Basin, in which the quarries are found, and a map by Drake, Southworth & Lee (1999) includes the area of the Seneca quarries. Southworth *et al.* (2008) provide details of geology along the C&O Canal, including a photograph of three vertical drill holes visible on a quarry face in their Figure 28. Results of recent testing on Seneca sandstone are included in a paper on Smithsonian building stones (Aloiz *et al*. 2014).

GHSR recognition

The Terms of Reference for the Heritage Stone Task Group advise that a GHSR may be recognized if the natural stone under consideration has most of the attributes required. Seneca sandstone has nearly all of these attributes, described in the following paragraphs.

Historic use for a period of at least 50 years

Seneca sandstone was used from the late eighteenth century to the beginning of the twentieth century, a period of more than 100 years. It was the only sandstone quarried in Maryland that had 'a recognized reputation in the market, or which furnish materials for more than local work' (Mathews 1898, 199).

Wide-ranging geographic application

Seneca sandstone was used mainly in the Washington and Baltimore region. However, the quarries are a unique surviving example of the extensive Upper-Triassic brownstone building industry, which existed in the northeastern United States during the last half of the nineteenth century. Cities like New York, Philadelphia, Baltimore, and Washington, DC, experienced explosive growth at that time, and the brownstone industry provided building stone to hundreds or perhaps thousands of American buildings. As tastes changed at the end of the century, the brownstone industry collapsed within a few years, and quarry sites in Connecticut, New Jersey, and Pennsylvania were developed for other purposes. Today little remains of what was once a mighty industry, but through luck and benign neglect the Seneca quarries were not obliterated by subsequent urban development.

Utilization in significant public or industrial projects

Seneca sandstone was used for significant public projects. The site of the Potomac Canal and Locks at Great Falls, built of Seneca sandstone from 1785 to 1801, was designated the first National Historic Civil Engineering Landmark in the National Capital area in 1969 by the American Society of Civil Engineers. Before completion of the C&O Canal to Seneca in 1831, use of Seneca sandstone was limited for federal buildings by poor transportation; for example, it was used only in the 1820s for the north and south porticos of the President's residence, known as the White House (Seale 1986, 159, 164). Benjamin

Latrobe, who was probably the country's most accomplished early architect-engineer, proposed its use for the U.S. Capitol's steps, pavement, balusters, and cornice moldings after the building was burned by British troops in 1814 during the 1812–1815 war between America and Great Britain (Latrobe 1815, 683). His successor at the Capitol, Charles Bulfinch (1763–1844), used it for the rotunda's floor, doorways, and a adjacent terrace in the 1820s (Peck 2013, 24, 93; Allen 2001, 162). The C&O Canal — intended as a national canal to unite the capital with the western territories as part of a great push for improvement of the United States' transportation infrastructure — also made significant use of the sandstone. The Union Arch aqueduct (1857–1864) built of Seneca sandstone and granite was essential in housing the major conduit for the capital's early public water supply. For its first 40 years the aqueduct was also the longest single-span masonry arch in the world. As such, it is a National Historic Landmark, an Historic National Civil Engineering Landmark, and on the National Register of Historic Places.

The most prominent building for which the sandstone was used is the Smithsonian Castle (1847–1855), a National Historic Landmark, but the stone was also used for Adolf Cluss' and Josef von Kammerhueber's Department of Agriculture on the National Mall (1868) and Mullett's DC Jail (1872). Other buildings include schools in the federal precinct [Giddings (1887), Ross (1887), and Grimké (1887)], churches [Luther Place Memorial Church (1873), St. Matthew's Cathedral (1895), and Trinity Episcopal Church (1849)], and monuments, such as the McClellan Arch (1871–1872) at Arlington National Cemetery (Fig. 12). The wall encircling the National Historic Landmarked Gallaudet College Historic District was also constructed of Seneca sandstone.

Common recognition as a cultural icon, potentially including association with national identity or a significant individual contribution to architecture

The Smithsonian Castle, which is located prominently on the National Mall, is symbolic of the Smithsonian Institution, which has an important place in the U.S.'s cultural heritage with its 19 museums, nine research facilities, and the National Zoological Park.

Ongoing availability of material for quarrying

Seneca sandstone can no longer be quarried, because the quarries are now on public parkland owned by the U.S. National Park Service and the State of Maryland; removal of stone is strictly controlled. Stone was made available to the Smithsonian Institution for construction of gateposts and other structures for its Enid Haupt Garden, however, which were completed in 1987. The Smithsonian has maintained a supply of stone from the demolished DC Jail, which it uses for repair of the institution's Castle.

Potential benefits (cultural, scientific, architectural, environmental and/or commercial) arising from GHSR designation

The GHSR designation would encourage preservation of structures and monuments made of the stone. Many Seneca sandstone buildings have been demolished in the past, notably the DC Jail, Trinity Episcopal Church, and the first Department of Agriculture building on the National Mall. Global Heritage Stone Resource recognition would also greatly assist the National Park Service and State of Maryland in the study, preservation, and interpretation of the quarry site so that future generations could

understand the brownstone industry of the nineteenth century. The designation might also stimulate interest in stabilization of the quarry's cutting building, which is vulnerable to collapse because of rampant vegetation and lack of maintenance (Figs.7–9). The building retains a machinery trough, as well as platforms and ironwork for mounting equipment, but exactly how equipment was arranged and powered has not been established (Douglas & Jones 1968). Industrial archaeology as part of a preservation effort could answer many questions about technologies employed at the site. The toepath of the C&O Canal National Historical Park extends the full length of the canal (over 300 kilometers) and is a popular walking and biking trail, which would provide significant visitation to a preserved and interpreted cutting building.

GHSR nomination

The GHSR nomination of Seneca sandstone is supported by the Association for Preservation Technology (APT) Washington D.C. chapter.

GHSR nomination/citation requirements

Formal name: Seneca sandstone

Origin of name: Seneca sandstone is named after the location of quarries west of Seneca Creek and the small port town of Seneca (no longer extant). These are said to have been named after the Seneca Indian tribe (Montgomery County 1999), a well-known member of the Iroquois Nation in upstate New York. An alternative version is that Seneca is a corruption of the local Indian word 'sinegar,' meaning a trading place (Peck 2013, 25).

Stratigraphic (or geological name): Upper-Triassic Poolesville Member of the Manassas Formation (Lee & Froelich 1989)

Other names: Seneca red sandstone, Seneca redstone, Potomac red sandstone

Area of occurrence: Two Upper-Triassic belts of sandstone are exposed in Maryland, but quarrying was almost entirely confined to the southern belt in the southwestern corner of Montgomery County (Mathews 1898, 200). There the Poolesville Member of the Manassas Formation sandstone crops out along the east bank of the Potomac River, where the Seneca sandstone quarries were located (Figs. 5, 6).

The Upper-Triassic belt extends across the Potomac River into Virginia in a southwesterly direction as far as the Rapidan River, where several sandstone quarries of the Manassas Formation had opened by 1868 near the town of Manassas on the Manassas and Virginia Midland Railroad line (Merrill 1889, 461). By 1880, 400,000 cubic feet were said to have been removed. These produced a fine-grained reddish brown stone resembling the lighter varieties from Seneca Creek. A stratigraphic map showing the the Culpeper basin is found in Lee and Froehlich (1989, Fig. 1).

The Newark Supergroup, of which the Manassas Formation is a Member, crops out along the eastern seaboard of North America from Nova Scotia to South Carolina (Fig. 1). It has been quarried

extensively for building stone along the Connecticut River in Massachusetts (East Longmeadow sandstone, bright brick red to reddish-brown], Connecticut (Portland brownstone, reddish-brown), New Jersey (New Jersey brownstone, variously white, grey, brown, and red), and Pennsylvania (Pennsylvania brownstone, reddish brown to purplish-brown) (Matero & Teutonico 1982).

Principal location of source quarries: The main quarries, which haven't been worked since around 1900, are located near Poolesville, Maryland, 34 kilometers northwest of Washington, DC, along the Potomac River (Figs. 5, 6).

Geological age and geological setting: The Seneca sandstone quarries are geologically a Poolesville member of the Manassas Formation, which is Upper Triassic. The Manassas Formation is located in the Culpeper Basin, which lies within a belt of Upper-Triassic to Lower-Jurassic fault-bounded troughs exposed in eastern North America from Nova Scotia to the Carolinas. These troughs, containing non-marine Newark Supergroup strata, are generally in alignment with the structural orientation of the enclosing Upper Precambrian and Lower Paleozoic crystalline and sedimentary rocks and lie mostly within the Piedmont province of the Appalachian orogenic belt. The Culpeper Basin originated and evolved during the Lower Mesozoic, a time of continental rifting that preceded Coastal Plain deposition and the development of the modern Atlantic continental margin (Lee & Froelich 1989).

Petrographic name: arkosic sandstone

Natural variability: The Poolesville Member of the Manassas Sandstone is described as consisting of pinkish-gray to reddish brown sandstone and reddish-brown siltstone, which occur in upward-fining sequences 3 to 6 meters thick. The sandstone is fine- to coarse-grained, locally pebbly, arkosic, micaceous, ferruginous, and locally silty and calcareous. It consists chiefly of subrounded and subangular quartz and feldspar grains in a ferruginous, micaceous, silty clay matrix cemented by clay, iron oxide, silica, and calcite. It is thin- to thick bedded and massive and is both planar and crossbedded, especially in pebbly channel-fill sequences where angular red shale chips are locally common (Burton 1995, 22).

The building stone obtained from the Seneca quarries was selected for its fineness, uniformity, and color. Mathews observed that the texture of stone placed on the market 'is very fine-grained and uniform' (1889, 201–202); fine- to medium-grained texture can be seen in Figure 13. Figure 14 shows specimens from the Smithsonian Castle and DC Jail. The color of the preferred building stone is variously described: dark red**;** red brown, varying from gray brown to distinctly red (Merrill 1910, 142); reddish brown or cinnamon to a chocolate or deep purple brown (Mathews 1898, 203); Munsell 10R 4/4 (weak red) measured on Smithsonian Castle sandstone (Aloiz *et al*. 2014).

Composition: an arkosic micaceous sandstone. Quartz and plagioclase are the major phases, followed by alkali feldspar, mica, hematite, titanite, apatite and zircon as minor and trace phases, seen in a sample of the sandstone from the Enid Haupt Garden gateposts (Fig. 14). Chemical composition of samples from the Smithsonian Castle and DC Jail was determined by instrumental neutron activation analysis (INAA); see Table 1.

Density: 2.35 g/cm^3 (Aloiz *et al.* 2014)

Porosity: 10% open porosity (Aloiz *et al.* 2014, Teutonico 1988)

Compressive strength: 59.5 MPa (Mathews 1898, 204)

Flexural strength: no data

Salt crystallization: no data

Saturation coefficient: no data

Suitability: Seneca sandstone has been utilized for cut building blocks, as on the Smithsonian Castle; for decorative trim on domestic architecture, such as sills and lintels; for the walls of industrial structures, such as the C&O Canal and Union Arch aqueduct; for monuments, such as the McClellan Arch at Arlington National Cemetery; and occasionally for paving, such as the center of the Potomac space in the National Museum of the American Indian, portions of the U.S. Capitol's rotunda floor, an adjacent terrace, and a walkway from the western gate to the main entrance of the building (no longer extant).

Vulnerability and maintenance of supply: The quarries are now on public parkland (Figs. 5, 6) owned by the National Park Service (C&O Canal National Historical Park) and State of Maryland (Seneca Creek State Park), which require special permission for removal of any stone. Blocks from the Seneca quarries, however, were made available for construction of the Enid Haupt Garden gateposts opposite the Castle and other structures in the garden in 1987 (Fig. 3). The Smithsonian retains a small supply of the stone from the demolished DC Jail to be used for repairs of the Castle.

Historic use: The first major public use of Seneca sandstone was to line locks and canals skirting rapids on the Potomac River, which were built at Great Falls by the Potomac Company established in 1785 with George Washington as its first president. Benjamin Latrobe proposed use of Seneca sandstone for steps, pavement, balusters, and cornice moldings on the U.S. Capitol in 1815 after it was burned by the British in 1814, and his successors at the Capitol used it for the rotunda's doorways and for paving in the Capitol's rotunda, an adjacent terrace, and a walkway on the grounds. In the 1820s and 1830s, many locks and canals were lined with the stone on the C&O Canal, arguably the best preserved example of the canal era in the United States. Extending from Washington to Cumberland, Maryland, the canal provided inexpensive transport for goods from the west to the capital, part of the great push for improvement of the U.S.'s transportation infrastructure during the nineteenth century. The canal also enabled Seneca sandstone to be transported to Washington for important buildings after it reached Seneca Creek in 1831. For its first 40 years, the Union Arch aqueduct (1857–1864), an essential part of the early public water supply for Washington built in part with Seneca sandstone, was the longest single-span masonry span arch in the world.

Buildings: Important buildings by well-known architects include the Smithsonian Castle (1847–1855) by architect James Renwick, Jr., and the DC Jail (1872) by federal architect Alfred B. Mullett. Many churches, school buildings, city markets by architect Adolf Cluss, and homes were built or trimmed with the stone during the 'brown decades' of the latter half of the nineteenth century (Peck 2013).

See the 'Utilization in significant public or industrial projects' section for a more complete list of buildings on which the stone was used.

Heritage issues: A number of historic Seneca sandstone structures have been demolished, notably the DC Jail, Trinity Episcopal Church, and the first Department of Agriculture building on the National Mall. The quarries are on public parkland owned by the National Park Service (C&O Canal National Historical Park) and the State of Maryland (Seneca Creek State Park). The rules of these organizations protect the quarries, requiring special permission for removal of any stone. The ruin of the cutting building in Seneca Creek State Park is vulnerable to collapse, however, as well as a frequent target of graffiti artists.

Other designations: n/a

Related dimension stones: East Longmeadow sandstone from the Deerfield Mesozoic Basin formation in Massachusetts is the closest in color to the Seneca sandstone of the mid-Atlantic Newark Supergroup sandstones. For future repair of stone on the Castle, the Smithsonian Institution obtained large blocks from a bridge abutment in Springfield, Massachusetts; this stone is almost certainly from East Longmeadow, which is located at Springfield's southern border. Used for the more recent construction of New York University's Bobst Library (1973), designed by the architects Philip Johnson and Richard Foster, the East Longmeadow stone appears slightly brighter than the Seneca sandstone. Red sandstone on buildings and cemetery monuments in Manassas, Virginia, is also a good match, but is no longer quarried as far as is known.

Principal literature

The principal historical literature on Seneca sandstone consists of early accounts of visits to the quarries by Latrobe (1815) and David Dale Owen (Report 1847). For construction of the Smithsonian Castle, the 1847 report of the building committee is again important, and for testing of stone prior to the building's construction, also the book by Robert Dale Owen (1849). Works by the geologists Merrill published in 1889 and 1910 (first published in 1891) and Mathews in 1898 provide important historical information regarding the quarries at the end of the nineteenth century. More modern geological literature is supplied by Olson (1980), Lee and Froehlich (1989), and Drake (1999). A recent book by Peck (2013) includes many historic photographs of the quarries, but the authors look forward to the definitive future publication, *Standing Stones: A History of Seneca, Maryland,* by the former National Park Service historian Robert J. Kapsch and Elizabeth Perry Kapsch.

Conclusions

The authors of the nomination advise that Seneca sandstone fulfils most of the criteria for a GHSR. Seneca sandstone was used from the late eighteenth century to the beginning of the twentieth century, a period of more than 100 years. It is associated with the first U.S. President as he sought to

improve transportation to and from the interior beginning in 1785. It had significant employment in the construction of Washington, DC, which was selected as the new federal capital shortly after the Revolutionary War in 1790. It was used in the early transportation system for the city (Potomac and C&O Canals), the public water system (Union Arch aqueduct), federal institutions (Smithsonian Castle, DC Jail), and local churches schools, markets, and houses. Many Seneca sandstone structures have been lost, and GHSR designation would encourage future preservation of buildings and monuments made of the stone as well as the quarry site itself, which is now public parkland owned by the National Park Service and State of Maryland. In particular, it could lead to stabilization of the quarry's historic cutting building and interpretation of the quarry site for generations to come.

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Captions

Fig. 1. Map showing the location of Seneca sandstone quarries near Washington, DC, in Triassic-Jurassic basins containing Newark Supergroup strata (indicated in black) near the coastal plain in eastern North America. Drawing after Olsen (1980) and Lee and Froelich (1989).

Fig. 2. Seneca aqueduct (ca. 1832), which allowed C&O Canal boats to pass over Seneca Creek, and a lock house in the background, both built of Seneca sandstone.

Fig. 3. The Smithsonian Castle (1847–1855) by James Renwick, Jr., with the Enid Haupt Garden gateposts (1987) in the foreground, both built of Seneca sandstone. Smithsonian Institution Archives, #90-6258.

Fig. 4. District of Columbia Jail (1872) by Alfred B. Mullett, architect, built of Seneca sandstone, seen in 1909 (demolished 1976). Library of Congress, LC-USZ62-106343.

Fig.5. Geologic map of the Seneca quarry area (detail of Drake *et al.* 1999). Lime green indicates the Poolesville Member, Manassas Sandstone (Upper Triassic, Culpeper Basin); yellow, alluvium (Holocene); Bs, abandoned quarry, building stone; Qal, surface deposits.

Fig. 6. Map showing Seneca sandstone quarries as well as the cutting building, C&O Canal, quarry master's house, the Seneca lock house, and Seneca school house, all built of Seneca sandstone. Roads are white; private property, off-white; Seneca Creek State Park, light gray; C&O Canal National Historical Park, darker gray; and water, darkest gray.

Fig.7. View of the original exterior northeast wall of the cutting building, now at the middle of the ruin; water flowed through the machinery trough (about 1½ m deep) at the center of the photograph toward a pool in the distance. Courtesy James Douglas.

Fig.8. Southwest exterior wall of the original cutting building; water flowed out from the machinery trough through the lower aperture into the pool at lower left.

Fig. 9. Modified Historic American Buildings Survey plan and elevations of the cutting building in the Seneca quarries. Library of Congress, Prints and Photographs Division, HABS MD, 16-SENCA.V.3-sheet2.

Fig. 10. Seneca quarry. Ten African-American workmen stand on an upper ledge; 10 white workmen are arrayed amidst machinery below (Mathews 1898, Plate XXVIII, Fig. 2)).

Fig. 11. Detail of Seneca sandstone carving on the Crown Cork & Seal Building (now known as the Copy Cat building), Guilford Avenue, Baltimore, MD. The base block with the head measures approximately 1 meter in width.

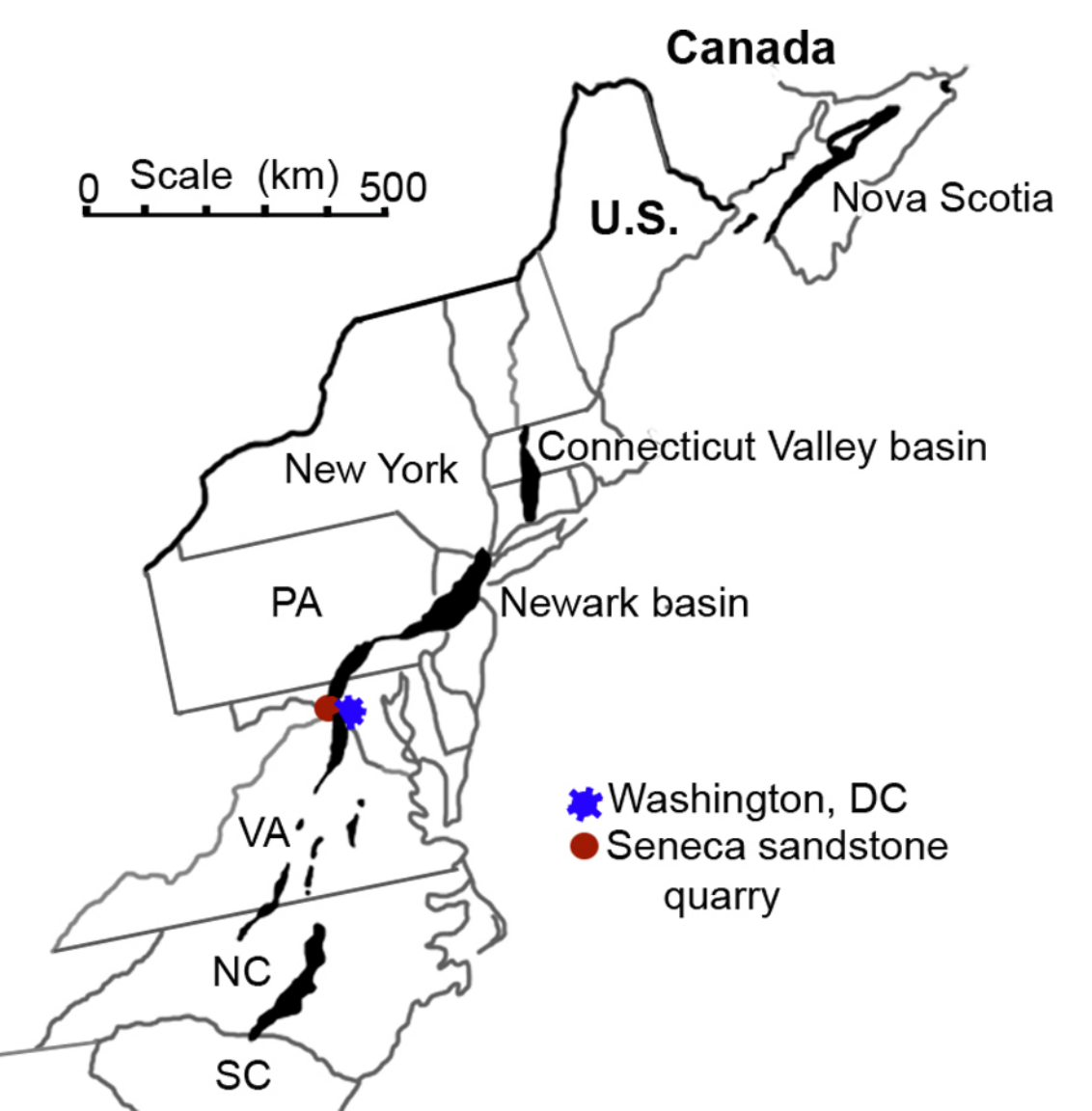
Fig. 12. McClellan Arch (1871–1872), Arlington National Cemetery, Arlington, Virginia. Dedicated to one of the most popular union but controversial Union generals of the Civil War, the Seneca sandstone arch was the original main entrance gate to the cemetery, built on the grounds of the former home of Robert E. Lee, commander of the Confederate States Army.

Fig. 13. Seneca sandstone: left, broken surface of Seneca sandstone from the DC Jail; right, sawn surface of the sandstone from the Smithsonian Castle.

Fig. 14. Large area x-ray map of the Seneca sandstone. False colored x-ray images are superimposed on a backscattered electron image [Al (red), K (green), Si (blue), and Ca (orange)]. Mineral abbreviations: qtz (quartz), pl (plagioclase), kfs (potassium feldspar), hem (hematite), bt (biotite), ttn (titanite), ap (apatite), and zrn (zircon).

Table 1. *Percentage of each element in two samples of Seneca sandstone from two buildings, analysed by INAA (Aloiz et al. 2014)*

	DC Jail		**Castle**	
Sample	**#1**	**#2**	**#1**	**#2**
SiO_2	57.76	57.40	56.26	53.36
TiO	0.62	0.62	0.75	0.78
Al_2O_3	23.21	23.26	22.94	25.05
Fe_2O_3	4.57	4.61	6.15	6.53
MnO	0.06	0.05	0.04	0.04
MgO	0.00	0.00	0.16	0.20
CaO	0.33	0.23	0.58	0.64
Na_2O	10.12	9.92	10.22	10.41
K_2O	3.26	3.84	2.83	2.91
CO_2	0.00	0.00	0.00	0.00
Other	0.08	0.07	0.06	0.07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Washington, DC
Seneca sandstone quarry
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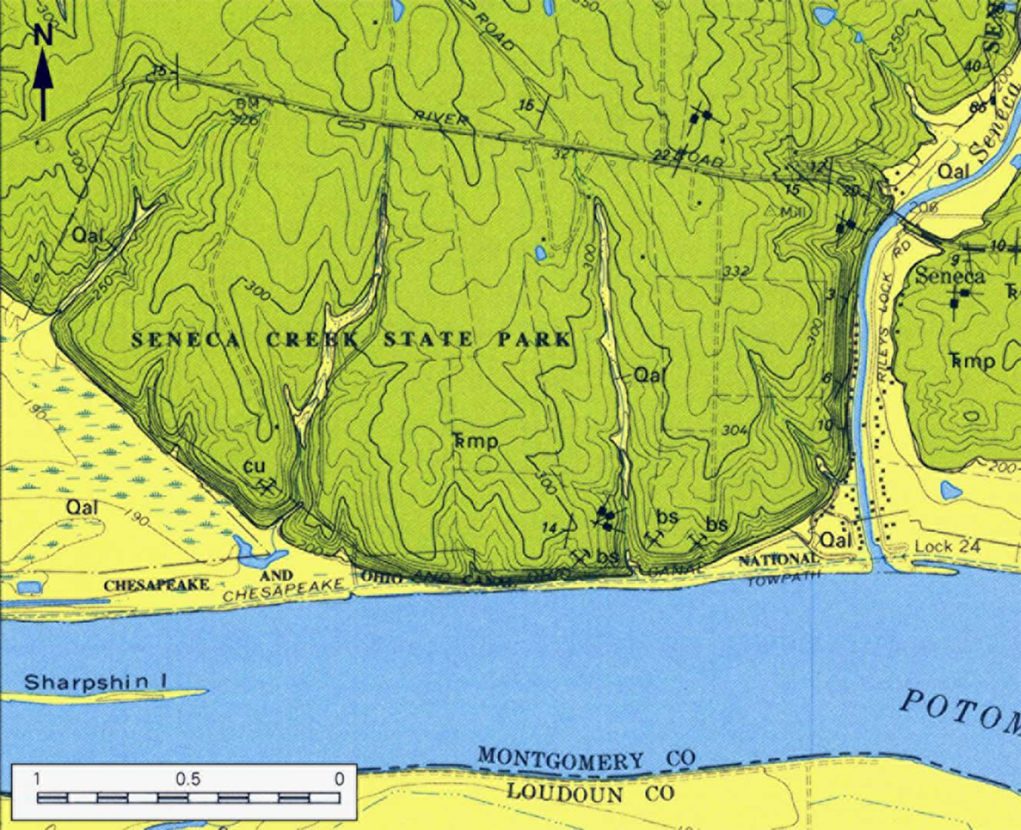
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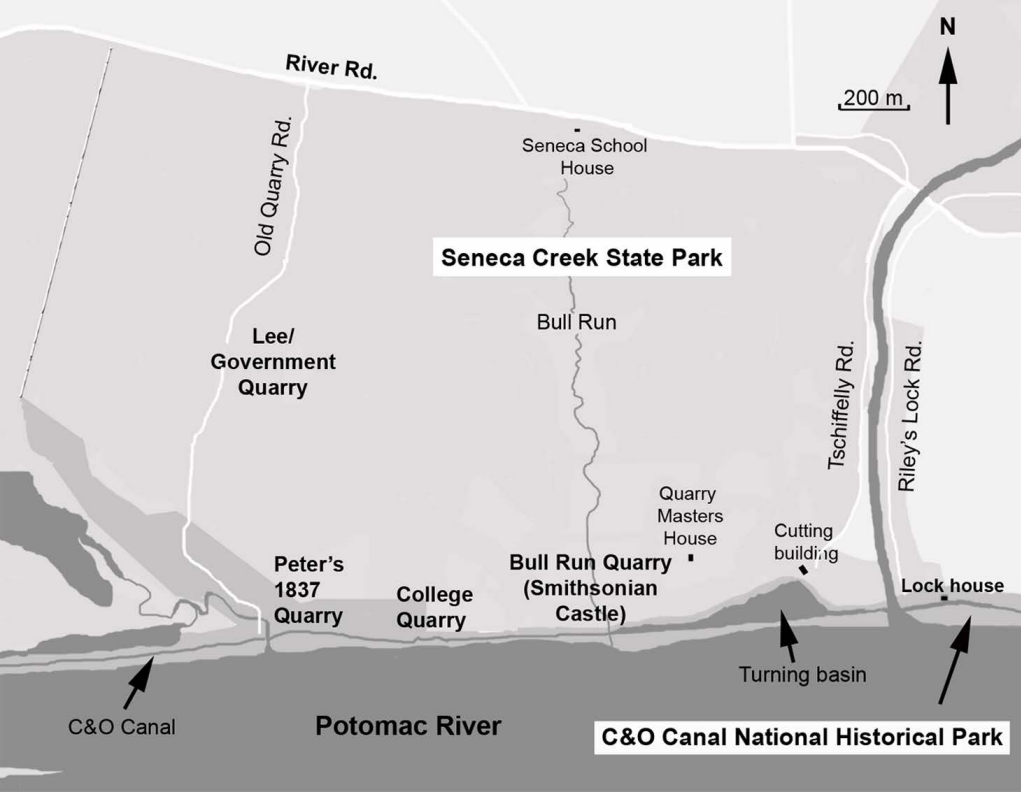
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Seneca Creek State Park
Bull Run
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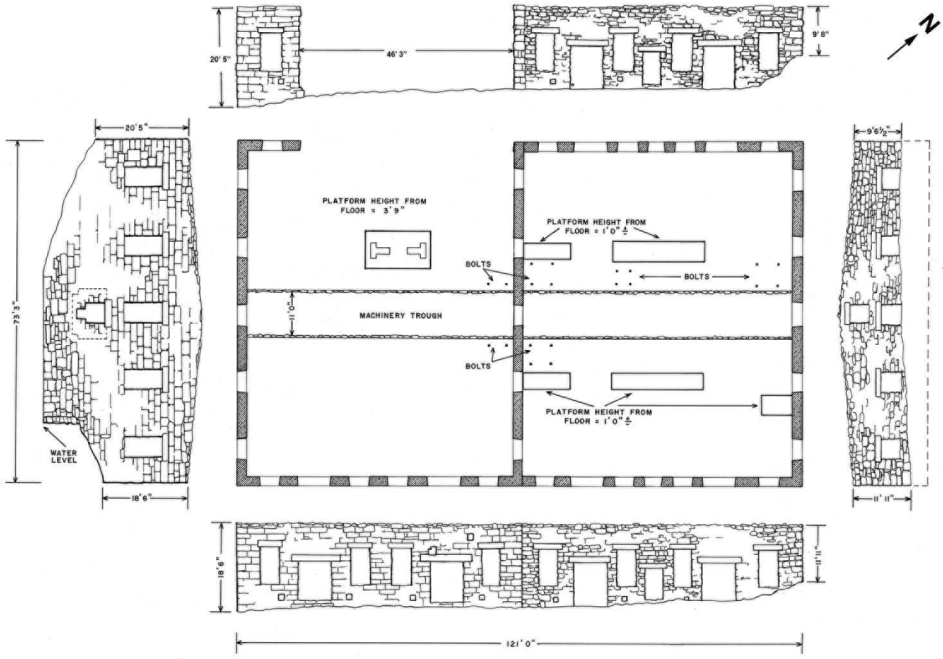
Tschiffelly Rd.
Riley's Lock Rd.
Quarry Masters House
Cutting building
Peter's 1837 Quarry
College Quarry
Bull Run Quarry (Smithsonian Castle)
Lock house
Turning basin
C&O Canal
Potomac River
C&O Canal National Historical Park



DRAWN BY: MARY B. SMITH

DIVISION OF MECHANICAL & CIVIL ENGINEERING
MUSEUM OF HISTORY & TECHNOLOGY, S.I.
UNDER DIRECTION OF THE NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

NAME AND LOCATION OF STRUCTURE
SENECA QUARRY CUTTING BUILDING - SENECA, MARYLAND

SURVEY NO. MD-299

HISTORIC AMERICAN BUILDINGS SURVEY
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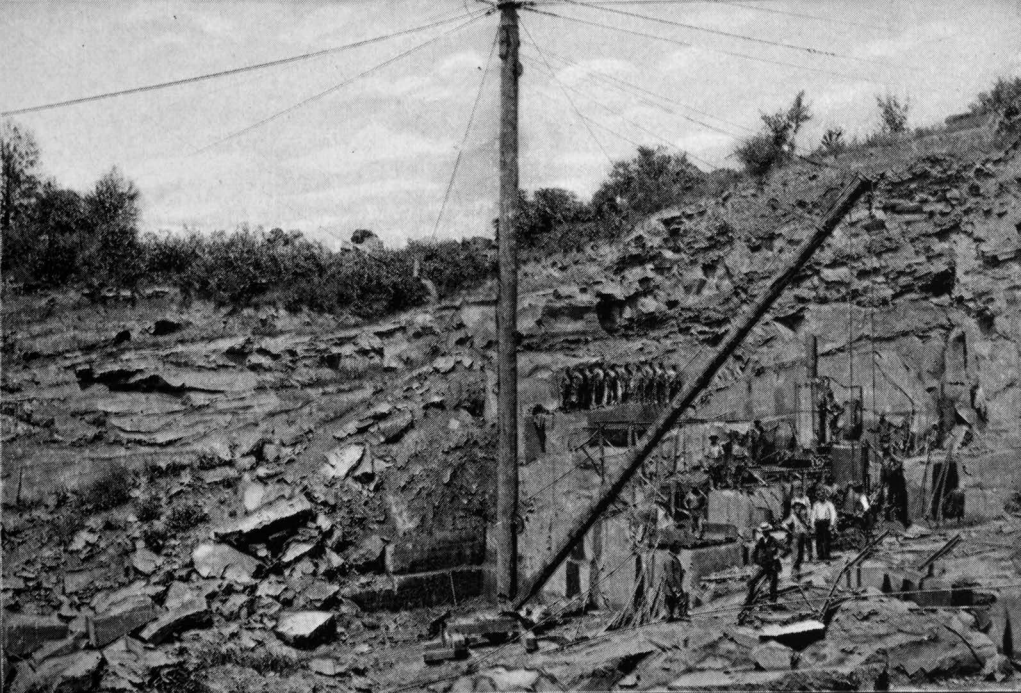


McCLELLAN
HERE REST 15,585 OF THE 315,555 CITIZENS WHO DIED
ON FAMES ETERNAL CAMPING GROUND THEIR SILENT TENTS ARE SPREAD
AND GLORY GUARDS WITH SOLEMN ROUND THE BIVOUAC OF THE DEAD


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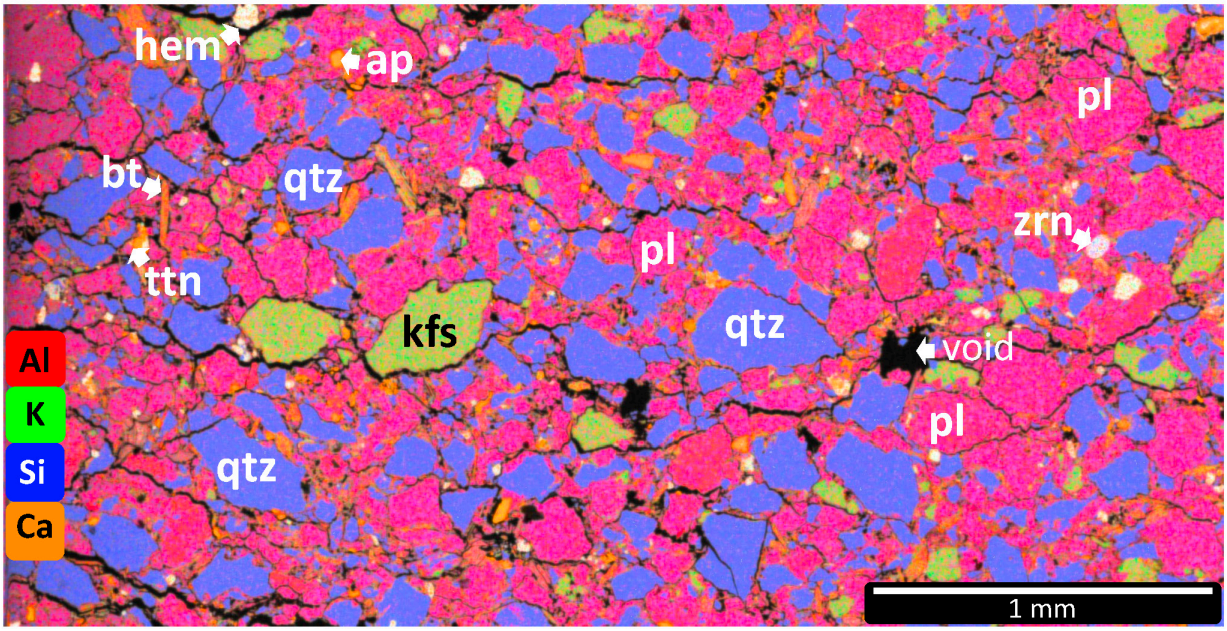
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