

Geologic Resources Inventory Scoping Summary

Vicksburg National Military Park, Mississippi and Louisiana

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The Geologic Resources Inventory (GRI) Program, administered by the Geologic Resources Division, provides each of 270 identified natural area National Park System units with a geologic scoping meeting, a digital geologic map, and a geologic resources inventory report. Geologic scoping meetings generate an evaluation of the adequacy of existing geologic maps for resource management, provide an opportunity to discuss park-specific geologic management issues and, if possible, include a site visit with local experts. The purpose of these meetings is to identify geologic mapping coverage and needs, distinctive geologic features and processes, resource management issues, and potential monitoring and research needs. Outcomes of this scoping process are a scoping summary (this report), a digital geologic map, and a geologic resources inventory report.

The Geologic Resources Division held a GRI scoping meeting for Vicksburg National Military Park on April 14, 2010, at the park headquarters/visitor center in Vicksburg, Mississippi. Participants at the meeting included NPS staff from the park, Geologic Resources Division, and Gulf Coast Network, as well as cooperators from the Mississippi Department of Environmental Quality (MDEQ), Office of Geology; and Colorado State University (table 2). Superintendent Mike Madell welcomed the group and expressed his interest in the geologic resources inventory. Madell had participated in previous scoping meetings for Niobrara National Scenic River and Missouri National Recreation Area.

During the meeting, Tim Connors (Geologic Resources Division) facilitated the group's assessment of map coverage and needs, and Lisa Norby (Geologic Resources Division) led the discussion of geologic features and processes. David Dockery (MDEQ Office of Geology) presented a geologic overview of the park, highlighting the Oligocene Vicksburg Group and overlying Pleistocene loess. Virginia DuBow (Vicksburg National Military Park) led the site visit. Of particular interest for the park is the Mint Spring Formation (Vicksburg Group), which has its type locality at the Mint Spring Bayou waterfall near the Vicksburg National Cemetery. Scoping participants visited the waterfall/type section during the site visit and also noted slope failure along the bluff near Mint Spring Bayou. During the site visit, participants also made stops at Battery De Golyer, where piping (erosion by percolating water, forming "pipes") in the loess is severe (fig. 1); the Illinois Memorial, which is the largest monument in the park; Shirley House (the only surviving wartime structure in the park) and surrounding property, which is experiencing erosion resulting from old (ca. 1930s) drainage systems that are now failing; and a site of piping along the park road south of the West Virginia Monument. In addition, participants viewed a major grading project underway at Graveyard Road and a recently completed project at Fort Hill. Since scoping, the Graveyard Road project has been completed. The contractor, Hemphill Construction Co., Inc., from Florence, Mississippi, graded and applied Bermuda grass seed mix to both sites.

This scoping summary highlights the GRI scoping meeting for Vicksburg National Military Park and includes the park setting, the plan for providing a digital geologic map, descriptions of geologic features and processes and related resource management issues, and a record of meeting participants

(see table 2). This document and the digital geologic map (once completed) will be used to prepare the final GRI report.

Park Setting

Vicksburg National Military Park serves as a lasting memorial to the campaign, siege, and defense of Vicksburg, Mississippi, during the American Civil War (1861–1865). The monuments at Vicksburg constitute one of the largest collections of significant commemorative military art in the United States and one of the most extensive collections of such art in the world (MACTEC Engineering and Consulting, Inc. 2009). The park also encompasses Vicksburg National Cemetery (established in 1866), which contains the remains of more Union Civil War soldiers (approximately 17,000) than any other cemetery in the country, with almost 40% of these graves being U.S. Colored Troops. The cemetery also holds the remains of service men and women from several other wars. In contrast to its wartime background, the park is now a peaceful landscape, providing habitats for many plants and animals and rigorous terrain for recreational walkers.

When established in 1899, the park encompassed the entire extent of the Vicksburg siege and defense lines (fig. 2). The lower one-third of the park was transferred to the City of Vicksburg in 1964. The National Park Service became the park's steward in 1933, when it was transferred from the War Department. The 730-ha (1,800-ac) park also includes the detached units of Louisiana Circle and South Fort (sites of Confederate fortifications), Navy Circle (the southern anchor of Union lines), and the remaining vestige of Grant's Canal (across the Mississippi River in Louisiana).



Figure 1. Piping at Vicksburg National Military Park. Joe Meiman (NPS Gulf Coast and Cumberland Piedmont networks) stands waist deep in a soil pipe eroded in loess at Battery De Golyer. Photo by Katie KellerLynn.

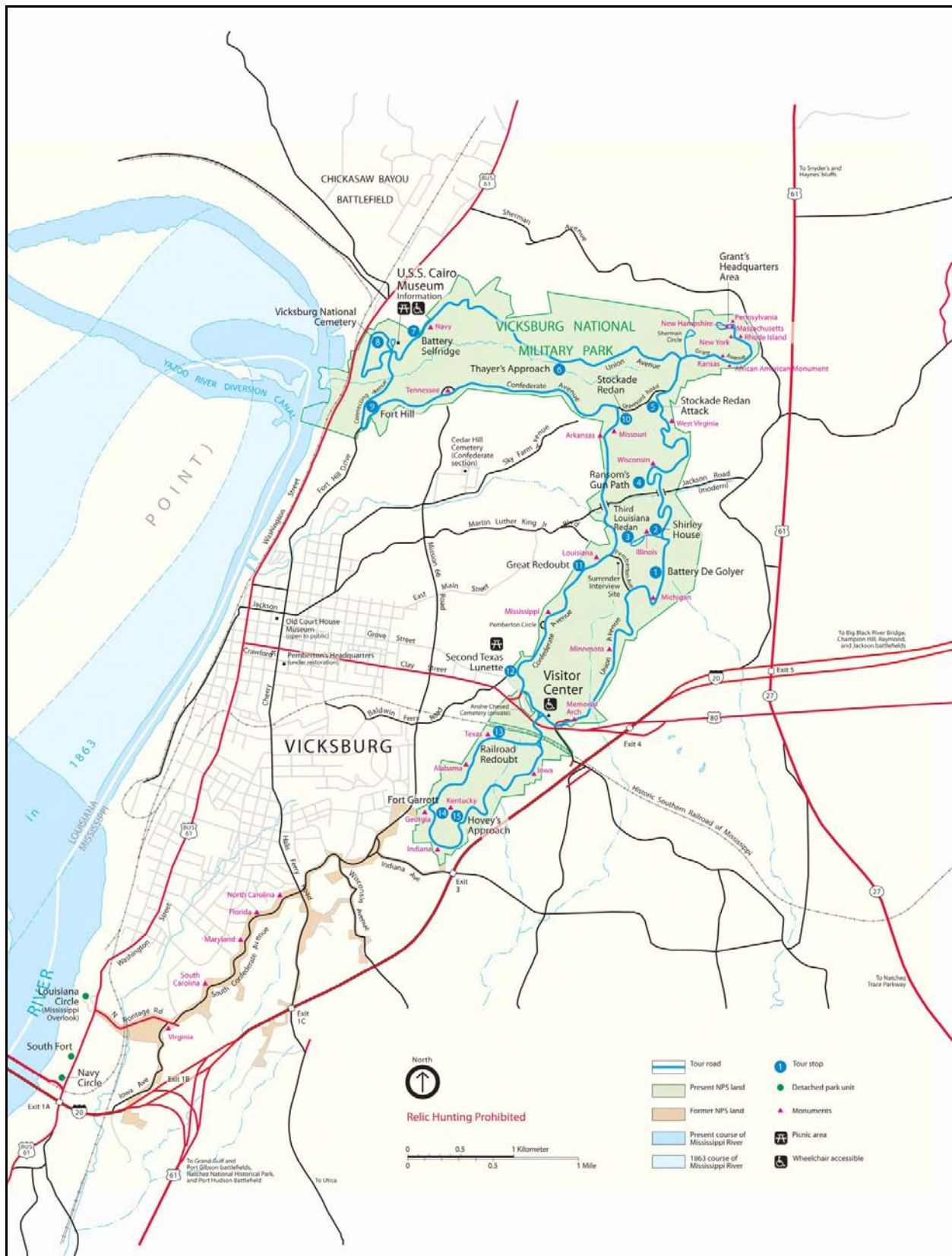


Figure 2. Vicksburg National Military Park. The park area is shown in green on the figure. In addition, Navy Circle, South Fort, and Louisiana Circle (green dots) are units of the national military park. The Grant's Canal unit (across the river in Louisiana) is not shown on the figure.

The topography of the park ranges in elevation from a low point of 23 m (75 ft) above sea level to a high point of 121 m (397 ft) above sea level at the site of the Louisiana Memorial. Variations in topography are evident along the tour road, which curves around hills, dips into ravines, and climbs ridges. The terrain also features 60-m- (200-ft-) high bluffs located on the present-day Yazoo Diversion Canal, which follows a former bend (oxbow) of the Mississippi River. Although the river's course has changed since the Civil War, many attributes of the land and the overall Vicksburg-campaign landscape persist today (MACTEC Engineering and Consulting, Inc. 2009).

One major change, however, is the historic-battlefield condition. Vicksburg Battlefield as it exists today bears little resemblance to the landscape at the time of the siege and defense of Vicksburg (Wiss, Janney, Elstner Associates, Inc., and John Milner Associates, Inc. 2009). Although the area was once heavily forested before European colonization, at the time of the siege, settlers had cleared the landscape for farming. The once-cleared topography is now densely forested, partly as a result of nearly 80 years of growth since the Civilian Conservation Corps planted trees to minimize erosion in the 1930s. Subsequent NPS management allowed forest growth to reclaim additional lands as a means of reducing operating expenses. Today, these areas serve as important wildlife habitat but poorly represent historic battlefield conditions (Wiss, Janney, Elstner Associates, Inc., and John Milner Associates, Inc. 2009).

Geologic Mapping for Vicksburg National Military Park

During the scoping meeting, Tim Connors (Geologic Resources Division) showed some of the main features of the GRI Program's digital geologic maps, which reproduce all aspects of paper maps, including notes, legend, and cross sections, with the added benefit of being GIS compatible. The NPS GRI Geology-GIS Geodatabase Data Model incorporates the standards of digital map creation for the GRI Program and allows for rigorous quality control. Staff members digitize maps or convert digital data to the GRI digital geologic map model using ESRI ArcGIS software. Final digital geologic map products include data in geodatabase and shapefile format, layer files complete with feature symbology, Federal Geographic Data Committee (FGDC)-compliant metadata, a Windows help file that captures ancillary map data, and a map document that displays the map and provides a tool to directly access the help file. Final GRI products are posted at <http://science.nature.nps.gov/nrdata/> (accessed August 4, 2010). The data model is available at <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm> (accessed August 4, 2010).

When possible, the GRI Program provides large-scale (1:24,000) digital geologic map coverage for each unit's area of interest, which is generally composed of the 7.5' quadrangles that contain NPS-managed lands. Maps of this scale (and larger) are useful to resource managers because they capture most geologic features of interest and are spatially accurate within 12 m (40 ft). The process of selecting maps for management begins with the identification of existing geologic maps in the vicinity of the National Park System unit. Scoping participants then discuss mapping needs and select appropriate source maps for the digital geologic data or, if necessary, develop a plan to obtain new mapping. In the lower 48 states, large-scale mapping is usually defined as "one inch to 2,000 feet" or quadrangles produced at a scale of 1:24,000 on a 7.5' × 7.5' base. There are thirty-two 7.5' quadrangles on a 30' × 60' (scale 1:100,000) sheet.

Vicksburg National Military Park has twenty-seven 7.5' quadrangles of interest: Madison, Brownsville, Queens Hill Lake, Oak Ridge, Redwood, Long Lake, Jackson, Clinton, Raymond, Edwards, Bovina, Vicksburg East, Vicksburg West, Terry Northwest, Learned, Cayuga, Big Black, Yokena, Utica East, Utica West, Carlisle, Willows, Grand Gulf, Hermanville, Port Gibson, Widows Creek, and Saint Joseph (fig. 3). However, only four of these quadrangles intersect the park: Redwood, Long Lake, Vicksburg East, and Vicksburg West. In addition to these four quadrangles, park managers are also interested in the Port Gibson, Widows Creek, and Edwards 7.5' quadrangles. Park staff selected these seven quadrangles as the area to be covered by the digital geologic map for Vicksburg National Military Park (table 1).

Table 1. Source Maps for Vicksburg National Military Park

Quadrangle of Interest (7.5' quadrangle)	Reference/Source	GMAP ¹	Scale	Format
Redwood	Saucier (1994)	70902	1:250,000	Paper & GIS
Long Lake	Saucier (1994)	70902	1:250,000	Paper & GIS
Vicksburg East	Bicker (1969)	21000	1:500,000	Paper & GIS
Vicksburg West	Saucier (1994)	70902	1:250,000	Paper & GIS
Port Gibson	Starnes and Davis (2004)	70594	1:24,000	Paper & GIS
Widows Creek	Bicker (1969)	21000	1:500,000	Paper & GIS
Edwards	Bicker (1969)	21000	1:500,000	Paper & GIS

¹GMAP numbers are identification codes for the GRI Program's database.

Of the seven quadrangles desired for a compiled park map, only the Port Gibson quadrangle is known to be published at a scale of 1:24,000, but it is not known to be available in a GIS format. During scoping, participants derived no firm plans of how to best provide large-scale geologic map coverage for the other six quadrangles, but GRI staff hopes that future discussions between the National Park Service and MDEQ Office of Geology will result in an adequate plan for covering the park's areas of interest.

During the GRI field trip of Vicksburg National Military Park, many stops involved looking at the loess deposits and associated erosional features. Bedrock geology was obscured by these deposits in most places. Therefore, it is noteworthy that the NPS Soil Resources Inventory has produced a digital GIS-based soils map to the current park boundary and it is available at <http://science.nature.nps.gov/nrdata/datastore.cfm?ID=48992> (accessed May 10, 2010).

Another important source of information is the "Saucier maps" (Saucier 1994), which were published by the U.S. Army Corps of Engineers. These maps are smaller scale, but cover four of the seven quadrangles of interest (fig. 4). Portions of these maps exist in a digital GIS format, and GRI staff has obtained shapefiles of these quadrangles from David Thompson (MDEQ Office of Geology).

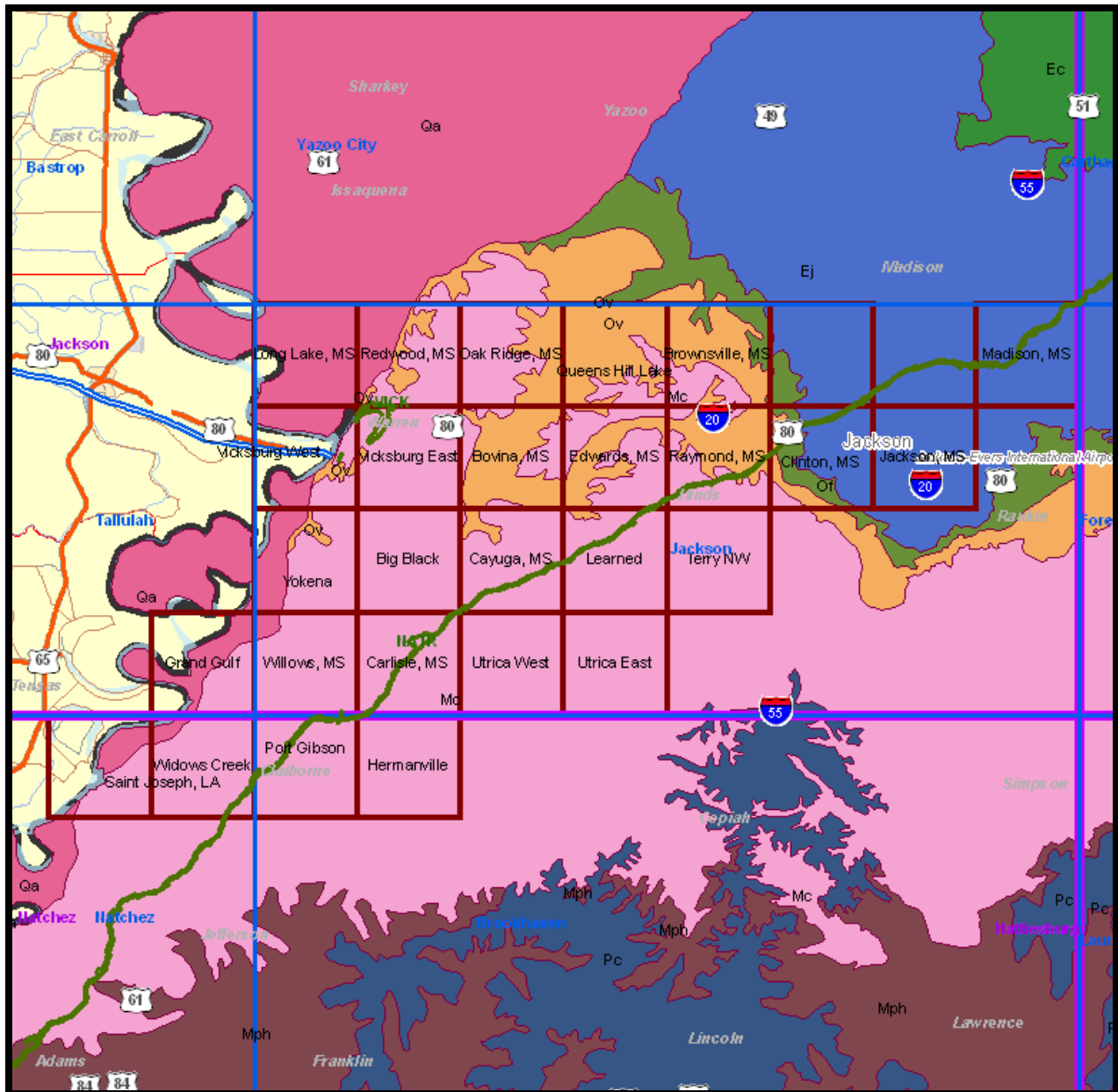


Figure 3. Geologic map of Mississippi in the vicinity of Vicksburg National Military Park. The digital geologic map of Mississippi (Bicker 1969) covers the park at a scale of 1:500,000. The lighter pink area on the figure represents Miocene sandstone (Mc); the darker pink is Quaternary alluvium (Qa), and the orange is Oligocene limestone (Ov). The names of the 7.5' quadrangles (scale 1:24,000) are labeled in black and outlined in maroon. The 30' x 60' (scale 1:100,000) sheets are shown in blue outline and blue text. The 1° x 2° (scale 1:250,000) sheets are shown in purple outline and purple text.

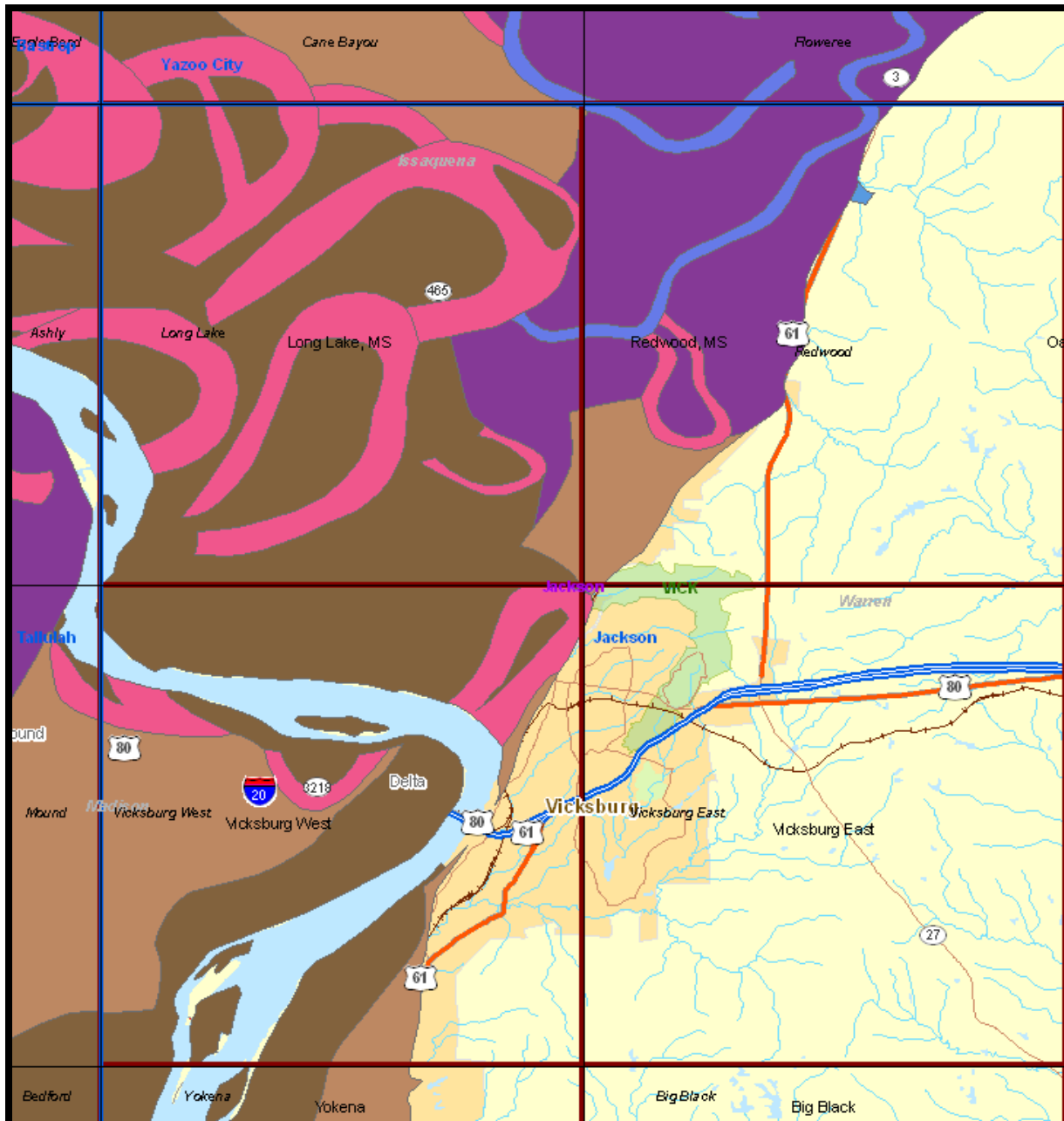


Figure 4. Footprint of Saucier maps around Vicksburg National Military Park. Saucier (1994) covers three of the seven 7.5' (scale 1:24,000) quadrangles of interest for the park (table 1): Long Lake, Redwood, and Vicksburg West.

Geologic Features, Processes, and Issues

The scoping session for Vicksburg National Military Park provided the opportunity to develop a list of geologic features and processes occurring at the park, which will be further explained in the final GRI report. Many of the features and processes have associated issues that are of resource management concern. During scoping Lisa Norby (Geologic Resources Division) asked what the park's "top 3" resource management issues were, and park staff replied, "Erosion, erosion, and erosion." This issue as it relates to the park's geology, namely loess, is listed first, followed alphabetically by other geologic features and processes at the park.

Loess

Short and simple, the terrain at Vicksburg is attributed to loess. Loess is a “cliff former,” creating the bluffs along the Mississippi River, and is stable in vertical cuts. However, when disturbed and at a slope, loess is very unstable. It is this characteristic that is responsible for the terrain at Vicksburg—deep ravines running in all directions with flat-topped ridges between.

Muhs (2006, p. 1405) defined loess as “sediment that has been entrained, transported, and deposited by the wind and is dominated by silt-sized (50–2 μm -diameter) particles.” In addition, it is recognized in the field as a distinctive sedimentary body (Muhs 2006). In Mississippi, this “distinctive sedimentary body” forms the high bluffs to the east of the Mississippi River’s alluvium. Loess bluffs rise abruptly from the Mississippi alluvial plain at Vicksburg and range in elevation from 23 m (75 ft) to 38 m (125 ft) high. This region contains the thickest deposits of loess soil in the Tennessee-Mississippi-Louisiana area (Cole et al. 1964).

The loess bluffs influenced early cultural settlement patterns, including road building, which became focused on the narrow ridgelines between the incredibly steep ravines that often had swampy bottoms. Loess also forms fertile soil—“brown loam”—which was extensively farmed in the 1800s. Settlers cut down trees on hilltops and gentle slopes and planted crops in the loess-derived soils.

With respect to the Civil War siege, two characteristics of loess are particularly significant: its tendency to stand in vertical bluffs, and its friable nature. Ridge tops formed on loess became ideal locations for defensive structures. Initially, the Confederates took up their position on the ridgeline surrounding the city to the north, south, and east. On the west, the Mississippi River and high loess bluffs provided protection. The nearly continuous ridgeline served as a lookout for Union activities. Behind the ridgeline, Southern troops excavated steep-walled trenches into the loess. Today, Confederate Avenue runs along this defensive line. Union Avenue marks the parallel position of Northern troops on the ridgeline immediately to the east and north. Steep ravines separate the two lines. In places, Union forces also dug tunnels through the loess, which required no revetments. The park road crosses once such tunnel at Thayer’s Approach; in the early 1900s, the tunnel was bricked in (Kolb and Durham 1967).

On a smaller scale, the friability of the loess resulted in fine dust that caked the soldiers’ clothing and equipment and turned roads into quagmires after summer showers. These conditions worked especially hard against Confederate soldiers who had no place to go but their trenches (Myers et al. 2005). Moreover, the geohydrologic properties of loess contributed to the shortage of water within the city during the siege. Loess is porous and is a poor groundwater reservoir, hence, the lack of water wells in it and the historic use of cisterns. When cisterns ran dry during the siege, soldiers and citizens lost their only supply of freshwater. This indirectly led to the outbreak of disease and the inability of the Confederate army to treat wounded its soldiers (Myers et al. 2005).

Cave Features

As mentioned previously, one of the most striking characteristics of loess is its tendency to stand in vertical bluffs (Kolb 1967). Inter-particle binding by clays or carbonates often results in considerable material strength and explains the ability of loess deposits to form vertical faces along river or stream banks and road cuts (Muhs 2006). This also explains the proliferation of loess

“caves” dug for shelter by soldiers and citizen to protect themselves from the constant bombardment of artillery from the Union army and navy during the siege. These were not true caves in the geological sense of naturally formed, subterranean openings. Yet, the caves were geological in the sense of loess’s ability to hold a vertical cut that could stand indefinitely. However, a few caves did become unstable during the constant bombardment, and some collapsed, burying inhabitants alive (Bufkin and Harrelson 2007). No loess caves have been preserved within the park, such as those once near the Shirley House, but the visitor center has an authentic display showing “cave life.” The caves were cool, dry and in some instances quite elaborate, consisting of several rooms (Grabau 2000). All the furnishings shown in the visitor center’s exhibit are original pieces from the Civil War era and are typical of household articles brought into the caves during the siege (National Park Service 2006a).

Erosion

Improper drainage on and within loess deposits can cause intensive gullying and severe piping at Vicksburg National Military Park. Removal of material at the base of a vertical deposit (“toe of a slope”) and saturation during storms can result in collapse or slumping of the overlying loess. During scoping, David Dockery (MDEQ Office of Geology) gave a slide presentation that included an example of slope failure on Highway 61, which caused a 6-m (20-ft) drop of the roadway. Indeed, as Dockery exclaimed, “It looks like an earthquake hit the thing.” Slope failure has also disrupted infrastructure in the park. In 2004, a section of Fort Hill failed, rendering a portion of the park road impassable. During the afternoon field trip, scoping participants saw numerous examples of erosion within the park: piping at Battery De Golyer (see fig. 1); the deep ravine behind Shirley House; piping along the tour road south of the West Virginia Monument; a major grading and drainage-engineering project at Graveyard Road; the bank dropping away from the creek near Thayer’s Approach; slumping along the bluff below Cemetery Road, which participants saw on the way to and from Mint Spring Bayou waterfall; and a recently “completed” grading and revegetation (Bermuda grass) project at Fort Hill, which is unfortunately already showing signs of gullying.

According to MACTEC Engineering and Consulting, Inc. (2009, p. 1-12), “soil erosion threatens military earthworks, archeological resources, and monument and landscape stability.” Efforts to control erosion at the park have included extensive grading and reshaping of slopes, slope stabilization, and repairing failed slopes, as well as localized repair with soil and crushed stone, and placement of new storm-water management control. A borrow pit behind the maintenance area is sometimes used to obtain material for erosion repair (Wiss, Janney, Elstner Associates, Inc., and John Milner Associates, Inc. 2009).

In 2009, the Vicksburg National Military Park team tasked with implementing the 2009 cultural landscape report selected the preferred alternative (Alternative C) for landscape management (National Park Service 2009c). This alternative calls for rehabilitating and maintaining areas of key military engagements, which today are obscured by woody vegetation. Rehabilitation involves removing woodland cover and maintaining a more open condition, which will facilitate interpretation and understanding of the Civil War landscape and wartime events. The goal is to remove the least woodland cover needed to reveal the most important historic landscape relationships in areas of key military engagements. Approximately 36 ha (90 ac) of clearing is proposed, as well as reforesting approximately 8 ha to 10 ha (20 ac to 25 ac) of currently cleared areas, and removing exotic plants from 9 ha (22 ac) of forested wetlands (National Park Service

2009c). As part of rehabilitation, park managers plan to include many of the best management practices outlined in Alternative B (Virginia DuBow, Vicksburg National Military Park, e-mail, April 24, 2010). These practices support soil conservation throughout the park and consider the role of vegetative cover in resource management. According to Alternative B, new land cover would be composed of “plant communities tailored to site-specific conditions, including soil moisture and slope and solar orientation. Land cover might include a combination of continued use of turf grasses and new warm-season grass and forb fields, savanna (a combination of grasses and widely spaced hardwood trees), wet meadows, or mesophytic forest” (Wiss, Janney, Elstner Associates, Inc., and John Milner Associates, Inc. 2009, p. 293).

Disturbed Lands

Disturbed lands are those parklands where the natural conditions and processes have been directly impacted by mining, oil and gas production, development (e.g., facilities, roads, dams, abandoned campgrounds, and trails), agricultural practices (e.g., farming, grazing, timber harvest, and abandoned irrigation ditches), overuse, or inappropriate use. The NPS Disturbed Lands Restoration (DLR) Program, administered by the Geologic Resources Division, usually does not consider lands disturbed by natural phenomena (e.g., landslides, earthquakes, floods, hurricanes, tornadoes, and fires) for restoration unless the areas are influenced by human activities. One disturbance identified during scoping at Vicksburg National Military Park was created by feral pigs, which have escaped from adjoining agricultural lands. Feral pigs spend much of their time rooting or digging with their noses in search of acorns, grasses, forbs, berries, roots, and bulbs; rooting significantly increases the rate of erosion. They also feed on ground-dwelling insects, worms, reptiles, amphibians, fish, small mammals, and carrion including other pigs (National Park Service 2010). Furthermore, pigs rooting near stream banks can cause the soil to loosen and wash away during rains, degrading water quality and negatively impacting riparian areas and aquatic species (National Park Service 2010).

Fluvial Features and Processes

Two slow-moving tributaries of the Mississippi River, Glass Bayou and Mint Spring Bayou have cut deep, steep-walled valleys into the loess at Vicksburg National Military Park. A third stream in the park, Stout’s Bayou, is an ephemeral waterway. In addition to bayous, fluvial features at the park include oxbow lakes and backswamps. Constant changes in the highly unstable course of the Mississippi River cut off many meanders, forming oxbows and backswamps. These fluvial areas abandoned by the Mississippi River have created a complex network of interconnecting waterways. At the time of the Civil War, many of these waterways were navigable by small steamboats, especially during high water (National Park Service 2009b).

In his slide presentation, David Dockery (MDEQ Office of Geology) highlighted flooding as a regular occurrence on the Mississippi River at Vicksburg. The most recent flood was April 2009. Park staff recalls “the flood of 2008” as being the highest in recent years. Downtown Vicksburg has a flood gate that manages flood waters and a wall that literally marks flooding events. Within the park, flooding on the Mississippi River causes Mint Spring Bayou to back up to the waterfall where turbid flood waters deposit sediment.

Historically, the Mississippi River flowed past the loess bluffs currently within Vicksburg National Military Park, making an almost 180° bend at Fort Hill in the northern section of the park. In 1876, the river eroded and cut through the DeSoto Peninsula approximately 5 km (3 mi) south of Fort Hill,

leaving the city of Vicksburg “high and dry” (see fig. 2). Today, the major water course flowing near the park’s northern reaches is the Yazoo Diversion Canal, created in the early 1900s by the U.S. Army Corps of Engineers to provide access to Vicksburg’s industrial harbor and boost the city’s economy by once again providing a port for river traffic (National Park Service 2006b).

The historic bend in the Mississippi River (called the “Tuscumbia Bend”) figured in the Vicksburg campaign (Henderson 2000). The Confederate army in Vicksburg commanded the Mississippi River through its position on the escarpment topped by the loess of the Walnut Hills. Capture of the city was necessary if Union troops intended to control the river. Union forces made two attempts to build a canal (now known as “Grant’s Canal”) across the narrow meander neck of the bend, which would have left Vicksburg on an “abandoned meander” and diverted water away from Confederate military positions. First, under the command of General Thomas Williams, Union soldiers attempted to construct a canal but disease, exhaustion, and a dwindling workforce caused Williams to abandon the effort. Second, General Grant took command of canal building in January 1863, but the project was again abandoned when flooding and exposure to Confederate artillery made the effort untenable.

Most of the canal has now been razed through agricultural operations. The small remaining tract, which has retained most of its original width and depth, was donated to the National Park Service in 1990 by local land owners working in conjunction with The Conservation Fund. This segment of the canal is the only reminder of this innovative but unsuccessful tactic of the Vicksburg campaign (National Park Service 2009a).

Paleontological Resources

During scoping, David Dockery (MDEQ Office of Geology) presented a geologic overview of Vicksburg National Military Park, which highlighted the park’s paleontological resources. Kenworthy et al. (2007) prepared a baseline paleontological resource inventory for the Gulf Coast Network which detailed the paleontological resources at Vicksburg National Military Park. The park hosts Oligocene fossils from the Vicksburg Group and Pleistocene fossils from the loess. The seven formations in the Vicksburg Group (Red Bluff Formation, Forest Hill Formation, Mint Spring Formation, Marianna Limestone, Glendon Limestone, Byram Formation, and Bucatunna Formation) preserve an abundant marine fauna consisting primarily of mollusks—144 bivalve species or forms (Dockery 1982) and 411 gastropod, scaphopod, and cephalopod species, subspecies, or varieties (MacNeil and Dockery 1984). The only formation in the Vicksburg Group that is not exposed in the park is the Red Bluff Formation. In addition, microfossils are abundant, including nearly 200 species of foraminifera and calcareous nannofossils (Cushman 1922, 1923; Todd 1952; Bybell 1982) and 92 species of ostracodes (Hazel et al. 1980). Investigators have also described fish otoliths (“ear bones”) from the Vicksburg Group (Frizzel and Lamber 1962; Frizzel and Dante 1965), and the French naturalist Charles A. Lesueur, who was the first to scientifically document fossils from the bluffs around Vicksburg in 1829, documented fish vertebrae, shark teeth, and ray plates (teeth). Notably, Lesueur’s “Walnut Hills” fossil locality is within Vicksburg National Military Park.

In addition to the Oligocene rocks within the park, Pleistocene loess deposits have been known to yield well-preserved fossils (Kenworthy et al. 2007). The loess hosts primarily land snails but also aquatic snails and bivalves as well as vertebrate remains, most notably mastodon (*Mammut*

americanum). Usually these vertebrate remains are buried beneath 3 m to 6 m (10 ft to 20 ft) of loess and become unearthed by erosion (Kolb and Durham 1967). To date, all discoveries of vertebrate remains in Vicksburg loess have occurred outside the park; however, the proximity of many of these discoveries indicates the potential for similar finds within park boundaries (Kenworthy et al. 2007).

Kenworthy et al. (2007) made some preliminary recommendations for management of paleontological resources at Vicksburg National Military Park. In light of scoping discussions, two of these recommendations seem appropriate to include here:

- Significant paleontological resource localities (e.g., Mint Spring Bayou waterfall and Lesueur's Walnut Hills locality) should be officially documented utilizing NPS Paleontological Resource Locality and Condition Assessment forms. Use of these forms satisfies GPRA goal Ia9 (Paleontological Resources) and provides baseline data for future resource management, monitoring, field studies, and interpretation.
- As mentioned in Kerbo and McDonald (2005), essentially all ground-disturbing activities in the park may uncover paleontological resources in the Pleistocene loess. Park staff should be made aware of such a possibility. While it may not be possible to mitigate all ground-disturbing activities due to the locally pervasive nature of the gastropod fossils, significant specimens should be collected. The MDEQ Office of Geology, Geologic Resources Division, or other appropriate institution should be contacted if articulated vertebrate or other significant specimens are uncovered.

Seismic Features and Processes

There are very few mapped faults in Mississippi, and seismic activity at Vicksburg National Military Park is a low management priority. However, with the approaching 200th anniversary of the New Madrid Earthquake—really a series of earthquakes between December 1811 and February 1812—seismic hazards are worthy of mention. The New Madrid seismic zone primarily covers an area north of Memphis, but during the historic event, shaking was felt in Natchez and Vicksburg, Mississippi.

Ground shaking from passing seismic waves is certainly a hazard, but the susceptibility of loess to collapse during an earthquake may be a more significant concern for park managers at Vicksburg. Hazards include (1) seismically induced landslides along the Mississippi River bluffs and (2) lateral spreading and subsidence resulting from liquefaction across the Mississippi River floodplain and along tributaries to the Mississippi River over at least 15,000 km² (5,790 mi²) (Frankel et al. 2009). Scoping participants mentioned anecdotal reports of islands in the Mississippi River “disappearing” during the New Madrid earthquake.

Unique Geologic Features

“Unique geologic features” are often mentioned in a park’s enabling legislation; these features are of widespread geologic importance and may be of interest to visitors and worthy of interpretation. Type localities and isotopic age dates are unique geologic resources, and are, therefore, of interest to a park’s geologic inventory. Vicksburg National Military Park hosts the type locality of the Mint Spring Formation (also known as “Mint Spring Marl”) (U.S. Geological Survey 2007). Mint Spring Bayou waterfall is the type locality and displays the type section (fig. 5).

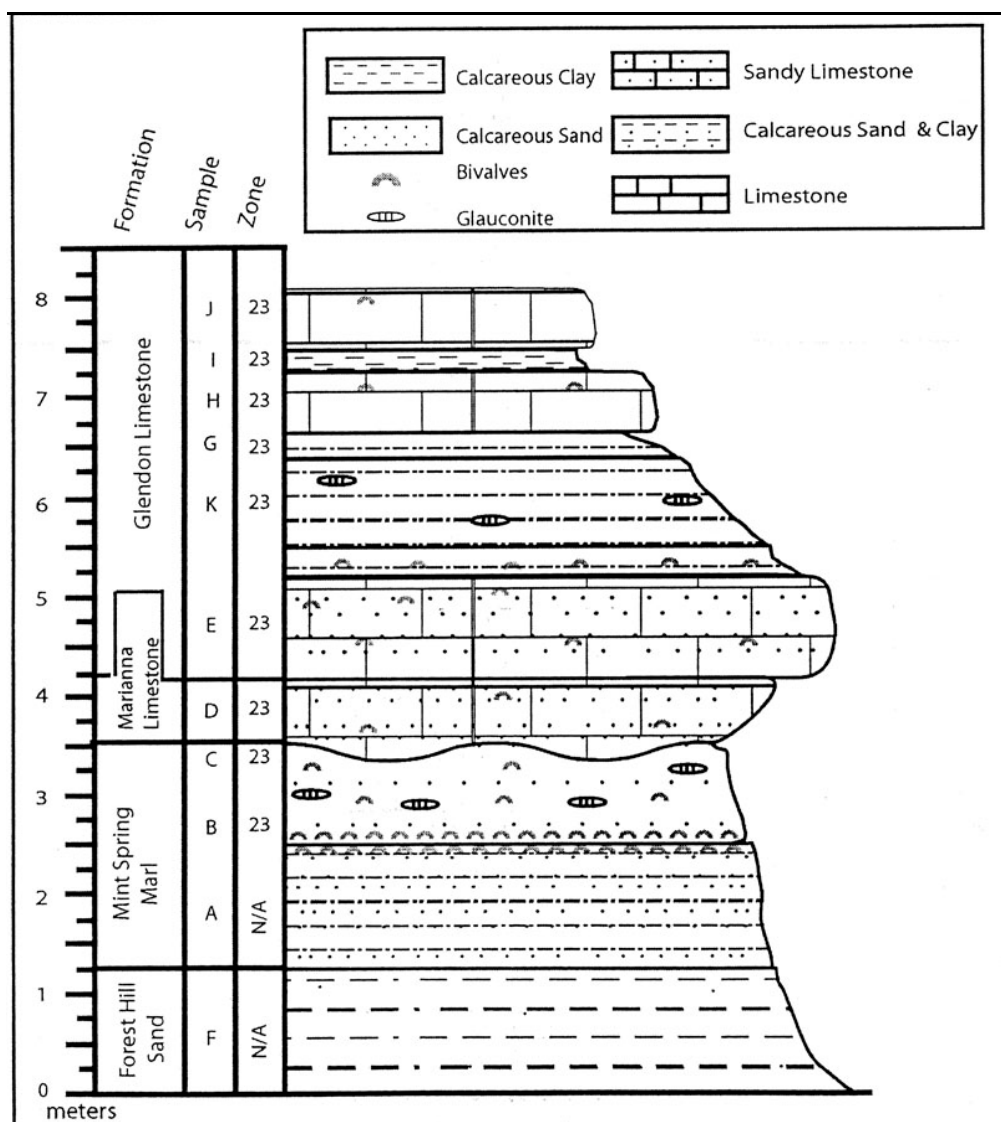


Figure 5. Mint Spring Formation type section. The type locality of the Mint Spring Formation is located at the Mint Spring Bayou waterfall in Vicksburg National Military Park. MDEQ Office of Geology figure (extracted from David Dockery's PowerPoint presentation, April 14, 2010, Vicksburg National Military Park).

Like Civil War history, historical geology abounds at Vicksburg National Military Park. In addition to Lesueur's historic documentation of the Walnut Hills, British geologist Charles Lyell, one of the "fathers of geology," made extended visits to the United States to study geology. In 1846, Lyell visited Vicksburg and published his findings as *A Second Visit to the United States of North America* (Lyell 1849). Specific to Civil War history, John Wesley Powell fought at Vicksburg. Powell, who is perhaps best known for being the one-armed captain who led the first expedition down the Colorado River in 1869, enlisted with the 20th Illinois volunteers at the outbreak of the war. A park monument commemorates Powell and Battery F of the 2nd Illinois Light Artillery. Powell lost his right arm at the Battle of Shiloh as captain of Battery F and returned to service and fought battles at Champion Hill, Black River Bridge, and Vicksburg. He excavated fossils from the loess walls of the Federal trenches that he occupied during the Vicksburg siege (Larson et al. 2004). Powell served as the director of the U.S. Geological Survey from 1881 to 1894.

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