State of Illinois
Rod R. Blagojevich, Governor

Illinois Department of Natural Resources
Illinois State Geological Survey

Guide to the Geology of Pere Marquette State Park and Surrounding Area, Jersey and Madison Counties, Illinois

Wayne T. Frankie and Donald G. Mikulic

Geological Science
Field Trip Guidebook 2007B

September 22, 2007
October 20, 2007

Cover photograph: *Confluence of Illinois and Mississippi Rivers at Grafton, Illinois (photograph by Wayne T. Frankie).*

Geological Science Field Trips The Illinois State Geological Survey (ISGS) conducts four tours each year to acquaint the public with the rocks, mineral resources, and landscapes of various regions of the state and the geological processes that have led to their origin. Each trip is an all-day excursion through one or more Illinois counties. Frequent stops are made to explore interesting phenomena, explain the processes that shape our environment, discuss principles of earth science, and collect rocks and fossils. People of all ages and interests are welcome. The trips are especially helpful to teachers who prepare earth science units. Grade school students are welcome, but each must be accompanied by a parent or guardian. High school science classes should be supervised by at least one adult for every ten students.

The inside back cover shows a list of guidebooks of earlier field trips. Guidebooks may be obtained by contacting Geoscience Outreach, Illinois State Geological Survey, Natural Resources Building, 615 East Peabody Drive, Champaign, IL 61820-6964. Telephone: 217-244-2427 or 217-333-4747. This information is on the ISGS home page: http://www.isgs.uiuc.edu.

Six USGS 7.5-minute Quadrangle maps (Alton, Brighton, Brussels, Columbia Bottom, Elsah, and Grafton) provide coverage for this field trip area.

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Natural Resources Building
615 E. Peabody Drive
Champaign, IL 61820-6964
217-333-4747
Home page: http://www.isgs.uiuc.edu

"We have seen nothing like this river [the Illinois] . . . for the fertility of the land, its prairies, woods, wild cattle, elk, deer, wildcats, bustards [cranes], swans, ducks, parrots, and even beaver, its many small lakes and rivers that on which we sail is wide, deep, and still."

–1673 Journal, Pere Marquette
(first written description of Illinois)

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Pere Marquette State Park and Alton Area

INTRODUCTION

The Pere Marquette State Park field trip area is located along the Illinois and Mississippi Rivers in Jersey and Madison Counties in southwestern Illinois. The trip generally follows the route of the Meeting of the Great Rivers Scenic Byway. The scenic river bluffs between Pere Marquette State Park and Alton, Illinois, have long attracted the interest of explorers, tourists, and geologists. Since the 1700s, many individuals have described the prominent cliffs here, which have also been the focus of many geological field trips over the last 70 years.

This field trip guidebook discusses the geologic history of the region and describes its impact on the settlement, development, and character of the area. The importance of the early stone industry in the development of Grafton and Alton is highlighted on this trip, and abandoned and operating quarries are visited.

For more than a century, the quarries at Grafton were the nucleus of a thriving industry that furnished the stone used in many prominent St. Louis area late nineteenth-century buildings and structures. Alton was long the center of a major lime industry. The success of both of these industries was in large part due to the availability of cheap river transportation.

Additionally, Grafton has long been known as one of the best trilobite-collecting sites in the Midwest, and specimens of *Gravicalymene celebra* from here can be found in museums across the nation.

Information on the geology and the history of the area has been covered by a number of earlier guidebooks (Collinson et al. 1954; Collinson 1957; Wilson and Odom 1960; Treworgy 1979; Reinertsen and Treworgy 1991; Wiggers 1997; Lasemi and Norby 2000; Mikulic and Kluessendorf 1999, 2000, 2002).

GEOLOGIC SETTING

The field trip area is situated at the confluence of the Illinois and Mississippi Rivers at Grafton and the confluence of the Missouri and Mississippi Rivers south of Alton at Wood River. This region of castellate bluffs and deep hollows is well-known for its scenic geologic beauty. This region has been subjected to a variety of geological processes, including flooding by ancient seas, sediment deposition, tectonic movement, weathering, erosion, and glaciation—all of which have helped to produce today's landscape.

The deposition of Paleozoic marine sediments is our starting point for the geologic history of this region. From about 543 million to about 290 million years ago, vast inland seas covered most of what is now the central United States for long periods (fig. 1). During this time, a variety of sediments were deposited on the sea floor, and these sediments now compose the fossiliferous sedimentary rocks forming the spectacular bluffs along the Illinois and Mississippi Rivers. In Jersey County, the oldest exposed rocks are Middle Ordovician (Kimmswick) limestones that crop out in a small area at the base of the bluff near Twin Springs in Pere Marquette State Park (figs. 2 and 3). These limestones are overlain by about 150 feet of late Ordovician Maquoketa Shale (fig. 2). Because they are easily weathered, the shales form more gentle slopes with few outcrops (see Maquoketa Shale slope, fig. 3).

The end of the Ordovician Period marks a very important event in Earth history. Starting about 443 million years ago, continental glaciation developed in what is now North Africa (then located at the south pole). As a result of this glaciation, sea level dropped several hundred feet worldwide, and, for several million years, this region was emergent. This period of glaciation marks one of the largest extinction events in the history of the planet.

Then, about 443 million years ago, at the beginning of the Silurian Period, the glaciers began to melt, and the sea once again flooded most of North America. At that time, the region we now know as Illinois was located about 20° south of the equator. Lime muds were deposited on the Silurian sea floor. These muds were later cemented into the dolomite strata that now form the lower cliffs from Pere Marquette State Park to Grafton. Silurian rocks are exposed at Stops 1 and 2.

Near the end of the Silurian Period, about 417 million years ago, the sea again withdrew from the region, resulting in a long episode of weathering and erosion, which removed much of the Silurian age rocks. The magnitude of this erosion can be seen in the variations in thickness of the Silurian rocks in this area. At Pere Marquette State Park, these dolomites are only about 60 feet thick, but they thicken eastward, reaching about 130 feet at the Grafton quarries.

About 30 million years later, during the Middle Devonian, approximately 387 million years ago, the sea again flooded the area, resulting in a thin layer of limestone less than 10 feet thick in this region. A few inches of sandstone, which is generally present at the base of these beds, may fill cracks and solution cavities extending downward up to12 feet into the eroded surface of the Silurian rocks.

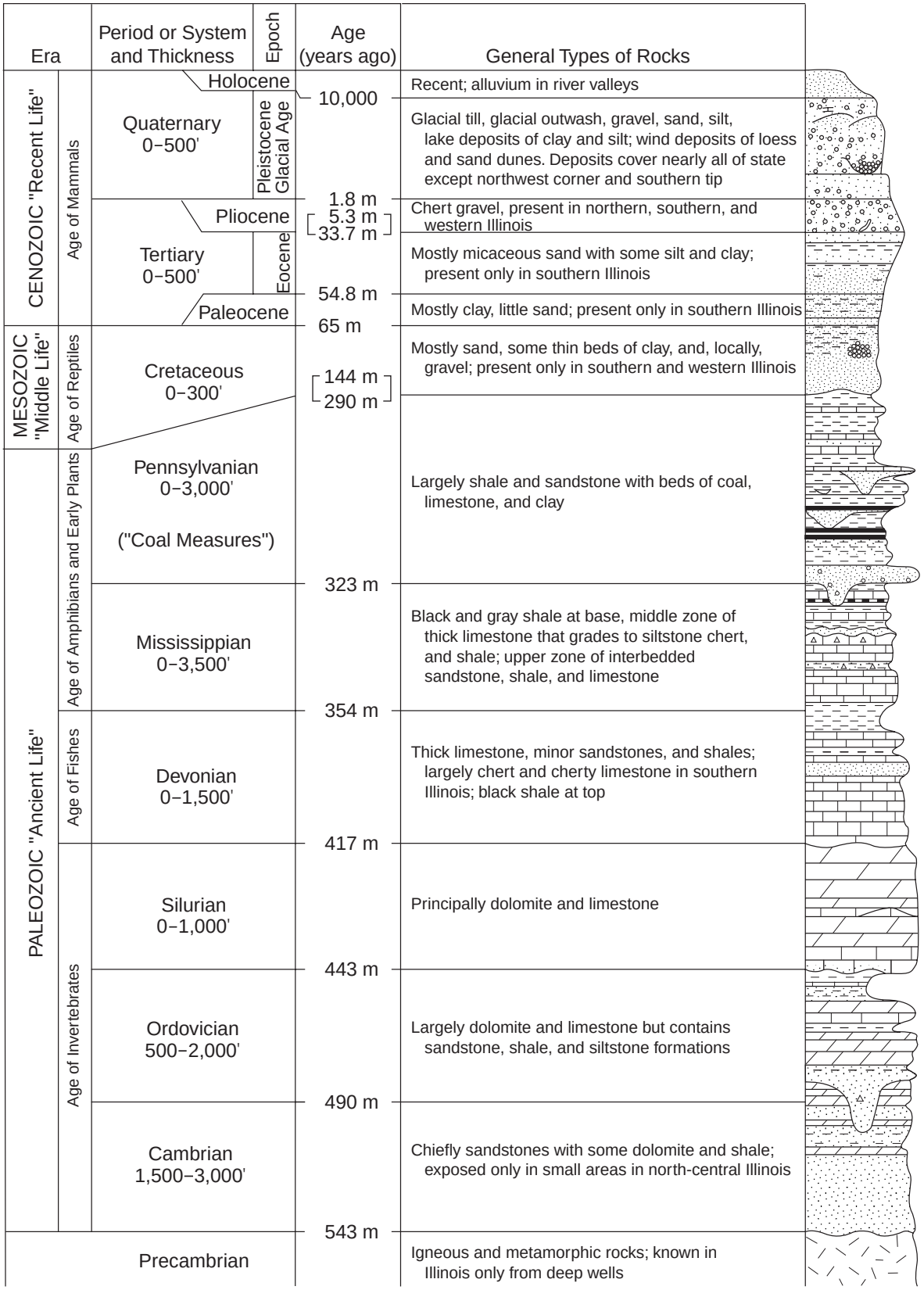


Figure 1 Generalized geologic column for Illinois.

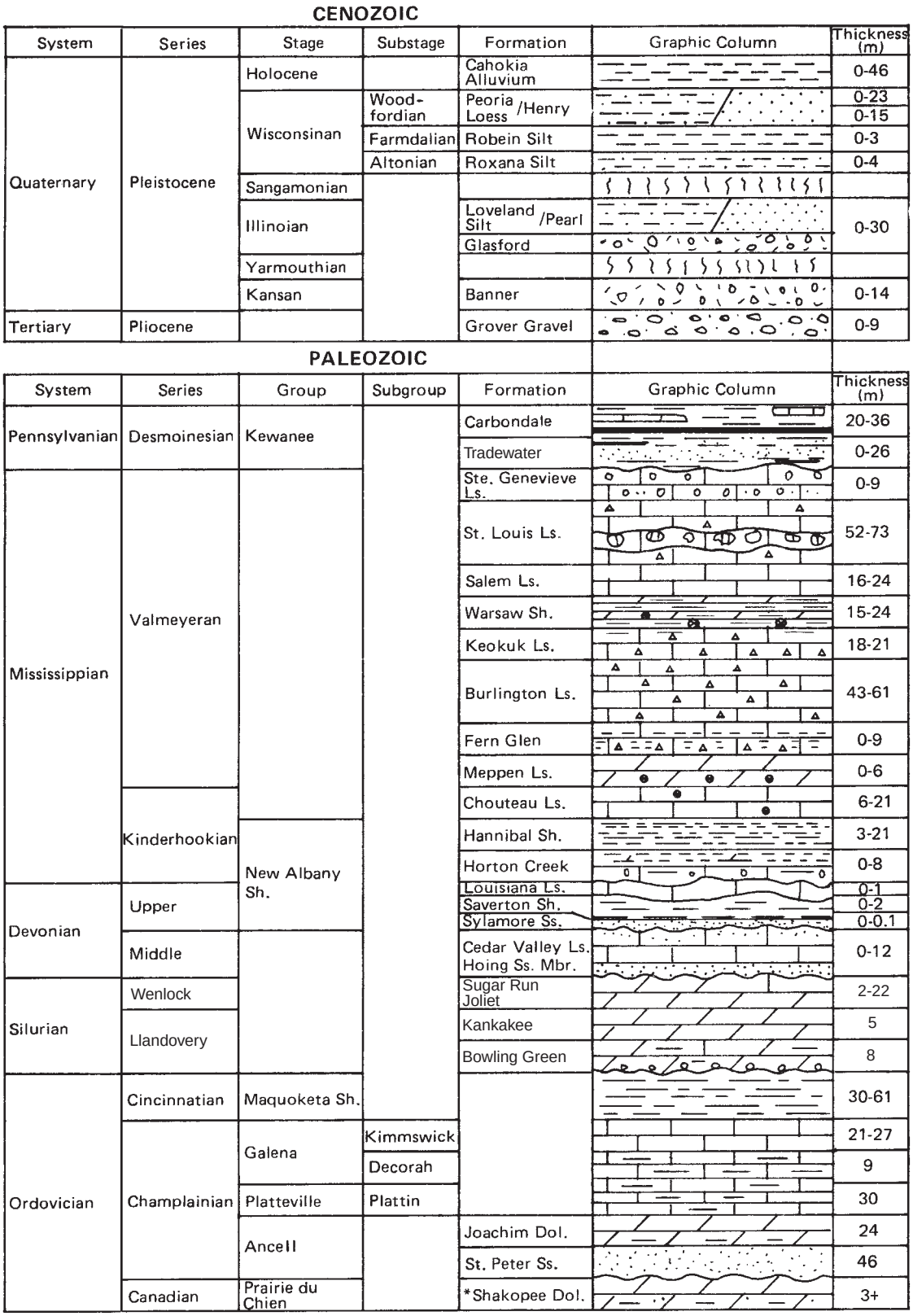


Figure 2 Generalized stratigraphic column of the field trip area (modified from Reinertsen and Treworgy 1991).
* Only upper part exposed.

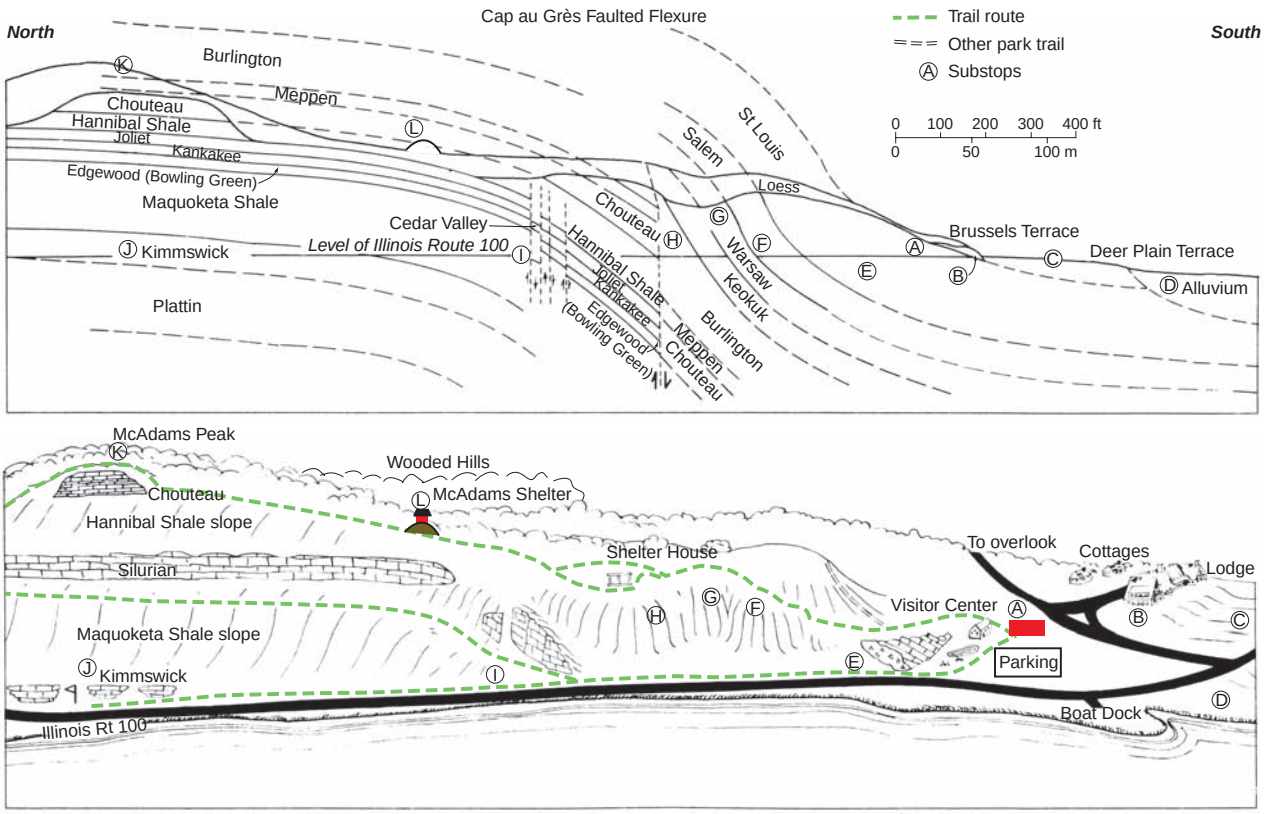


Figure 3 Pere Marquette State Park. Cross section (above) along Goat Cliff Trail showing Cap au Grès Faulted Flexure. Trail guide (below) to stops 1A to 1L (Rubey 1952, Collinson et al., 1954).

Another important break in marine sedimentation occurred after deposition of these Middle Devonian strata. Above this break, approximately 25 feet of Late Devonian and Early Mississippian shales were deposited, which now form a conspicuous vegetated slope between the cliff faces of the Silurian and Devonian rocks below and the Mississippian limestones above (see Hannibal Shale slope, figs. 2 and 3). The upper cliff face of the Mississippian limestones (see Chouteau, figs. 2 and 3) is modest in the area of Pere Marquette State Park, but it thickens toward the east where it forms the spectacular cliffs extending from the Raging River Water Park at Rice Hollow located east of Grafton to the old lime quarries and mines at Alton. Both of these relationships are present at Stop 1.

The Mississippian rocks (about 354 million years old), which are several hundred feet thick in the area, represent a complex history of marine deposition, as shallow seas alternately advanced across and withdrew from the region. At the end of this time, sea level dropped once again, and vast swamps developed, marking the beginning of the Pennsylvanian Period (323 million years ago). Sediments that were deposited during that period have since been lithified into shales, sandstones, limestones, and coal. These rocks have long been eroded from most of the field trip route along the rivers, but they are still present at higher elevations in southern Calhoun County, northeastern Jersey County, and eastern Madison County. In general, the region remained above sea level after the Pennsylvanian Period (290 million years ago), but little rock record remains in the Midwest to represent this vast amount of time.

STRUCTURAL HISTORY

Paleozoic rocks form the foundation of the regional geology seen today. However, several other geologic events and processes played major roles in creating the scenic cliffs and river valleys in the area.

Pere Marquette State Park is located in the central Mississippi Valley area where strata dip gently away from the Ozark Dome located in southern Missouri and into the Illinois Basin to the east and northeast (fig. 4). The Ozark Dome was a low-lying landmass during late Cambrian time and subsequently subsided and re-emerged at various times during the Paleozoic Era. The Ozark Dome has remained a prominent landform

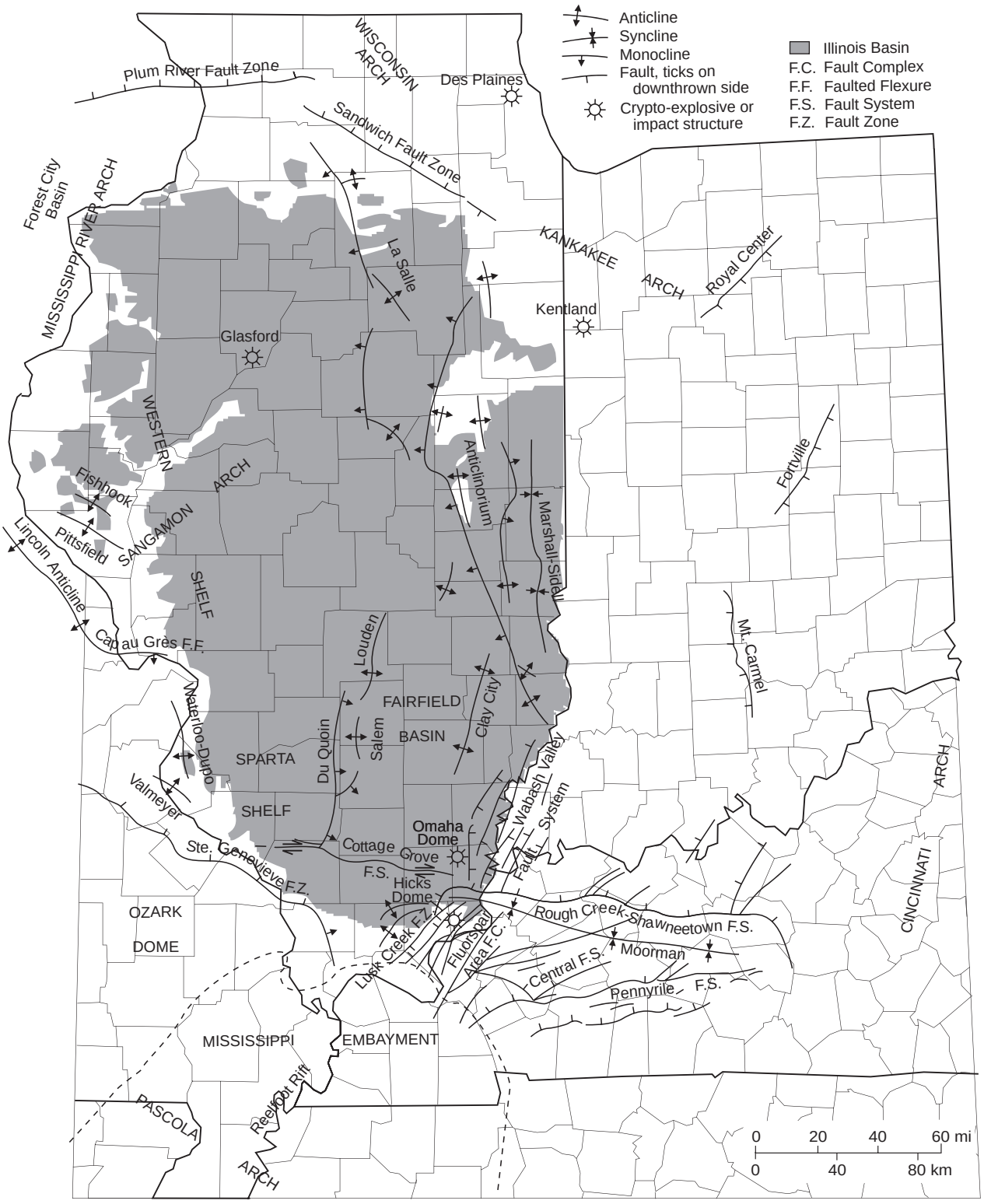


Figure 4 Structural features of Illinois (Buschbach and Kolata 1991).

from Pennsylvanian time. To the north of the Ozark Dome, two other major positive structures, the Lincoln Anticline and the Mississippi River Arch, separate the Forest City Basin in northwestern Missouri and southwestern Iowa from the Illinois Basin on the east. The Mississippi River Arch is very broad and flat; it trends northward and extends generally along the Mississippi River between Illinois and Iowa. The Lincoln Anticline generally trends northwestward, roughly parallel to the Mississippi River in northeastern Missouri from the Missouri-Iowa boundary to Madison County, Illinois.

The southeastern end of the Lincoln Anticline curves sharply eastward into Calhoun County, Illinois, just to the west of the park where it forms a steeply inclined, faulted monoplane known as the Cap au Grès Faulted Flexure (fig. 4). The Cap au Grès Faulted Flexure has several smaller structures superimposed upon its gently sloped northern flank. The southern flank of the fold in Illinois forms a steeply inclined plane that plunges to the south (fig. 3). The name Cap au Grès Faulted Flexure is derived from Cap au Grès bluff (French for sandstone headland) in western Calhoun County. The southern flank of the Cap au Grès Faulted Flexure contains a narrow zone of strata that dips up to 90° (normally up to 65°) southward and is penetrated by discontinuous, vertical faults (fig. 3). According to Rubey (1952), the zone containing dips greater than 50° is about 1,000 to 1,475 feet wide. Strata ranging in age from Ordovician to Mississippian are exposed at the surface within this narrow, deformed zone. The structure extends east-southeastward for about 60 miles through Lincoln County, Missouri, and southern Calhoun, Jersey, and northwestern Madison Counties in Illinois. The Cap au Grès structure dies out between Grafton and Alton beneath the broad alluvium-filled valley of the Mississippi River.

Development of this structure began during the Paleozoic as a result of tectonic activity. This structural feature formed primarily during the late Paleozoic, although it may overlie a deeply buried fault in older Precambrian rocks. The flexure has had a major impact on the exposure of Paleozoic rocks across parts of Calhoun and Jersey Counties, as is especially apparent in the southwest end of Pere Marquette State Park (fig. 3). At this end of the park, rocks on the north side of the structure have been uplifted hundreds of feet relative to rocks on the south side. This uplift can be seen on geologic maps of the area, which show that Pennsylvanian and youngest Mississippian rocks are present on the south side of the structure, whereas Ordovician, Silurian, Devonian, and older Mississippian rocks occur at the same elevations on the north side (fig. 5). These two sides are separated by a strong folded zone exhibiting some faulting, which, although not usually well exposed, is reflected in a number of outcrops from Twin Springs at Pere Marquette State Park, to several localities east along Illinois Route 100, to exposures near the Brussels Ferry.

The best exposures of the Cap au Grès Faulted Flexure are in a series of outcrops in Pere Marquette State Park along Illinois Route 100; they will be discussed at Stop 1. The Cap au Grès Faulted Flexure underwent recurrent deformation throughout the Paleozoic Era and in later times. Major movement along the Cap au Grès structure occurred in Middle or Late Mississippian to Early Pennsylvanian time, as evidenced by an angular unconformity where the Pennsylvanian Tradewater Formation (Desmoinesian Series) overlies steeply folded Mississippian St. Louis Limestone (Valmeyeran Series) and older strata (Rubey 1952). If younger Mississippian strata (the Ste. Genevieve Limestone and the younger Chesterian-aged rocks) had been deposited across the area and were involved in the deformation, they were removed by erosion before the Pennsylvanian strata were deposited. This movement of the Cap au Grès Faulted Flexure is contemporaneous with other major tectonic events in the Eastern Interior Region and coincides with the Alleghenian and Ouachita mountain-building events (orogenies) along the eastern edge of the North American continent. Later movements along the faulted flexure tilted Pennsylvanian strata, leaving nearly 150 feet of the Pennsylvanian Tradewater and Carbondale Formations preserved on the south side of the flexure but only patchy remnants of the two formations on the structurally high north side (Rubey 1952). Still more recent movement along the Cap au Grès Faulted Flexure occurred in the late Tertiary, coincident with or immediately following deposition of the Pliocene Grover Gravel onto the flat, post-Pennsylvanian erosional surface (Willman et al. 1975). The gravel is preserved on both the south and north sides of the flexure and has been displaced about 150 feet (Rubey 1952). This late Tertiary movement is reflected in the upland topography to the west in Calhoun County. There is no evidence for movement along the flexure since the Tertiary.

The flexure most likely had an impact on the flow direction of major rivers in the area. West of Pere Marquette State Park, the Illinois and Mississippi Rivers flow nearly straight south, but they both turn abruptly to the southeast, where they eventually merge at Grafton. The reason for this change in flow direction is probably related to their intersection with the Cap au Grès Faulted Flexure. Below the confluence of the rivers at Grafton, the Mississippi follows the east-southeastern trend of the Cap au Grès Faulted Flexure to the Madison County

line near Alton, where the structure disappears. The Mississippi River again turns and flows to the south near Alton. The Missouri River valley joins the Mississippi River valley north of Alton. The Missouri River joins the Mississippi River south of Alton near Wood River.

The Cap au Grès Faulted Flexure forms the structural transition between the southeastern extremity of the Lincoln Anticline to the north. The Troy-Brussels Syncline is located south and parallel to the Cap au Grès Faulted Flexure (fig. 4). More detailed information concerning the Cap au Grès Faulted Flexure can be found in publications by Nelson (1995) and Treworgy (1979).

The long period of post-Paleozoic erosion also had an important role in sculpting the landscape. Even with the tectonic effects of the Cape au Grès structure, most of

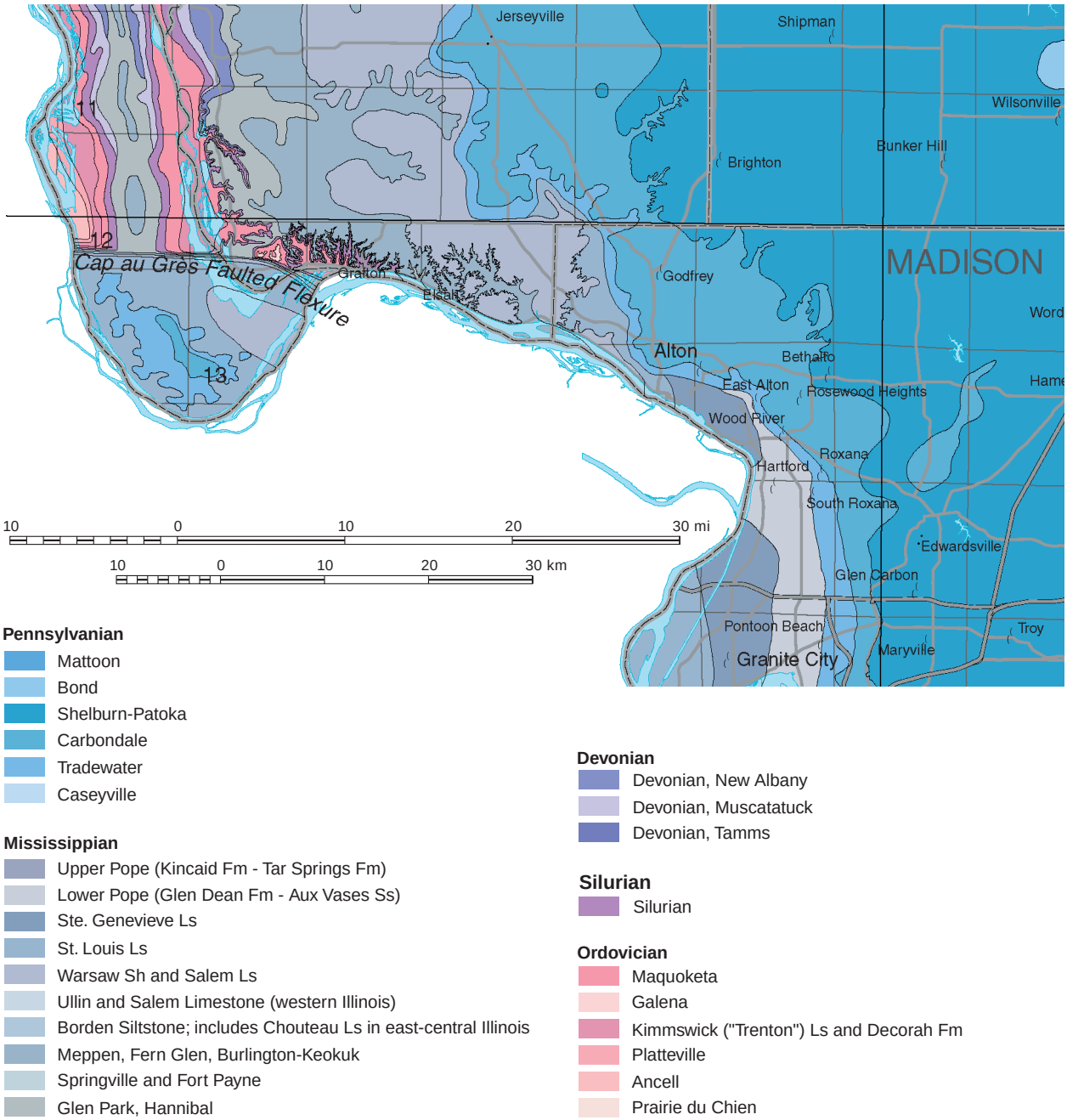


Figure 5 Generalized geologic map of the field trip area (Kolata 2005).

the surrounding area probably was relatively flat-lying throughout this vast amount of time. Subsequently, the long period of erosion eventually produced a highly dissected landscape of river drainage, which is especially evident in the areas not buried by later glacial sediments. In Jersey County, the Mississippi and Illinois Rivers both continue to flow in ancient valleys eroded into Paleozoic rocks by earlier rivers over a span of millions of years.

GLACIAL HISTORY

The beginning of the Quaternary Period, about two million years ago, marks the development of continental glaciers to the north that eventually advanced across large areas of North America. The ice sheet from the Illinois Episode may have extended across the Mississippi and Illinois River valleys in this area (fig. 6). Most if not all of these deposits within the valley have been removed by erosion, but such deposits are present on the top of bluffs to the north and east. The current surficial deposits map of this area indicates that the ice sheet from the Illinois Episode extended only to the eastern edge of the Mississippi River valley in parts of the field trip area but was absent in most of western Jersey County, including the Illinois River valley, all of Calhoun County, and the Missouri side of the Mississippi River. The later Wisconsin Episode glacier did not extend far enough south to cover this region (see fig. 6), but that ice sheet had a significant impact on the area's geologic character. Glacial meltwater periodically flooded, scoured, and enlarged pre-existing valleys before partially filling them with sediment. The advance of glacial ice sheets in other areas of the state also had an important impact. For example, the Illinois River now f1ows through the former channel of the ancestral Mississippi River. Prior to the Quaternary, the Mississippi River flowed east of its current channel, looping from Rock Island through central Illinois and then turning south at Hennepin to flow through the valley now occupied by the Illinois River in this region (fig. 7). Advancing Quaternary ice sheets eventually spread across the ancient Mississippi River valley, located to the north, and buried the original channel. As a result, the river was rerouted from the Rock Island area toward the southwest where it intersected the channel of the ancient Iowa River, which forms the current channel of the Mississippi River. When glaciation ceased, drainage from the Great Lakes gave rise to a new river—the Illinois—which, in this part of the state, follows and flows through the ancestral Mississippi River valley. In addition to sediments deposited along river channels by glacial meltwater, this region also was blanketed by a very fine-grained glacial sediment called loess. These windborn deposits are exceptionally thick along the Illinois and Mississippi River valleys in this area, reaching more than 25 feet in some places. Figure 7 shows the various glacial episodes and deposits in this area of Illinois.

At the close of the most recent glaciation (the Wisconsin Glacial Episode, ending about 13,000 years ago in Illinois), the topography of this region was much the same as we now see it. Human activity, however, has increasingly impacted the landscape. Native Americans mined and used a variety of geological materials to make tools and other objects. They also built hundreds of mounds in the area, many of which can still be seen along the bluff tops. This mound building reached its zenith with the construction of large ceremonial and burial mounds at Cahokia (about 35 miles southeast of Pere Marquette State Park) where a city developed around 1,000 A.D. The Cahokia mounds rival the size of contemporary structures elsewhere in the world.

PERE MARQUETTE STATE PARK

Local civic groups sought to preserve the land by the river as a state park during the late 1930s. They raised money and were successful in persuading the State of Illinois to match their funds for the purchase of the land. In 1932, the State was given 2,600 acres for the park, and the State purchased an adjoining 2,500 acres of conservation area. Later acquisitions and recent land purchases have brought the total to approximately 9,500 acres, making it the largest state park in Illinois. The newly created state park was originally named Piasa Bluffs State Park but, by popular demand, was renamed in memory of Father Jacques Marquette, the French Jesuit missionary priest, who in 1673 along with explorer Louis Joliet (Jolliet), were the first Europeans to enter what is now the State of Illinois at the confluence of the Mississippi and Illinois Rivers.

History. The history of Pere Marquette State Park centers around that of the Illinois River. The forces that formed the river can be traced to ancient glaciers that pushed their way down over most of Illinois, stopping just short of the park. In the path of the glaciers and their meltwaters, a rich network of streams and rivers formed, and tons of soil and bedrock were ground to dust, which rose and blew up against the hillsides. These ancient layers of windblown soil, called loess, can be seen along the roads and trails of Pere Marquette.

Gradual climate changes over thousands of years made the region an ideal environment for the prairie grasses and plants that eventually covered two-thirds of Illinois. Deciduous forests, dominated by oak and hickory, held their ground along rivers, streams, and upland hills

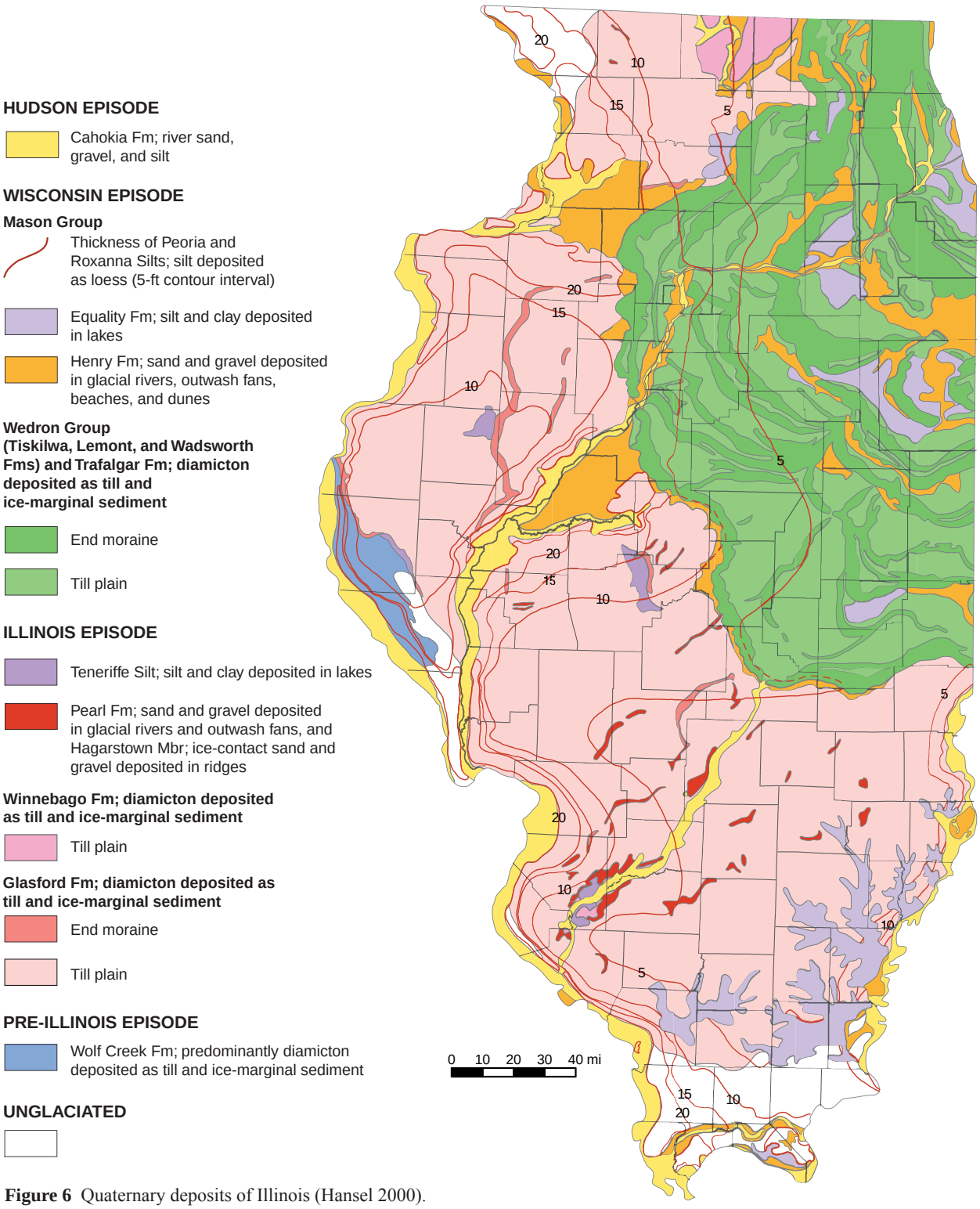


Figure 6 Quaternary deposits of Illinois (Hansel 2000).

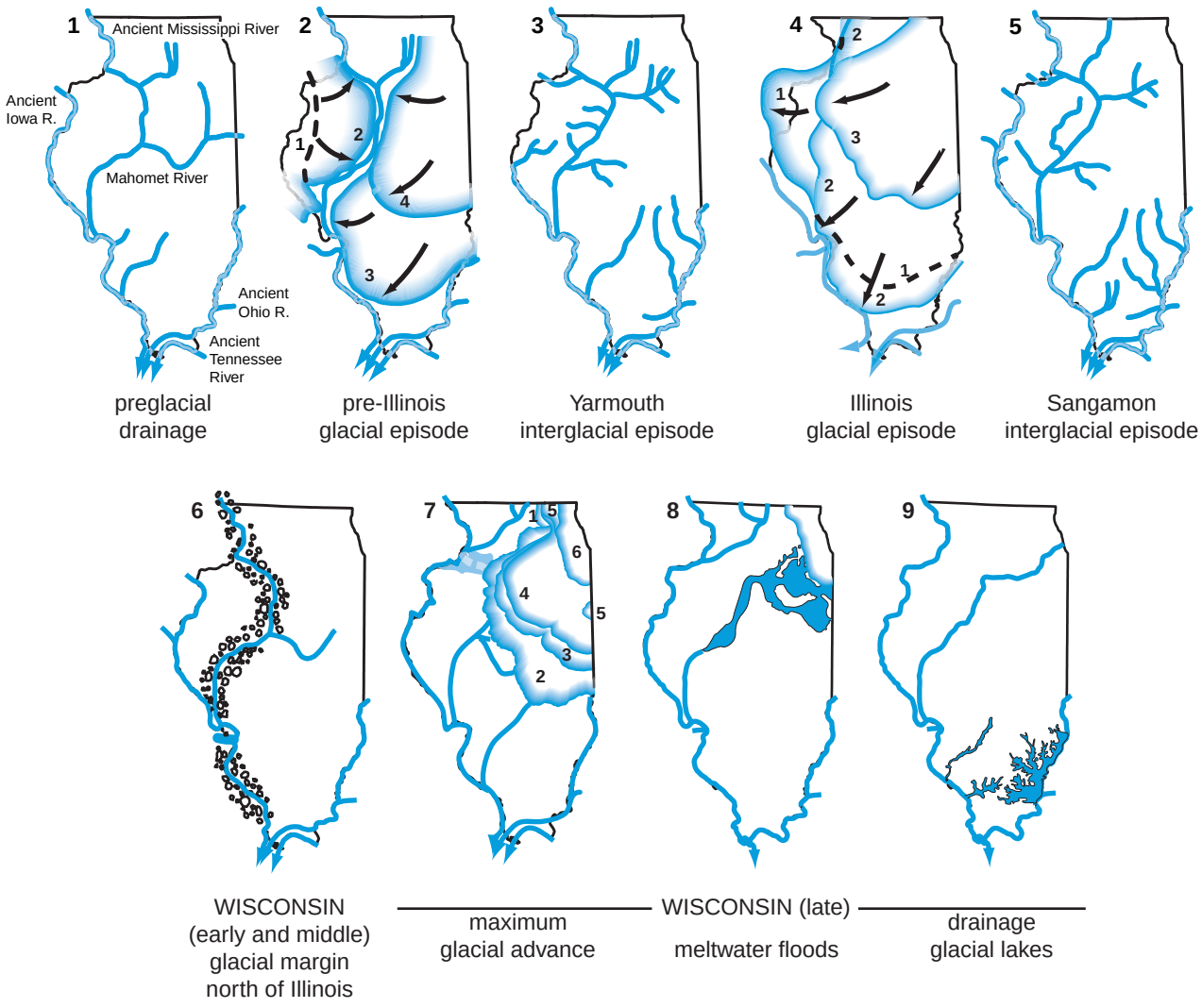


Figure 7 Sequence of glaciations and interglacial drainage in Illinois (Killey 2007).

protected from prairie fires.Throughout the hills, ravines, and prairies, Native Americans hunted game, gathered food, and later made homes. Archaeologists describe six native American cultures common to this region. Evidence of their presence here has been found in the form of fragments of pottery, spear points, and planting tools. Burial mounds also are distributed throughout the park, including one atop McAdams Peak.

When Europeans began to explore the Illinois country, most of the Native Americans they met were members of the Illini tribe. The first Europeans to reach the confluence of the Mississippi and Illinois Rivers was a group led by Louis Joliet and Pere (Father) Jacques Marquette, a French Jesuit missionary, in 1673. Marquette and Joliet, accompanied by French voyagers, paddled down the Mississippi River as far as the Arkansas River in search of a passage to the Pacific Ocean. Learning from the Native Americans that the Mississippi River emptied into the Gulf of Mexico, Marquette and Joliet turned back, returning by way of the Illinois River and stopping near what is now Pere Marquette State Park. A large stone cross east of the park entrance commemorates their historic landing here.

On the Mississippi Bluffs, the explorers encountered something that has become a local legend: "we saw . . . two painted monsters which at first made us afraid and upon which the boldest savages dare not long rest their eyes." They learned that the creature was part bird, with the face of a man, scales like a fish, horns like a deer,

and a long black tail. The creature was called Piasa. A representation of the Piasa Bird is still maintained in paint on the bluffs west of Alton.

The park is dotted with over 150 small Native American burial mounds, and the Illini Confederacy occupied the area when Joliet and Marquette made their journey. A number of archaeological studies have been conducted here, most notably at the location of the Pere Marquette Lodge. Prior to its construction in the 1930s and again during the lodge's expansion in 1985, evidence that the location was a prehistoric habitation site was uncovered. Indian tribes in the area were the Hopewell and Illini. The Illini were the tribe to put the original Piasa Bird on the bluffs near what is today Alton.

Native Americans controlled the Mississippi Valley with their flourishing fur trade centered on the Illinois River until the French and Indian War of 1760. The British took over in 1763, and the area became the State of Illinois in 1818.

The geologic history of the park encompasses nearly 450 million years of Earth history. Silurian rocks (417 to 443 million years ago) compose most of the lower bluffs along Goat Cliff Trail in the park and provide a key to understanding the region's complex geology. Most of the original park buildings, bridges, and other stone structures are constructed of Silurian rocks quarried nearby. The park lodge is an outstanding example of the architectural use of this building stone. We will visit Silurian outcrops at Stops 1 and 2. No time has been scheduled to tour other areas of the Park, but it is recommended that users of this guidebook drive the scenic roadways, taking time to stop at the lookouts. In addition, you might want to visit the lodge and other buildings to see how local Silurian rocks were used as building stone.

Pere Marquette Lodge. Most of the older park bridges, retaining walls, and other buildings were built from Silurian rock quarried from the Callahan quarry in Jerseyville Hollow at Grafton and, to a lesser extent, within the park itself. Pere Marquette State Park Lodge was erected between 1933 and 1939 by the Civilian Conservation Corps (CCC), at a cost $352,912.00. The architect for the lodge was Joseph F. Booten. The massive poles (as much as 3 feet in diameter) used as roof and wall supports and the other wood in the chalet-like buildings are Douglas fir, western cedar from Oregon, and peckey cypress. The CCC did all of the metal work, including the chandeliers in the lobby and dining room, door handles, and window locks. "Three hots and a flop" constituted the bulk of a corpsman's payday. Today their dedication and craftsmanship are here for all of us to enjoy. The Pere Marquette State Park Lodge and cabins were added to the National Register of Historic Places in 1985.

The 700-ton fireplace is the most prominent feature of the great room at the lodge; it soars to a roof height of 50 feet and is an outstanding example of high-quality dressed stone produced at the Grafton quarries. These quarries were very successful because stone there could be quarried and dressed into large, thick blocks that possessed great strength and were capable of supporting large structures such as this fireplace.

Some of the nearby cabins are constructed of Silurian (Bowling Green Dolomite) rocks that were quarried by the CCC in Graham Hollow, located within the eastern part of the park. These Silurian rocks occur at a lower level, are thinner bedded, and are of poorer quality than the Grafton building stone.

Because the Grafton quarries have been closed for more than 30 years, newer masonry structures at the park, such as the Visitor Center (erected 1997) and recent additions to the lodge, are made of Ordovician stone quarried in Minnesota, or, in the case of retaining walls, concrete blocks.

Specimens of the famous Grafton trilobite *Gravicalymene celebra* can be observed in the stonework at a number of locations inside the older portions of the lodge; they are most readily seen in the hallway between the great room and the restaurant. Fossil burrows and trails made by ancient marine organisms in sea floor muds can be seen in flooring both inside and outside the lodge. Other fossils occur in the stonework as well, but weathering on the outside of the building commonly makes them difficult to observe. A few silicified brachiopods and other fossils, however, are actually enhanced by the weathering.

GUIDE TO THE ROUTE

We'll start the trip at Pere Marquette State Park, in the Visitor Center parking lot (NE, SW, SE, SE, Sec. 9, T6N, R13W, 3rd P.M., Brussels 7.5-minute Quadrangle, Jersey County). Mileage will start at the exit of the Visitor Center parking lot.

You must travel in the caravan. Please drive with headlights on while in the caravan. Drive safely, but stay as close as you can to the car in front of you. Please obey all traffic signs. If the road crossing is protected by an Illinois State Geological Survey (ISGS) vehicle with flashing lights and flags, please obey the signals of the ISGS staff directing traffic. When we stop, park as close as possible to the car in front of you, and turn off your lights.

Private property Some stops on the field trip are on private property. The owners have graciously given us permission to visit on the day of the field trip only. Please conduct yourselves as guests and obey all instructions from the trip leaders. So that we may be welcome to return on future field trips, follow these simple rules of courtesy:

- Do not litter the area.
- Do not climb on fences.
- Leave all gates as you found them.
- Treat public property as if you were the owner, which you are!
- Stay off all mining equipment.
- Parents must closely supervise their children at all times.

When using this booklet for another field trip with your students, a youth group, or family, remember that you must get permission from property owners or their agents before entering private property. No trespassing, please.

Six USGS 7.5-minute Quadrangle maps (Alton, Brighton, Brussels, Columbia Bottom, Elsah, and Grafton) provide coverage for this field trip area.

Please note: A large number of the roads and intersections are unmarked. Paying special attention to the mileages and the route maps will help individuals conducting their own field trips in the future.

STOP 1. Goat Cliff Trail, Pere Marquette State Park (NE, SW, SE, SE, Sec. 9, T6N, R13W, 3rd P.M., Brussels 7.5-minute Quadrangle, Jersey County). On the day of the field trip, we will follow the Goat Cliff Trail from the trailhead located at the southwest corner of the Visitor Center parking lot.

Miles to next point	Miles from start	
0.0	0.0	Exit Visitor Center parking lot. Set your odometers to 0.0 at the exit of the parking lot. TURN LEFT onto Illinois Route 100 (also known as McAdams Highway).
0.05	0.05	Pass the main entrance to Pere Marquette State Park on the left and the marina entrance on the right. The lodge on the left sits on the Pleistocene Brussels Terrace at an elevation of about 470 feet above mean sea level. Illinois Route 100 crosses the lower, younger Deer Plain Terrace at an elevation of about 435 feet above msl.
0.55	0.6	Campground entrance is on the left.
0.9	1.5	Outcrop on the left consists of nearly flat-lying Pennsylvanian Carbondale Formation shale and siltstone. This bedrock occurs on the south side (flank) of the Cap au Grès Faulted Flexure. Illinois Route 100 parallels the general west-east trend (strike) of the Cap au Grès Faulted Flexure from Pere Marquette State Park toward Alton. The amount of folding along the Cap au Grès Faulted Flexure diminishes to the east where it dies out near Alton.

0.2	1.7	Duncan Hill group campground entrance is on the left.
0.1	1.8	The Smith-Duncan House and Eastman Barn (constructed about 1850) are on the left. This stone house and barn are constructed of Silurian dolomite quarried in this area. These structures were added to the National Register of Historic Places in 1999. Because the Silurian stone contains a small amount of iron carbonate, it weathers to a soft tan.
0.4	2.2	Deer Lick Hollow and the entrance to the Pere Marquette riding stables are on the left. Starting from Deer Lick Hollow, the rock strata rise nearly 900 feet stratigraphically over less than a half-mile distance as we rise out of the Troy-Brussels Syncline. The Troy-Brussels Syncline is located immediately south and trends parallel to the Cap au Grès Faulted Flexure. A group of small transverse faults cuts across the Cap au Grès Faulted Flexure so that strata are offset mostly horizontally (Rubey 1952). Rocks on the west side of Deer Lick Hollow are offset so that they crop out about 200 feet farther north and somewhat higher than those on the east side. The large strike fault that cuts the flexure is offset about 300 feet horizontally, and the rocks immediately south of it and west of the transverse fault group are overturned and dip about 60° to the north-northeast.
0.2	2.4	The outcrop on the left is the oolitic Mississippian age, Ste. Genevieve Limestone that is dipping southward at 40 to 45°. We are now slightly south of the crest of the Cap au Grès Faulted Flexure. The strike (the direction a bed takes as it intersects the horizontal) of Mississippian strata, which crop out along the left side of Illinois Route 100 for the next 0.7 mile, ranges from N70° W to N85° W; dips range from 22 to 75° to the south.
0.1	2.5	Entrance to Two Rivers Fish and Wildlife Refuge. Gilbert Lake is on the right.
0.15	2.65	Outcrop of Mississippian Burlington Limestone, on the left, 40 feet above Illinois Route 100 along the cut for the bike path. These are the easternmost exposures of the steeply dipping beds of the Cap au Grès Faulted Flexure. The beds strike N78° W and dip 68° to the south. According to Collinson (1957), the Burlington is about 100 feet topographically lower than the base of the older, flat-lying Silurian rocks that are exposed upslope 500 feet to the north, but they are 300 feet higher stratigraphically.
0.05	2.7	Entrance to Brussels Ferry on the right. Brussels Historic District is located 5 miles across the river. Notation on the topographic map calls this location the Deer Plain Ferry.
0.9	3.6	T-intersection from the left (Graham Hollow Road). CONTINUE AHEAD. Cross Graham Hollow Creek. Graham Hollow Road runs north to the Ridge Road in Pere Marquette State Park. On the east side of the Ridge Road, west of Graham Hollow, is an old quarry pit that was operated by the Civilian Conservation Corps (CCC) in the 1930s to supply crushed stone and building stone for construction in the park. Many of the cottages near the lodge were built of this stone. This quarry exposes about 25 feet of the Silurian Bowling Green Dolomite. Above this, on the west side of the road, is a road cut in cherty Kankakee Formation Dolomite that continues as natural outcrops farther north.
0.3	3.9	Outcrop of dipping bedrock on the left. The road swings around a large slump block of Silurian dolomite several hundred feet long and 60 to 80 feet thick. The block has pulled away from the joint-faced cliff behind it, and, being lubricated by the underlying Maquoketa Shale, has rotated so that it dips back 40° N to 55° N. The Silurian Bowling Green (Edgewood) Dolomite is exposed in the portion of the slump block beneath the fence. In the lower third of the block above the fence, the cherty Kankakee Dolomite containing silicified fossils is overlain by the Joliet Dolomite with 1 or 2 feet of Devonian Cedar Valley Limestone at the top.

0.2	4.1	The Maquoketa Shale underlies the slope in front of the Silurian bluffs 800 feet to the left (north). The crest of the Lincoln Anticline plunges to the east.
0.2	4.3	The entrance to the parking lot for Pere Marquette monument is on the left.
0.1	4.4	Pere Marquette monument is on the left. The monument marks the spot near where the expedition led by Louis Joliet and Father Jacques Marquette camped in September 1673. Marquette's journal mentions this first recorded entrance of Europeans into Illinois. The stone cross, which marks their landing site, was reportedly hewn from a sidewalk slab of Grafton stone that was removed from the front of the Ruebel Hotel in Grafton; however, other claims state that the rock may have come from a quarry in Jerseyville Hollow.
0.1	4.5	T-intersection from the left (Ski Lift Road). CONTINUE AHEAD. Ski Lift Road follows Camden Hollow. A small abandoned quarry east of the hunting area parking lot in Camden Hollow exposes the Ordovician-Silurian contact. Although the contact here does not appear to be very dramatic, it represents one of the most significant geologic events in the history of life on Earth. Glaciation at the end of Ordovician time resulted in a major drop in worldwide sea level, which was reflected in this area by emergence and erosion of the former Ordovician age sea floor. The environmental impact of this worldwide event resulted in one of the five largest extinctions in the history of life on our planet. This contact occurs throughout Pere Marquette State Park and the western part of Grafton; however, it is usually covered by talus and is exposed at only a few spots such as Camden Hollow. At Camden Hollow, approximately three feet of Ordovician Maquoketa Shale are overlain by about 1.5 feet of the Ordovician Noix Oolite Member of the Edgewood Formation; the Noix is a light gray to white oolitic limestone. The Maquoketa-Noix contact is irregular and slightly mineralized. There is a thin bioclastic layer at the base of the Noix, and shale lenses or clasts occur in the rest of the unit. A thin layer of greenish gray clay marks the Noix Oolite-Bowling Green Dolomite contact, which is the Ordovician-Silurian boundary. The Bowling Green is orangeish gray, massive- to medium-bedded dolomite about 15 feet thick. A larger, abandoned quarry to the north of this outcrop exposes about 25 feet of Bowling Green Dolomite. A continuous bluff exposure skirts the east side of Camden Hollow north to a scenic intermittent waterfall where a 30-foot section topped by cherty Kankakee Dolomite is exposed.
0.05	4.55	Entrance to Illinois Youth Detention Center-Pere Marquette, Illinois Department of Corrections, on the left. CONTINUE AHEAD. The beautiful stone buildings at this site were built of Grafton stone by Harry Ferguson between 1922 and 1932 at what was then the Glencliffe Jersey Farm, a showplace dairy farm. Ferguson willed this farm to the State of Illinois upon his death in 1943, and, in 1961, the farm became the Illinois Youth Detention Center.
0.2	4.75	Silurian dolomite occurs in the lower cliff to the left (north). The upper cliff is mainly Mississippian Chouteau Limestone with the Meppen Limestone in the reentrant near the top and nearly 30 feet of Burlington Limestone at the top.
0.05	4.8	Dagett Hollow is to the left. Enter Grafton (population 650). The ruins of an old stone bridge over Daggett Creek are located some distance to the north. Grafton is known as the “Home of the Wintering Bald Eagles.” The peak period to view the eagles is between December 1 and March 1. Located at the confluence of the Illinois River and Mississippi River, this area was known by Native Americans as “The Gathering of the Waters.” This old Illinois community has been inundated by floods many times over the years, including the 1993 flood, which attracted national attention and resulted in the relocation of some residents to the high ground north of town. Illinois Route 100 is Main Street in Grafton. Grafton was the home of a major building-stone industry for well over 100 years. Not unex-

pectedly, many buildings, retaining walls, and other structures erected in Grafton were made of this local stone, giving the community a unique appearance and architectural character. Many of these stone structures still stand and are listed in this road log. A number of stone buildings and structures in Grafton have also been placed on the National Register of Historic Places, particularly those in the Grafton Historic District, which runs along Main Street west from Jerseyville Hollow Road. Although the field trip does not stop at Grafton, this road log is arranged so that you can do a self-guided walking tour of the stone structures in town. Collectively these buildings exhibit a wide range of stone-working skills and masonry styles that are related both to the period of construction and to the cost of producing stone materials.

0.2	5.0	Former City of Grafton Waterworks on the right (south). The old Waterworks Building was erected of Grafton stone in 1936 in a masonry style typical of that period.
0.4	5.4	T-intersection from the left (Springfield Road). CONTINUE AHEAD. Springfield Road follows Mason Hollow to the north. The stone cottage to the north at 100 North Springfield Street is the Paris Mason Building (constructed 1840) built of rough-dressed blocks of Grafton stone typical of that early period. This house was placed on the National Register of Historic Places in 1994; its architectural style is mid-nineteenth century revival. Paris Mason was one of the original settlers in this area, and this part of Grafton was once called Mason's Landing.
0.2	5.6	Evans Street to the left. St Patrick's Church (founded in 1871) is located to the north at 11 North Evans Street. This was the church of Irish and German quarry workers and was constructed of Grafton stone. The quoins, stringline, window sills, and surrounds are composed of sawed stone. The rest of the building is made of rough-dressed blocks showing considerable variation in size and shape, suggesting that a cheaper grade of stone was used. A substantial amount of mortar was needed because the stone blocks of widely varying size did not fit together well.
0.2	5.8	On the left is a 30-foot-high cliff of Silurian dolomite; at this location, strata dip very slightly to the east-southeast. This exposure may represent either a large slump block or may be related to the Lincoln Anticline. This exposure is about 300 feet south of the crest of the Cap au Grès Faulted Flexure. At the base of the west end of the outcrop, the Kankakee-Joliet contact is exposed. The undercut in the cliff at road level was long ago cut by the Mississippi River and serves as a reminder that rivers have a tendency to change their courses. Grafton is where the Illinois River joins the Mississippi River.
0.15	5.95	Mulberry Street. Former site of the Grafton School on the north side of Main Street at Mulberry Street. The original stone school, built in 1874, was one of the most prominent Grafton buildings constructed of local stone until it was razed in 1967. More recently, its brick replacement met the same fate, but an old stone school retaining wall along Main Street has recently been rebuilt. Numerous other local-stone retaining walls can be seen to the east along the north side of Main Street. Nearly all of the stone buildings indicated on the 1894 Sanborn Insurance Atlas maps of Grafton, except for the school, are still standing. Old stone cottage (constructed 1840) at 211 W. Main Street on the right (south) side of the road. This building is made of rough-dressed Grafton stone with better-dressed quoins, sills, and lintels. Although the blocks are better-matched than at the church, a lot of mortar was still needed in its construction. The building is currently the home of the Piasa Winery. The sidewalk east of the cottage retains some of its old stone slabs. During the late nineteenth century, most of the sidewalks in Grafton undoubtedly were made of large planned slabs of Grafton stone. Most of these slabs have since been removed and replaced with concrete, a typical modern alteration of which most people are unaware.

0.05 6.0 T-intersection from the right (Maple Street). CONTINUE AHEAD. To the south at the foot of Maple Street is New Wharf (constructed 1846). This old Grafton-stone pier, located along the river, was placed on the National Register of Historic Places in 1994.

The Purdon Saltbox House (constructed 1836) is at 120 W. Main Street, just east of Maple Street. This house is constructed of very rough-dressed blocks of Grafton stone except for the sills and lintels. This building is listed on the National Register of Historic Places.

Between Maple Street and Sycamore Street are several buildings that use stone in their construction. A large frame house (constructed 1895) at 119 W. Main Street, which is on the National Register of Historic Places, has a rough-dressed foundation of local stone. The frame house at 109 W. Main Street has a sawed-stone foundation and front steps. A stone shed is located on the north side of the street.

0.05 6.05 Sycamore Street. The rebuilt remnants of a once-extensive rock garden, made of locally collected geodes, can be seen near the northeast corner of Sycamore and Main Streets in the Grove Memorial Park. The geodes weather out of Mississippian Warsaw Shale in the area.

0.05 6.1 T-intersection from the left (Illinois Route 3/North Market Street). CONTINUE AHEAD. Illinois Route 3, to the left, begins its ascent of Jerseyville Hollow, one of the longest and finest geologic sections in this part of the state. Exposures are essentially continuous, enabling us to study a complete section from lower Silurian Bowling Green Dolomite (Edgewood) up through Mississippian Burlington Limestone. Some of the Silurian section might be repeated in the lower part of the hollow because of faulting. Several old quarries, including the Callahan Quarry, are located in the Silurian rocks in this hollow. The following section is exposed (from the top downward):

Mississippian System	Thickness in feet
Valmeyeran Series	
Burlington Limestone	45
Fern Glen Limestone	20
Meppen Limestone	7
Kinderhookian Series	
Chouteau Limestone	50
Hannibal Shale	25
"Glen Park" Formation	1
Devonian System	
Upper Devonian Series	
Sylamore Sandstone	0.34
Middle Devonian Series	
Cedar Valley Limestone	5
Silurian System	
Niagaran Series	
Joliet Dolomite	57
Alexandrian Series	
Kankakee Dolomite	28
Bowling Green (Edgewood Dolomite)	20
Ordovician System	
Cincinnatian Series	
Maquoketa Formation (from shallow dug well)	
Total	258.34

(Modified from Reinertsen and Treworgy 1991)

0.1 6.2 T-intersection from the left (North Vine). The Slaten-LaMarsh House (also known as Potter's House Gallery) is located on the southwest corner of Main and Vine Streets at 25 E. Main Street. This building is constructed of rough-dressed Grafton stone and has carved stone steps. The architectural style is mid-nineteenth century revival. The building was added to the National Register of Historical Places in 1994. The building is currently operating as a guest house.

The foundation of the building at 203 E. Main Street was constructed of local building stone, as were most of the buildings of the time. A number of internal and external molds of the trilobite *Gravicalymene celebra* can be seen in protected blocks at the back of the building. Many of the other building stone blocks used throughout Grafton probably also contain trilobites; however, fossils are difficult to see on weathered surfaces.

0.1 6.3 Intersection (North Oak). The Rubel Hotel at 217 East Main (constructed 1884) and the Grafton Bank at 225 East Main are on the right. The Rubel Hotel was placed on the National Register of Historic Places in 1994. The architectural style is early commercial. The Grafton Bank, placed on the National Register of Historic Places in 1994, is an example of the classic revival architectural style.

The Victorian brick house at 229 West Main Street has Grafton stone foundation, steps, sills, and coping beneath the wrought iron fence on the southwest corner of Main and Oak Streets.

The front of the Grafton stone building at 301 West Main (constructed in 1859), is constructed of well-sawed blocks. The east side of the building, which would have abutted another building, is composed of rough, irregular-dressed stone. Foundation blocks below the string line are also rough-dressed.

The large local-stone building at the northeast corner of Main and Oak Streets has its original stone front covered with a newer facade. The sides of the building are rough-dressed stone. Just east of here is a garage, behind which is an excavated outcrop of beds of Grafton building stone.

Retaining walls of local stone are common on the north side of Main Street between Vine and Cherry Streets.

0.1 6.4 Intersection (Cherry Street).

The former quarry office of the Grafton Stone & Transportation Company (constructed 1859) is on the southeast corner of Main and Cherry Streets. The front and west walls of this building are constructed of very well-dressed or sawed large and thick Grafton-stone blocks of the type that would have been furnished to the St. Louis market as the highest-quality building stone available. Numerous drill marks can be seen in the uppermost course of stone on the west wall. The east wall of the building is made of very rough-dressed blocks and at one time may have abutted another structure. This building is one of the most historically significant buildings in Grafton because it symbolizes the commercial development of the stone industry here, having served as the office and company store of the Grafton Stone & Transportation Company, the first company to regularly ship Grafton stone to the St. Louis market. Unfortunately, the Grafton Stone & Transportation Company has not yet been listed on the National Register of Historic Places. The Full Moon Masonic Lodge has long owned this building.

The Charles Brainerd House (constructed 1885) at 420 East Main Street was owned by a former superintendent of the Grafton Quarry Company. This large brick house contains examples of fine Grafton-stone foundation sills, lintels, and stringline. This house is listed on the

National Register of Historic Places. The house is now operated as the Mississippi Half-Step Restaurant.

The historic Grafton Boat Company building is located to the right at the base of Brown and Cherry Streets. This shipyard manufactured a variety of vessels, ranging from small steel pleasure boats, lifeboats, PT (patrol torpedo) boats, barges, and at least 33 tow boats. The Old Boatworks once housed an old paint house and machine shop. Although boat building ceased in Grafton in the early 1980s, the Kampsville II Ferry, Brussels Ferry, Barge II Ferry, and the Brussels II Ferry made at the Old Boatworks are in use daily.

During the height of the steamboat era, the boat building and repair business also came to Grafton. The Rippley Hardware Co. built steel motors and dredge boats for use on the Mississippi River. A number of barges were also constructed by the Fleak Ship Co., which was also located in Grafton. The buildings that are now The Loading Dock and the Grafton Boatworks (constructed 1892) were used by the Rippley brothers for their boat construction business. The company made an important contribution to the World War I effort, in 1919 producing 1,000 lifeboats to be used on Allied ships and employing about 125 men. During the 1920s, the company was purchased by Mid West Boat Co. and later by Everett Fry, who changed the name to Grafton Boat Works. (This information adapted from http://www.praireghosts.com/grafton.html/.)

Main Street formerly ended at a rock bluff and old quarry wall just east of the Brainerd House. This portion of the bluff was removed in the early 1960s during construction of the McAdams Parkway.

0.2 6.6 The rubble area in the rock wall (on the left) at the sign for the bike path marks a fault zone, which appears to have lateral but little, if any, vertical displacement. Just east of the fault, the rock wall turns to the north and marks the west end of the old abandoned quarry formerly operated by the Grafton Stone & Transportation Company (fig. 11) and its successor, the Grafton Quarry Company. The quarry wall to the north exhibits about 50 feet of Silurian building-stone beds (unit E, fig. 12) overlain by about 10 feet of middle Devonian limestone and up to 20 feet of loess.

This quarry is on private property and should not be entered without the owner's permission. The high quarry walls are extremely dangerous and should not be approached under any circumstance. Illinois Route 100 runs across the old quarry floor of the abandoned Grafton Quarry Company here.

0.1 6.7 Simms Hollow is to the left. Exposed at the southeast corner of the mouth of Simms Hollow are the boundaries between the Silurian age Kankakee Dolomite (unit B, fig. 12) and the overlying Joliet Formation Dolomite, which includes the Brandon Bridge Member (unit C, fig. 12) and Romeo Member (unit D, fig. 12). The lowermost unit exposed is the Kankakee Dolomite, a vuggy, crystalline, massive- to irregular-bedded, yellowish orange dolomite that contains locally common fine bioclastic debris. The base of this unit is covered. The contact with overlying strata (equivalent to the Brandon Bridge Member of the Joliet Dolomite) is slightly mineralized and irregular. The Brandon Bridge strata are mostly laminated, thin-bedded, very dense, purplish gray dolomite. This lithology changes abruptly into the overlying unit, which appears to be equivalent to the Romeo Member of the Joliet Dolomite. This unit is very massive, vuggy, light yellowish gray, crystalline dolomite containing common to abundant fine pelmatozoan debris. Here the Romeo is characterized by common vertical burrows as much as one foot long.

0.1 6.8 Entrance to the Grafton Visitor Center on the left. TURN LEFT.

STOP 2. Keller Quarry, Grafton Visitor Center (SE, NW, NW, Sec. 14, T6N, R12W, 3rd P.M., Grafton 7.5-minute Quadrangle, Jersey County). On the day of the field trip, follow the caravan to the large gravel parking lot. The Silurian building-stone beds, Silurian-Devonian unconformity, and Quaternary loess are examined here.

0.3	7.1	Exit the Visitor Center and TURN LEFT onto Illinois Route 100. **CAUTION: Fast-moving traffic from the right and left. Great view of the bluffs along the Mississippi River after making the turn.**
0.2	7.3	Pass two overgrown quarries in Silurian rocks on the left. These quarries were in operation by at least 1872, but little else is known about their history.
0.3	7.6	T-intersection from the left (Palisades Parkway). CONTINUE AHEAD. Palisades Parkway follows Rice Hollow.

Raging Rivers Water Park, on the left, is located on the former site of the Illinois Powder Company manufacturing plant. The explosives produced at this plant were used in the local quarries but mostly shipped to other locations. It is said that the employees had a "bang-up job." An old TNT box is on display at the Grafton Visitor Center.

A north-south fault has been reported to be located in Rice Hollow between Silurian rocks on the west and Mississippian rocks on the east in bluffs.

Silurian rocks in the Grafton area dip down a few degrees toward the east. As a result, basal Silurian rocks, such as those exposed at Camden Hollow, dip below the river level near the center of Grafton. At the same time, successively younger strata are exposed in the Silurian section as one travels east from Camden Hollow, which explains why the thick sequence of building-stone beds seen in the old quarries at the east edge Grafton is absent west of town. Whether this dip or faulting is responsible for the disappearance of Silurian beds here is uncertain.

The bluffs from here east to Alton are composed entirely of Mississippian limestones and some shales. These bluffs are more than 280 feet high in places, making this one of the most extensive river bluff exposures in Illinois.

1.2	8.8	T-intersection from the left (Chautauqua Road). CONTINUE AHEAD. The Sherman Hollow and Babbs Hollow are to the left. The Chautauquan West geologic section is special because a distinct angular unconformity occurs between the Kinderhookian Chouteau Limestone and overlying Valmeyeran Meppen Limestone. Here the Meppen attains its maximum thickness (20 feet) in Illinois. For the next 6 miles, the bluffs are predominantly Burlington Limestone. Unusual erosion of the bluffs has produced projecting buttes or cusps and alternating hollows. Excellent exposures of Mississippian age strata occur in the 1.5 miles of river bluff that separate Chautauqua and Elsah.
1.5	10.3	T-intersection from the left (Elsah Road). CONTINUE AHEAD. Elsah and Principia College are located to the left.

The historic town of Elsah was founded by James Semple in 1853 and began as a river town named Jersey Landing. The town's nineteenth century charm has been well preserved, and, in 1973, Elsah was the first entire community to be listed on the National Register of Historic Places. As in Grafton, the use of local stone materials had a significant impact on the character

of this community. Many of the old stone houses here are constructed of local Mississippian limestone, which is distinctively white in color and more thinly bedded than the Silurian dolomite used in Grafton buildings. Nearby is Principia College, a Christian Science liberal arts school with a beautiful campus overlooking the Mississippi River. In 1999, building excavations on the top of the bluff at nearby Principia College uncovered the remains of a mammoth.

0.1	10.4	Cross unnamed creek.
4.2	14.6	T-intersection from the left (Lockhaven Road). CONTINUE AHEAD.
0.1	14.7	Cross Piasa Creek.
0.2	14.9	Lockhaven public boat access road on the right. CONTINUE AHEAD.
0.7	15.6	Entering Madison County. T-intersection from the left (Godfrey Road). CONTINUE AHEAD. The small community to the left is named Riehl.
1.1	16.7	STOP LIGHT. T-intersection from the left (Clifton Terrace Road). CONTINUE AHEAD.
0.5	17.2	T-intersection from the left (Iroquois Trace). CONTINUE AHEAD. Youngblood Hollow is to the left.
1.3	18.5	T-intersection from the left (entrance to Godfrey Park). CONTINUE AHEAD.

Godfrey Park was established within an abandoned quarry. Godfrey Park is locally known as Norman's Landing. A rendering of the Piasa was once painted on the bluffs but was destroyed by water seeping from the bedrock. Later, a large billboard with a painting of the Piasa Bird was attached to the bluff. However, this rendering did not set well with the local population, and the Piasa Bird now resides in a new Piasa Park near Alton. Close examination of the bluff reveals small patches of paint from the previous pictograph and the steel anchor bolts that were used to attach the billboard. Godfrey Park is dedicated to Laus Hoffman, Godfrey's first mayor.

0.6	19.1	Abandoned quarry on the left. Hop Hollow is to the left.
0.8	19.9	Enter the city limits of Alton (population 31,000).
0.5	20.4	T-intersection from the left. Entrance to Piasa Park. CONTINUE AHEAD. A reproduction of the Piasa Bird is located on the bluffs above the old abandoned mine tunnels on the left. A number of old abandoned mines and quarries occur along the bluffs for next 0.8 mile.
0.6	21.0	**CAUTION: Cross Illinois Terminal Railroad. The crossing is marked by lights only.**

A fault is located in the bluff on the left, just before the grain elevator near the east end of the Lincoln Anticline-Cap au Grès Faulted Flexure, where strata dip only about 30° to the south. Adjustments along the flexure have resulted in minor faulting. Several small faults, with vertical displacement of a few inches to a few feet and a horizontal displacement of several tens of feet, occur in this area. Along the bluffs to the left, cross-beds occur about six feet above the abandoned quarry floor. These cross-beds consist of oolitic grainstones within the Mississippian age Ste. Genevieve Limestone.

0.2	21.2	STOP (three-way). T-intersection from the left (State Street). CONTINUE AHEAD. Located on the east end of the large grain elevator are two painted lines. The lower black line marks

		the highest level of the floodwaters on April 28, 1973, and the upper red line marks the highest level of the floodwaters on August 1, 1993.
0.2	21.4	STOP LIGHT. Intersection (Illinois Route 100 and U.S. Route 67). Piasa Street is to the left, and Landmark Street is on the right. TURN RIGHT. Follow U.S. Route 67.
0.2	21.6	A great view of the new Clark Bridge that spans the Mississippi River between Alton and Missouri can be seen.
0.3	21.9	STOP LIGHT. Intersection (Henry Street). CONTINUE AHEAD.
0.1	22.0	STOP LIGHT. Intersection (Ridge Street). CONTINUE AHEAD.
0.1	22.1	STOP LIGHT. Entrance to Clark Bridge on the right. CONTINUE AHEAD.
0.1	22.2	STOP LIGHT. T-intersection from the left (Broadway Connection). Junction of U.S. Route 67, Illinois Route 140 to the left, and Illinois Route 143 to the right. Follow Illinois Route 143 East to the right. Wood River is 4 miles ahead.
0.5	22.7	STOP LIGHT. Intersection (Discovery Parkway). CONTINUE AHEAD. A large levee is on the right.
1.0	23.7	Prepare to turn right into U.S. Corps of Engineers National Great Rivers Museum and the Melvin Price Lock and Dam.
0.6	24.3	STOP LIGHT. Intersection (Lock and Dam Way Road). TURN RIGHT. Entrance to National Great Rivers Museum and the Melvin Price Lock and Dam.
0.2	24.5	Entrance to Riverside Pavilion parking lot. TURN LEFT into parking lot.

STOP 3. Lunch, National Great Rivers Museum, and the Melvin Price Locks and Dam (SW, SW, NW, Sec.19, T5N, R9W, 3rd P.M., Columbia Bottom 7.5-minute Quadrangle, Madison County). After lunch, we will tour the National Great Rivers Museum and the Melvin Price Lock and Dam.

0.0	24.5	Retrace route to Illinois Route 143.
0.2	24.7	STOP LIGHT. Intersection (Illinois Route 143 and Lock and Dam Way Road). TURN LEFT onto Illinois Route 143.
1.5	26.2	Enter the Alton city limits (population 31,000). Blue herons and egrets are common sites in the wetlands on the right.
0.3	26.5	STOP LIGHT. Intersection (Discovery Parkway). CONTINUE AHEAD.
0.6	27.1	Approaching junction of U.S. Route 67 and Illinois Route 140. Follow U.S. Route 67.
0.2	27.3	STOP LIGHT. Intersection (Broadway Connection). End of Illinois Route 143. Follow U.S. Route 67.
0.2	27.5	STOP LIGHT. Entrance to Clark Bridge on the left. CONTINUE AHEAD.

0.1	27.6	STOP LIGHT. Intersection (Ridge Street). CONTINUE AHEAD.
0.1	27.7	STOP LIGHT. Intersection (Henry Street). CONTINUE AHEAD.
0.4	28.1	Approaching junction with Illinois Route 100. Prepare to turn left, following the Meetings of Great River Road and the Illinois Great River Road.
0.2	28.3	STOP LIGHT. Intersection (Illinois Route 100 and U.S. Route 67). TURN LEFT onto Illinois Route 100. The Alton Regional Convention and Visitors Bureau is on the northwest corner of the intersection.
0.2	28.5	STOP (three-way). T-intersection from the right (State Street). CONTINUE AHEAD.
0.2	28.7	**CAUTION: Cross Illinois Terminal Railroad. Crossing is marked by lights only. Abandoned quarry on the right.**
0.3	29.0	Prepare to turn right.
0.1	29.1	Entrance to Piasa Park. TURN RIGHT.

STOP 4. Piasa Park (SE, NE, SE, Sec.10, T5N, R10W, 3rd P.M., Alton 7.5-minute Quadrangle, Madison County). We will discuss the legend of the Piasa and present a historical overview of Alton's early quarrying and lime industry.

0.2	29.3	Exit park. TURN RIGHT onto Illinois Route 100.
0.6	29.9	Enter the city limits of Godfrey (population 16,300).
0.8	30.7	An abandoned quarry is on the right.
0.4	31.1	T-intersection from the right. The entrance to Godfrey Park is on the right. CONTINUE AHEAD.
1.5	32.6	T-intersection from the right (Iroquois Trace). Youngblood Hollow is to the right. CONTINUE AHEAD. Sign for Ouatoga Bluff on the right.
0.4	33.0	STOP LIGHT. T-intersection from the right (Clifton Terrace Road). TURN RIGHT. After making the turn, on the outcrop to the left is the high water mark for August 1, 1993.
0.8	33.8	STOP (one-way). T-intersection (Clifton Terrace and West Delmar Avenue/Illinois Route 3). TURN RIGHT.
1.5	35.3	T-intersection from the left (Boy Scout Lane). CONTINUE AHEAD.
0.5	35.8	STOP LIGHT. School crossing. CONTINUE AHEAD. Gilson Brown School is on the right.
0.8	36.6	STOP LIGHT. Intersection (Pierce Lane to the left and Frontenac Place to the right). CONTINUE AHEAD.
0.1	36.7	STOP LIGHT. T-intersection from the left (Homer M. Adams Parkway/Beltline Highway). TURN LEFT. Follow Illinois Route 3

0.4	37.1	STOP LIGHT. Intersection (St. Ambrose Lane). CONTINUE AHEAD. Approaching junction of Illinois Route 111 and U.S. Route 67. Prepare to turn left onto U.S. Route 67.
0.3	37.4	STOP LIGHT. Intersection (State Street to the right and Godfrey Road to the left). TURN LEFT follow U.S. Route 67. Entering Godfrey city limits (population 16,300).
0.6	38.0	STOP LIGHT. Intersection (Martin Luther King Drive/U.S. Route 67). CONTINUE AHEAD.
0.6	38.6	STOP LIGHT. Intersection (Celesa Street to the right, and Taylor Avenue to the left). CONTINUE AHEAD.
0.4	39.0	STOP LIGHT. Intersection (Stampler Lane). CONTINUE AHEAD.
0.3	39.3	STOP LIGHT. T-intersection from the right (Tolle Lane). CONTINUE AHEAD. Louis and Clark Community College is on the left.
0.2	39.5	STOP LIGHT. Intersection (Elm Street). CONTINUE AHEAD.
0.3	39.8	STOP LIGHT. Intersection (Pearl Street). CONTINUE AHEAD.
0.6	40.4	T-intersection from the left (Airport Road). CONTINUE AHEAD. Approaching intersection (Illinois Route 111/ U.S. Route 267 and U.S. Route 67). Merge into left lane, and follow U.S. Route 67 toward Jerseyville.
0.2	40.6	T-intersection from the right (Illinois Route 111/U.S. Route 267). CONTINUE AHEAD. Merge into left lane, and follow U.S. Route 67 toward Jerseyville. **PLEASE NOTE. The U.S. Routes 267 and 67 have recently been switched, and the current topographic maps do not reflect these changes.**
3.0	43.6	Entering Jersey County. Cross creek and prepare to turn left into Lohr Quarry. Entrance to Kim Materials-Lohr Quarry on the left. TURN LEFT.

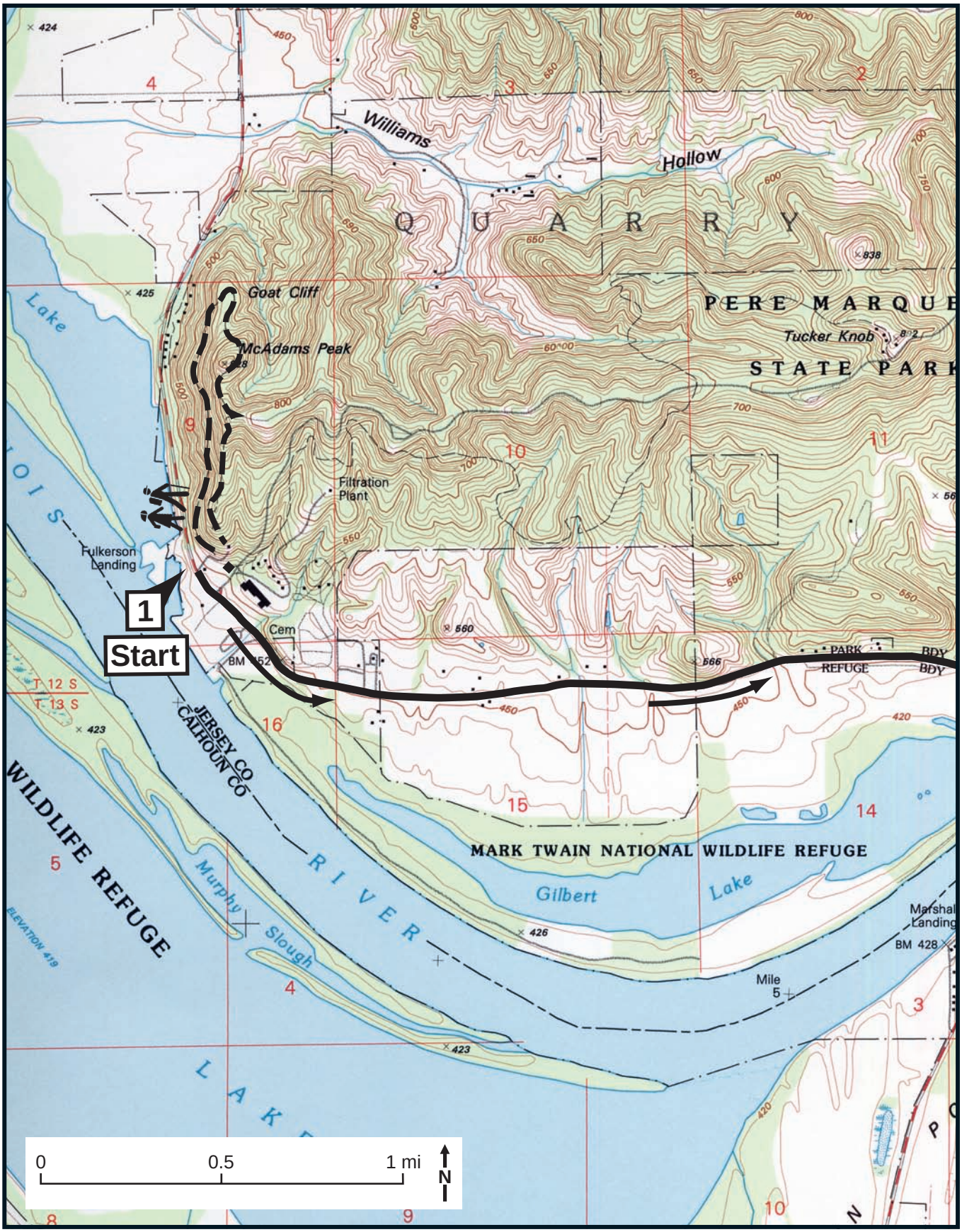
STOP 5. Kim Materials, Inc. Lohr Quarry (NW, SE, SE, Sec.5, T6N, R10W, 3rd P.M., Alton 7.5-minute Quadrangle, Madison County). We will discus both the stratigraphy and the mining operation at this quarry.

End of trip.

Turn around, and retrace field trip route back to U.S. Route 67.

TURN RIGHT onto U.S. Route 67 to Alton.

TURN LEFT onto U.S. Route 67 to Jerseyville and Illinois Route 16.


Williams
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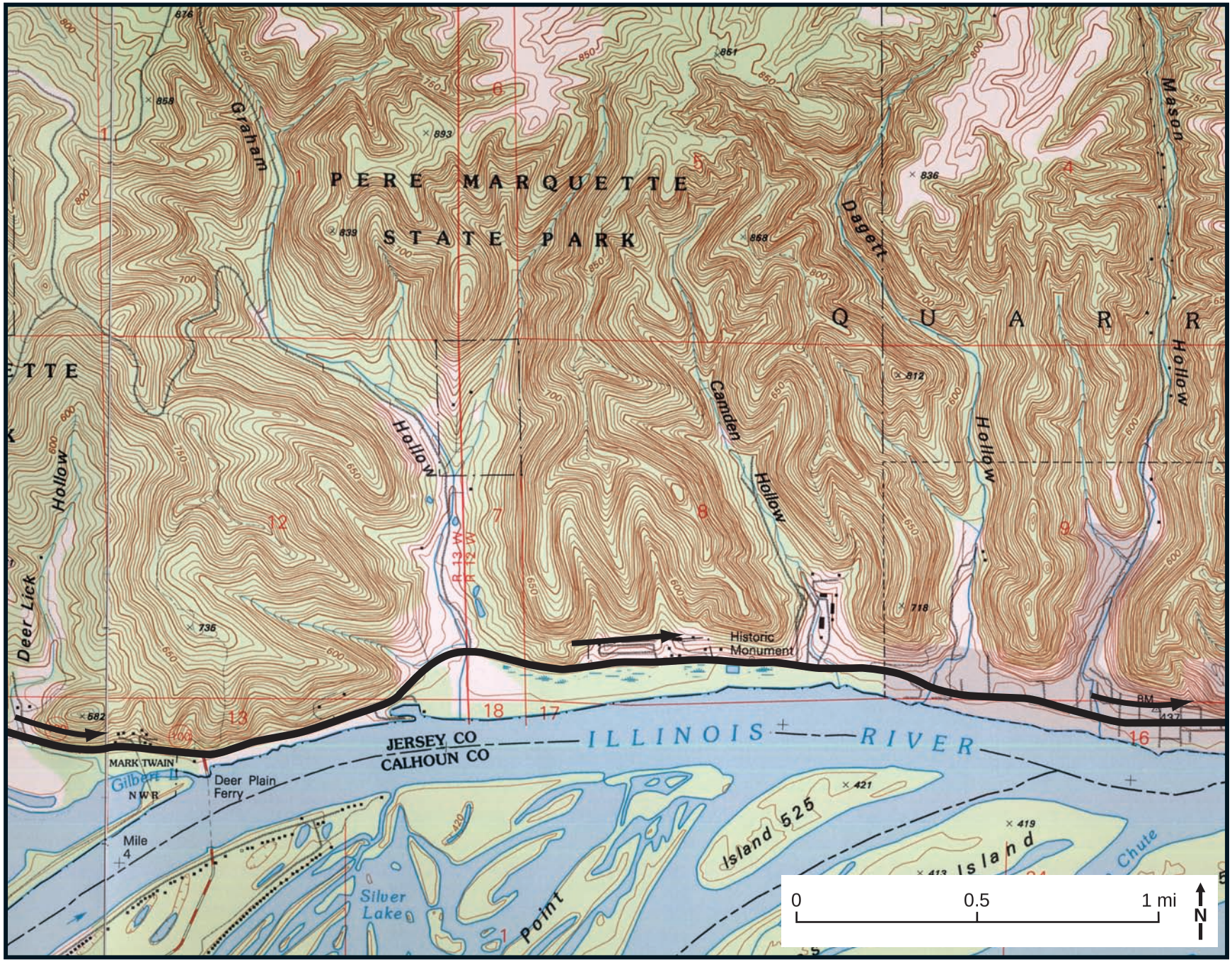
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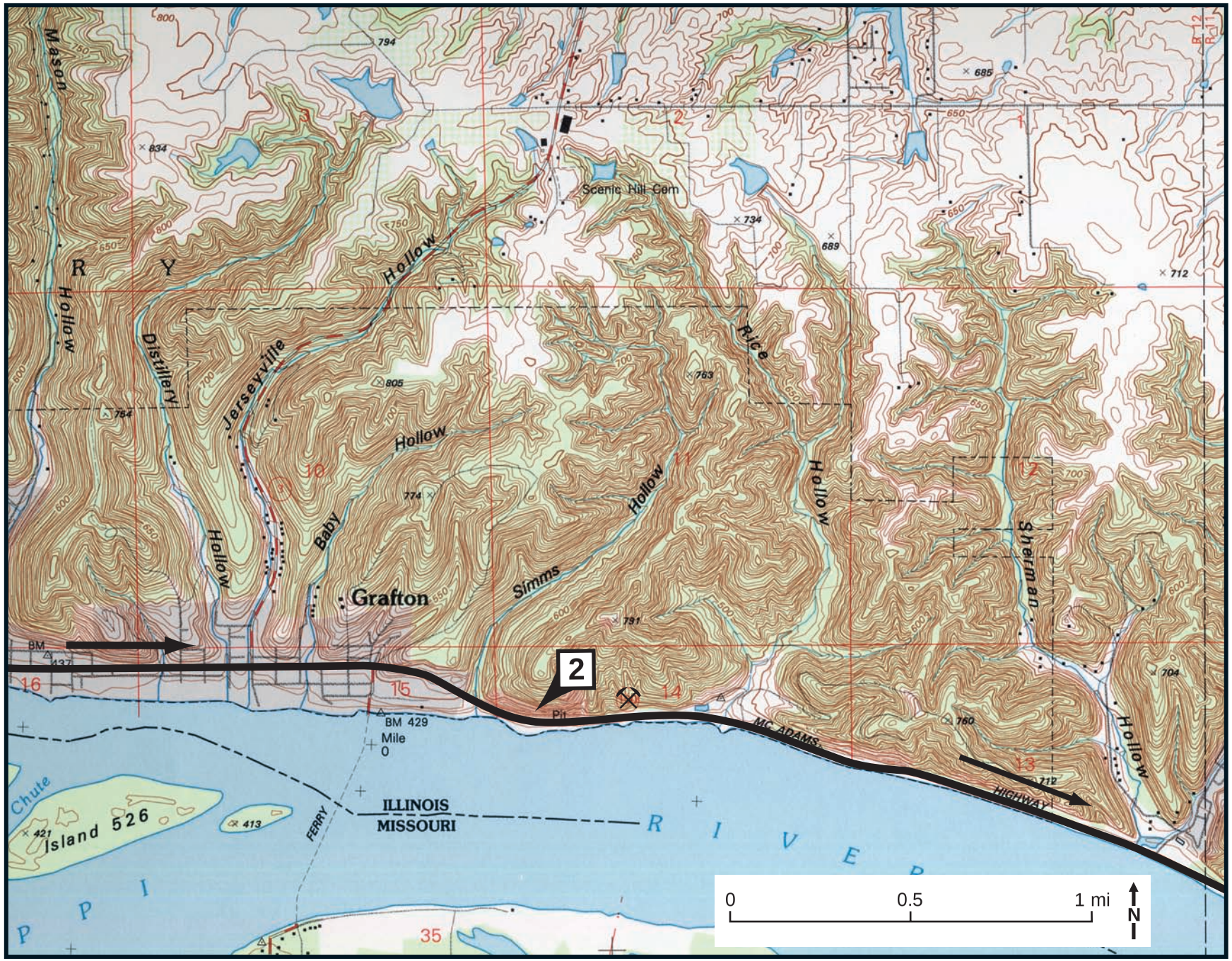
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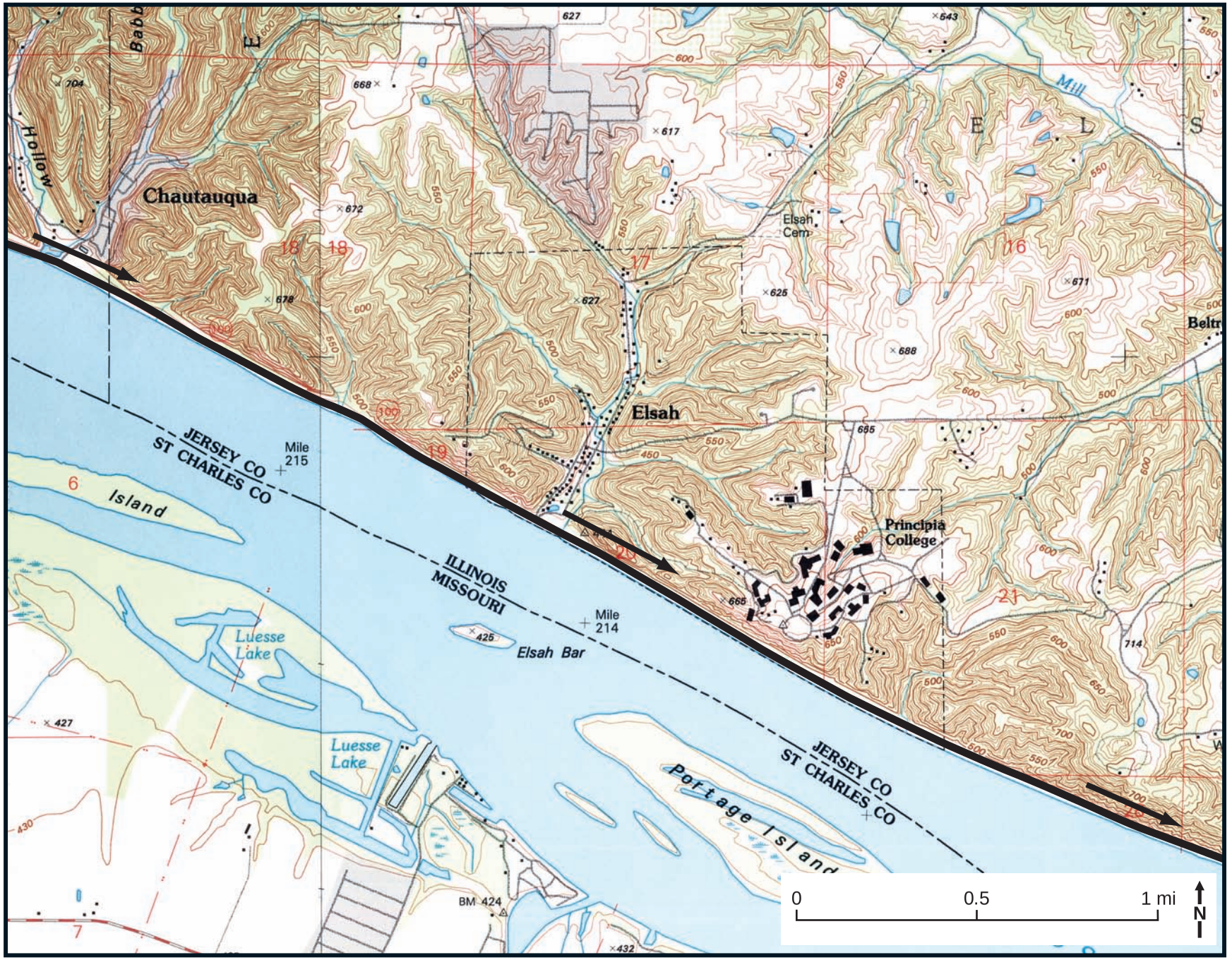
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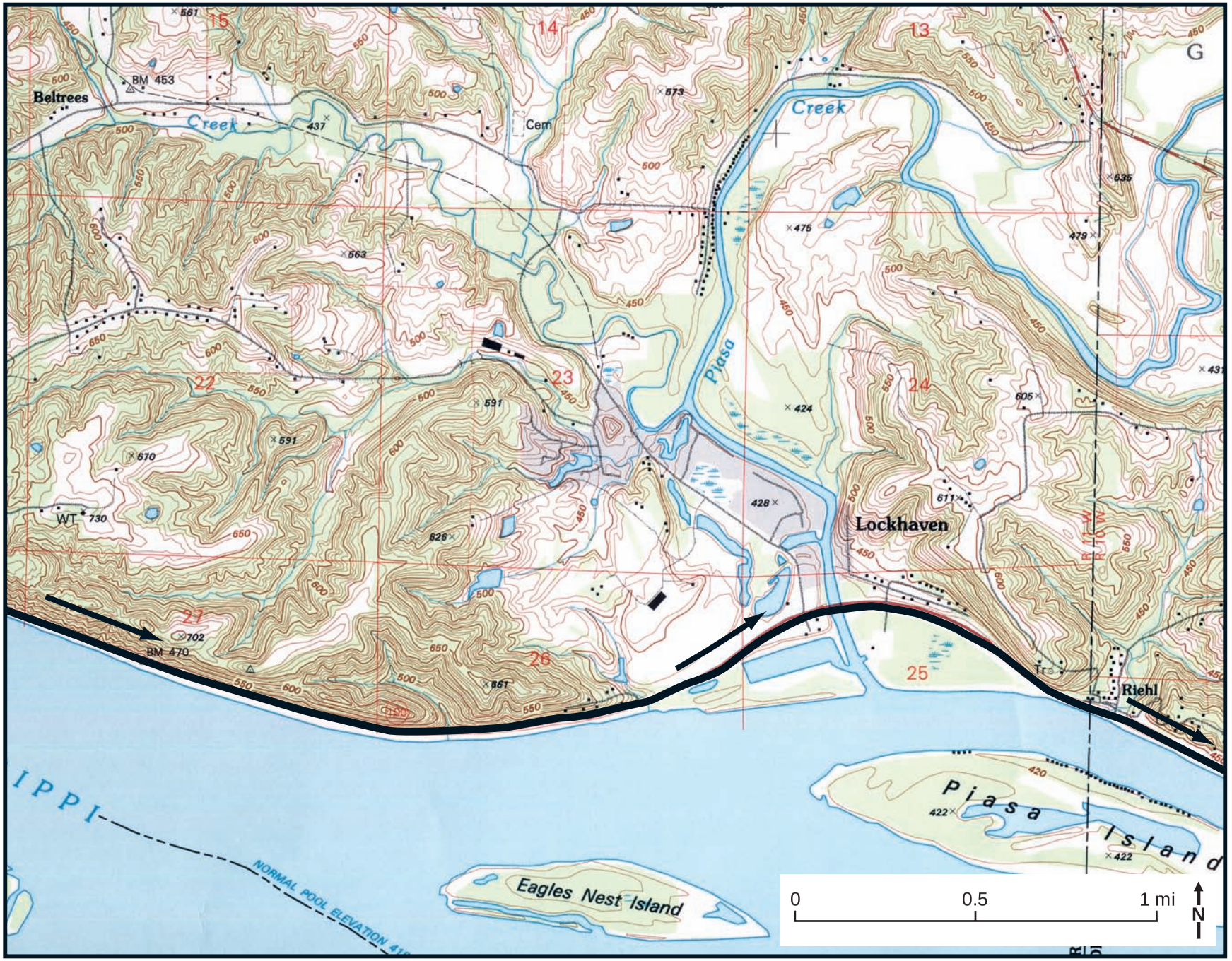
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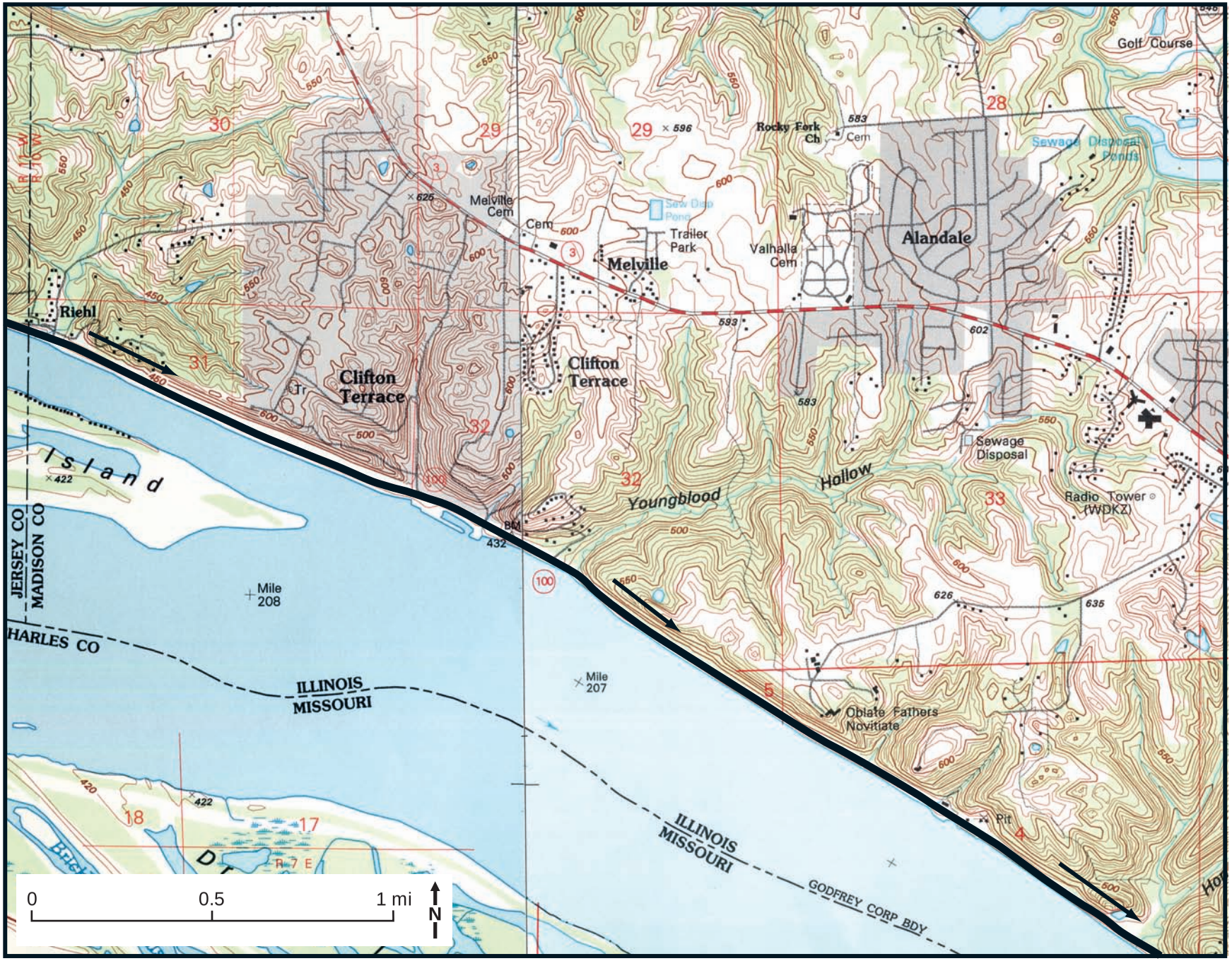
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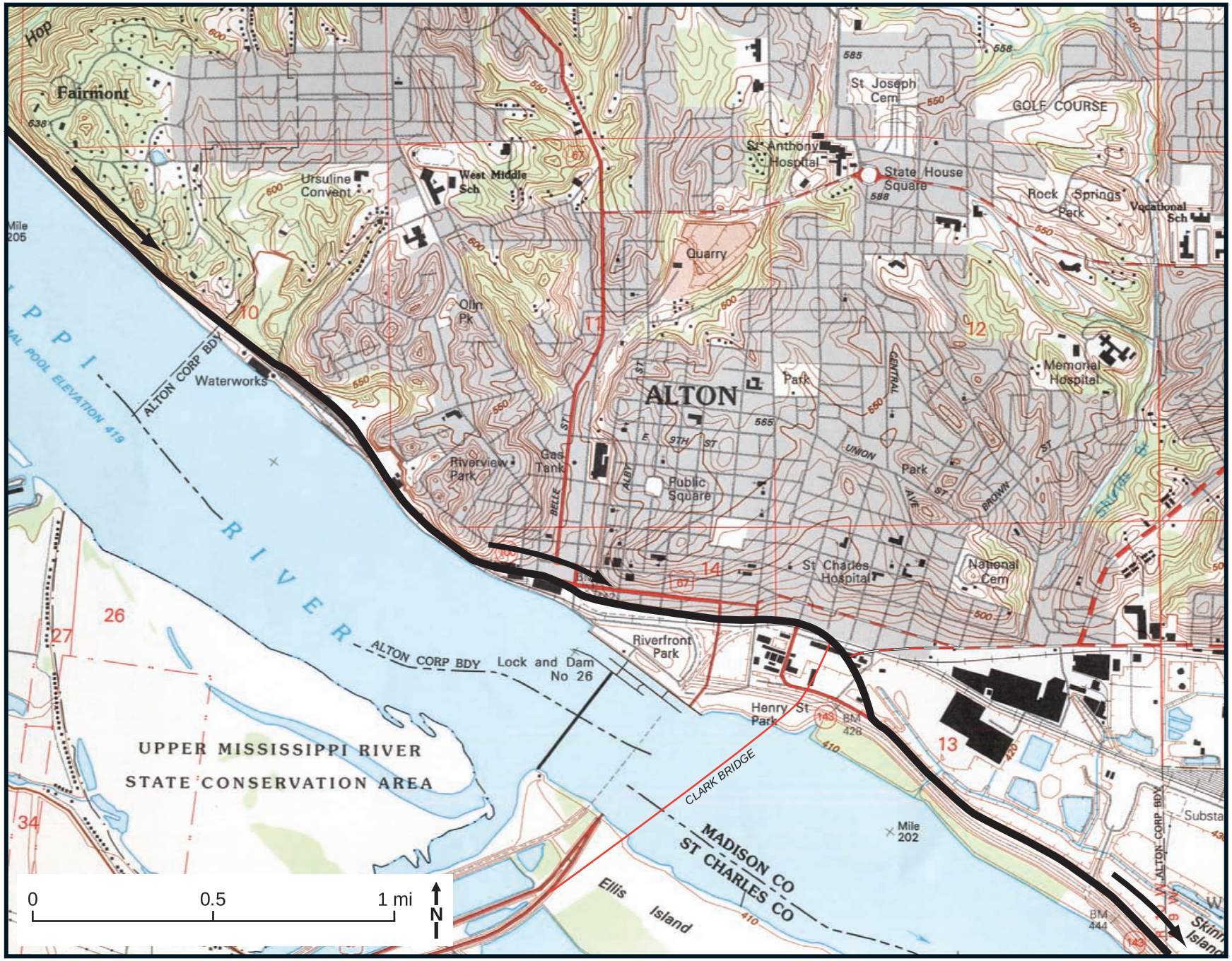
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Gas Tank
Public Square
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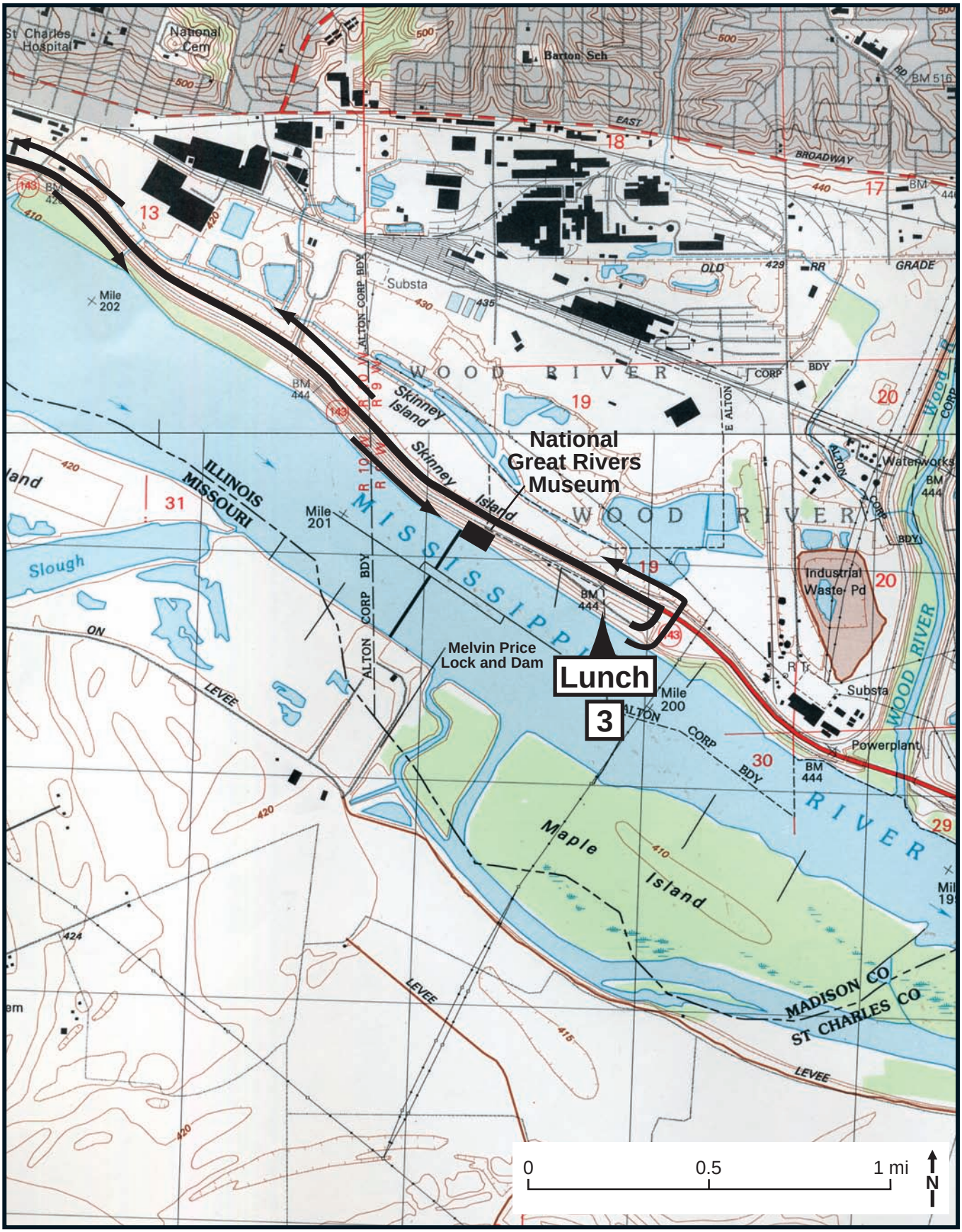
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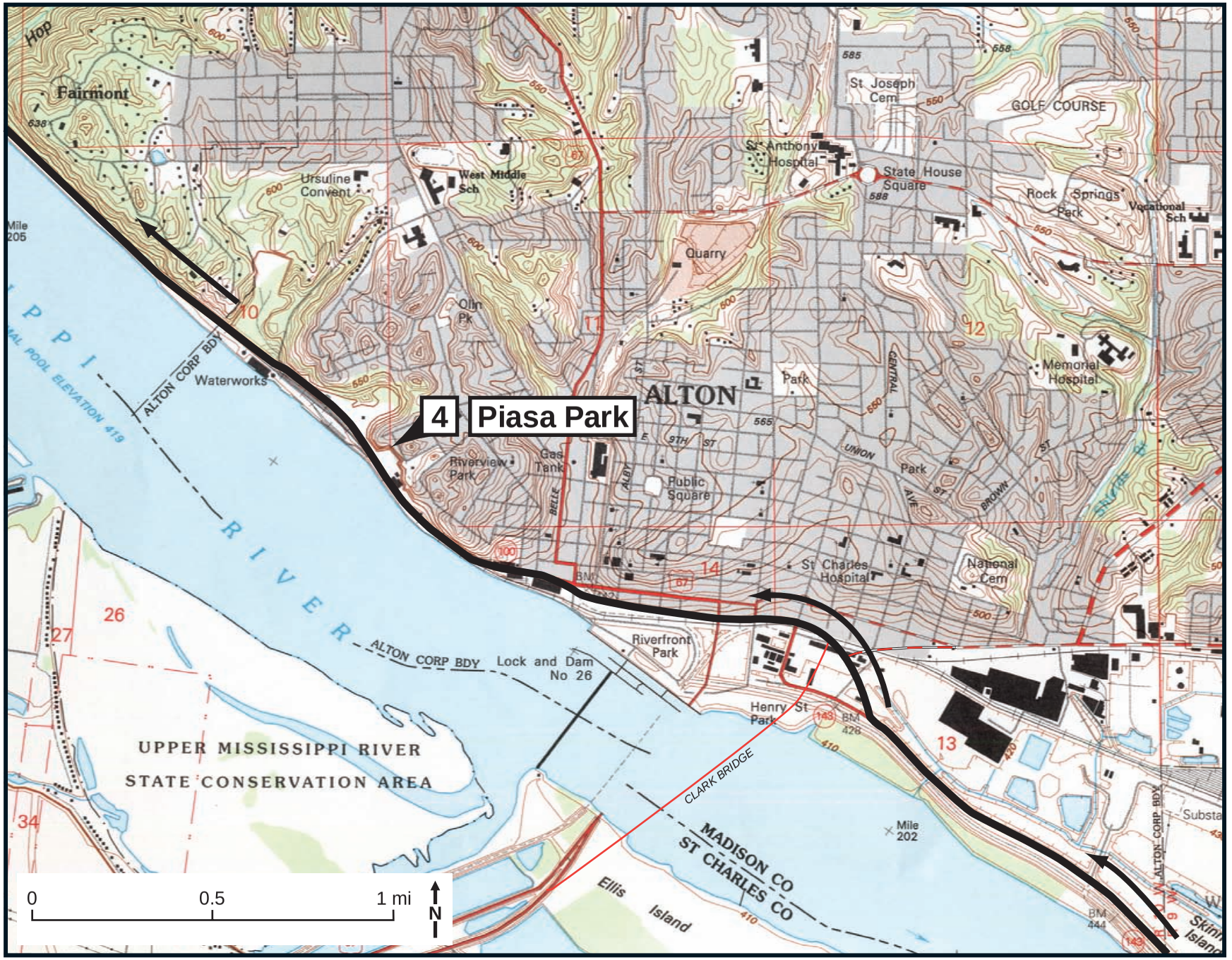
4 Piasa Park
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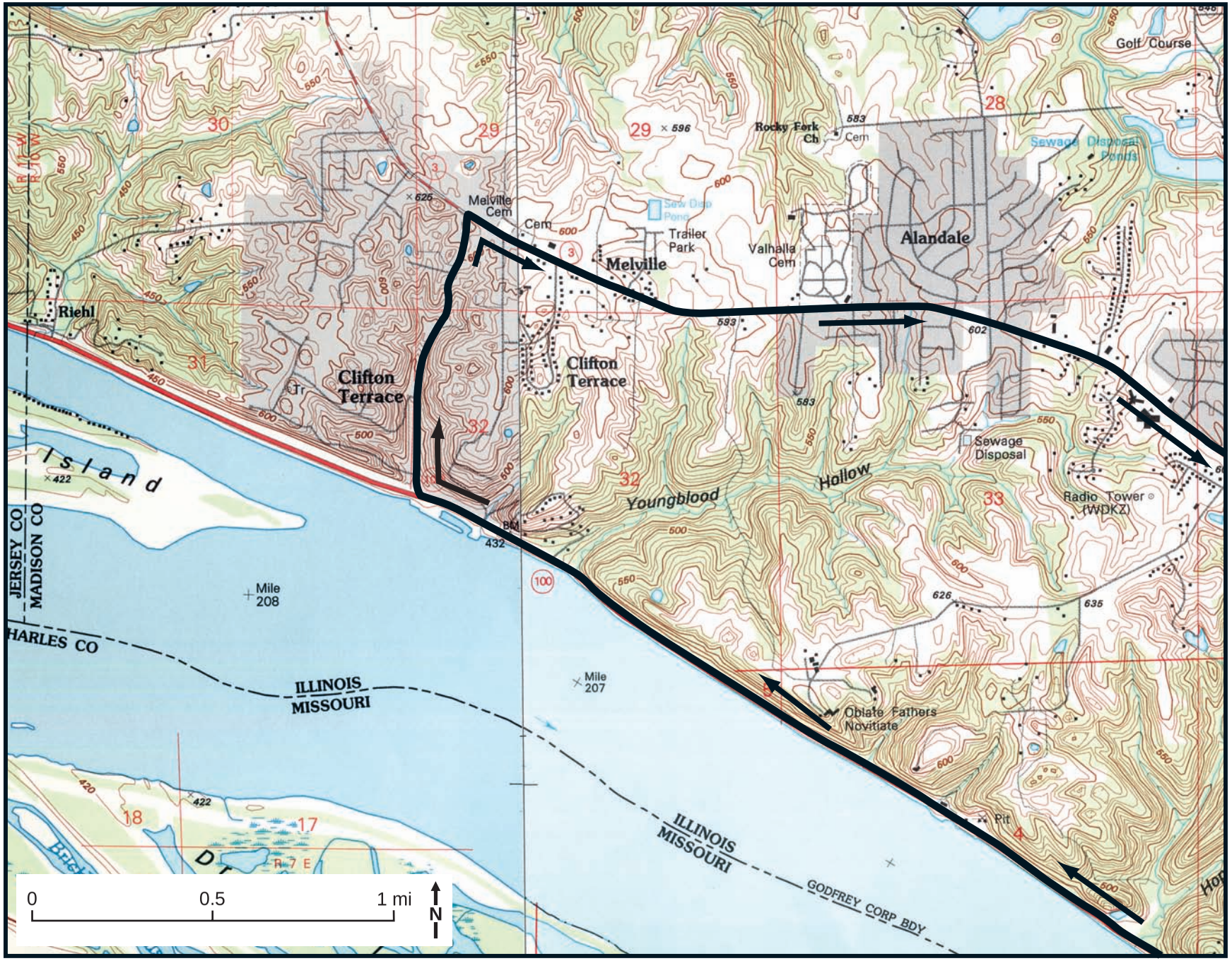
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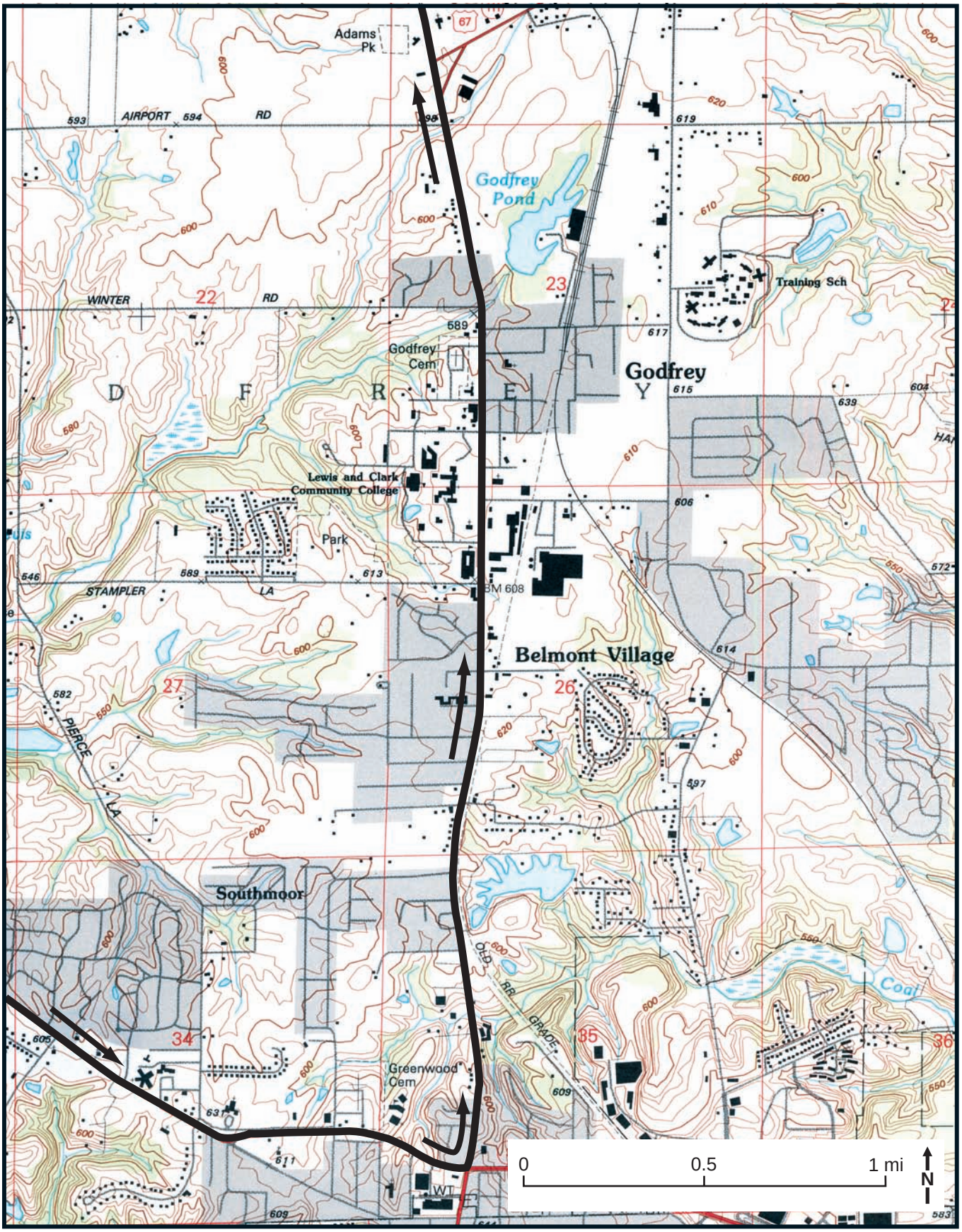
Adams Pk
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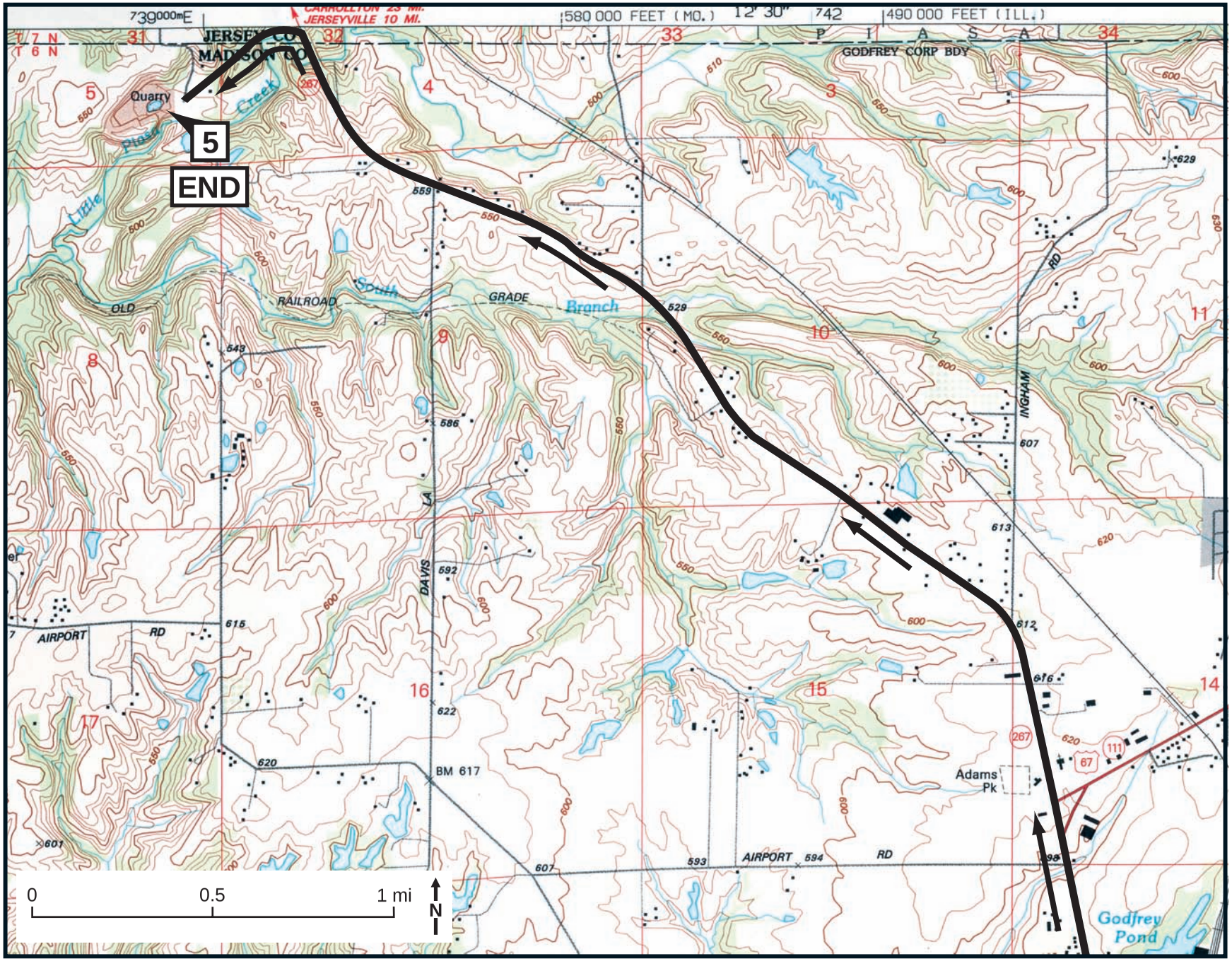
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Little Creek
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STOP DESCRIPTIONS

STOP 1. Goat Cliff Trail, Pere Marquette State Park (NE, SW, SE, SE, Sec. 9, T6N, R13W, 3rd P.M., Brussels 7.5-minute Quadrangle, Jersey County).

The trailhead for Goat Cliff Trail is located at the southwest corner of the Visitor Center parking lot. As a reminder, fossil collecting or hammering on state park outcrops is strictly prohibited. Many scenic geologic overlooks and rock exposures can be found along the roadways and trails in Pere Marquette State Park. Stop 1 descriptions have been subdivided into a series of substops, lettered A to L (see fig. 3 for locations).

Previous guidebooks don't totally agree in the identification and nomenclature applied to various locations along the trail. McAdams Peak is the high knoll (elevation 828 feet above sea level) that is locally known as the Goat Cliff Hill Prairie Overlook (Stop 1K, fig. 3). The McAdams Peak Shelter (Stop 1L, fig. 3) is along the same ridge but located farther south at a lower elevation (751 feet above sea level). Most of the guidebooks have confused the McAdams Peak Shelter with an older smaller stone shelter, located approximately 1,000 feet south of and lower than the McAdams Peak Shelter. This smaller stone shelter is located along a small side trail that branches off the Ridge Trail to the right.

The Goat Cliff Trail is the oldest in the park and was originally laid out in 1934 by members of the National Youth Administration, one of the Depression-era work programs. The woods in this area are an example of a young forest. When the park was created in 1931, the area below the bluffs was all hill prairie. The Civilian Conservation Corps (CCC) planted trees, such as sugar maple, which now dominate the area. Fire suppression policies also encouraged trees at the expense of hill prairie. Pawpaw, Kentucky coffeetree, and shagbark hickory are common in the area. Woodland wildflowers are easily found on the lower portion of the trail. Spring flowers along the trail include bluebells, red trillium, jack-in-the-pulpit, and spring beauty.

Cap au Grès Faulted Flexure: Setting the Stage

Strata in the west-central part of Illinois generally dip very slightly to the east and southeast into the Illinois Basin. In this area of the state, however, the Cap au Grès Faulted Flexure forms a steeply arched fold trending northwest-southeast (figs. 4 and 5). The southern limb of the Cap au Grès Faulted Flexure contains a narrow zone of deformed strata that dip southward as much as 90°. West of the park, the flexure crosses the Illinois River and extends across southern Calhoun County. Within and east of the park, the flexure trends eastward along the park's southern boundary and the southern edge of Jersey County. The flexure disappears near Alton in Madison County (fig. 4). Major tectonic movement along the flexure occurred from Late Mississippian to Early Pennsylvanian time, coinciding with mountain building along the eastern edge of North America. The most recent movement took place during the late Tertiary. Several faults with displacement of up to 450 feet occur along the flexure, exposing strata ranging in age from Ordovician to Mississippian.

The weak zone of deformation along the Cap au Grès Faulted Flexure has influenced the course of the Illinois and Mississippi Rivers, which seek the path of least resistance. Instead of separate rivers each flowing south-southeast, they join together in this area and flow east-southeast.

Stop 1A: Visitor Center

Pere Marquette's Visitor Center, opened in October of 1997, welcomes you with a three-dimensional map of the park, a gift shop and information center, a 270-gallon aquarium, and other displays and exhibits concerning the Illinois River, wildlife habitat, local history, and geology. The Visitor Center exhibits include collections of fossils, artifacts, plants, and animals from the park and surrounding area. Designed to complement the CCC-era lodge, the Visitor Center won the State of Illinois Thomas H. Madigan Award for Aesthetic Integration in 1998.

Stops 1B, 1C, and 1D: Pleistocene Deposits and Landforms

From the Visitor Center, you can look across to the lodge. Take note of the location of Stops 1B, 1C, and 1D (fig. 3).

Despite the fact that the Wisconsin Episode glacier did not extend into this area, glacially related deposits are present within the park. The river terraces were formed by glacial outwash deposited during retreat of the ice farther north. These terraces mark the former level of the Illinois River, which subsequently has been deepened by erosion. Pere Marquette Lodge is located on the Brussels Terrace (Stop 1B), which is composed

of interbedded sand and silt deposited in a lake that formed when glaciers blocked the ancestral Mississippi River in the vicinity of St. Louis. The Brussels Terrace slopes down about 40 feet to the Deer Plain Terrace (Stop 1C) at the level of the highway. The Deer Plain Terrace consists of younger glacial outwash composed of gravel, sand, and silt. The present "modern" river floodplain is located south of Illinois Route 100 (Stop 1D) and is about ten feet below the Deer Plain Terrace. The modern floodplain is largely inundated by backwater from the Melvin Price Locks and Dam at Alton.

Studies of the sedimentology and bathymetry (measuring water depth and charting bottom topography) of the Illinois and Mississippi Rivers were conducted in Pool 26 above the old lock and dam at Alton by the Illinois State Water Survey, the Illinois State Geological Survey, and the Illinois State Natural History Survey in the early 1980s. The Surveys were examining the effects of boat traffic on habitats of the rivers' ecosystem (Schnepper et al. 1981, Goodwin and Masters 1983).

The researchers found that, with few exceptions, bottom materials in the deeper parts of the channel, where it has been dredged for navigation, are mainly sand. In shallower parts of the channel bottom, silt is the major constituent of the sediments. Navigation traffic may contribute greatly to the relative lack of clay and silt in the deeper parts of the channels. Bottom-dwelling organisms such as clams, mussels, and worms (food source for fish, ducks, and early humans) have difficulty living in a sandy habitat.

The creation of wetlands along the valley bottoms is improving bottom habitats outside the navigation channels, which in turn will provide a better environment for fish and waterfowl. The U.S. Fish and Wildlife Services-Two Rivers National Wildlife Refuge oversees the Gilbert Lake Division and the Calhoun Division (Swan Lake), located along the east and west sides of the Illinois River valley, respectively. In addition, the Illinois Department of Natural Resources manages a number of wildlife management areas along the Illinois and Mississippi Rivers.

Stop 1E: St. Louis Limestone

The trail ascends a series of steps past a nearly complete section of the St. Louis Limestone. The following description starts from the northern end of the exposure. The basal breccia, striking 85° northwest and dipping 26° to the south, is composed mainly of angular fragments of fine-grained limestone that is slightly argillaceous and silty. Some fragments are partly rounded, and the deposit is called a conglomerate in some reports. The breccia is widely distributed from southeastern Iowa through western Illinois and northeastern Missouri. Overlying the breccia, about 70 feet of limestone are exposed along the trail. Apparently, the beds above the breccia exhibit some type of cyclical deposition. The upper top 10 feet of the section consists of very sandy coarsely oolitic limestone that may be the Ste. Genevieve Limestone, or it may represent a St. Louis-Ste. Genevieve transition zone. Even though these rocks are younger than any other rocks exposed in the park, they occur at a lower elevation than much older rocks to the north along Goat Cliff Trail because of folding and faulting within the flexure.

In a zone about 10 feet above the breccia, the corals *Lithostrotion proliferum* and *Lithostrotionella castelnaui* are common, along with bryozoans and brachiopods. *Spirifer littoni* and *Dictyoclostus tenuicostus* have been identified from beds immediately above the breccia, and *Linoproductus ovatus* is common in the uppermost oolitic beds.

Stop 1F: Salem Limestone and lower St. Louis Limestone

The Salem Limestone is represented in the section along this trail by a single long, narrow, rather steeply dipping outcrop of limestone on the promontory just south of the Warsaw re-entrant. The outcrop, which consists of rounded, broken fossil fragments and whole small fossils in a calcium carbonate matrix and containing many calcite-filled vugs, extends to the base of the bluff, where it includes some oolitic limestone. South of the Salem ridge is the more prominent exposure of the lower St. Louis Limestone (Stop 1E).

Stop 1G: Valley in Warsaw Shale

North of the Salem Limestone and south of the stone shelter house promontory is a deep re-entrant in the bluff that marks the position of the Warsaw Shale. The shale does not crop out, but its presence is indicated by Warsaw geodes, which are scattered over the hillside below the trail. The geodes here are not the type prized by collectors but are largely filled with calcite.

1H: Fault in Mississippian Rocks

A fault is located on the steep slope about 200 feet below the shelter house. This fault is not well exposed, but evidence of it is apparent when stratigraphic correlations are carefully applied.

Two different interpretations of this fault have been made, depending on the identification of the strata on the south side of the fault. The first interpretation (Rubey 1952) suggested that the fault is contained within an exposed chert breccia that cuts across the Burling-

ton and Meppen formations. Rubey calculated that this fault was downthrown on the south side; stratigraphic displacement is about 65 feet, and vertical throw is about 150 feet (fig. 3).

A second interpretation (Treworgy 1979) may be made if the formation on the downthrown side of the fault is identified as Keokuk Limestone. Such identification is based on the character of the chert breccia in and south of the fault zone. The brecciated chert has dolomitic mottling and banding, which is also a distinguishing feature of some 30 feet of extremely cherty brecciated limestone and dolomite in the lowermost part of the Keokuk of this area and northward. Furthermore, the proximity of Warsaw geodes on a nearby slope to the south (Stop 1G) causes some doubt as to whether there is enough space for both the Keokuk and part of the Burlington to be present between the Warsaw and the fault. If the second interpretation is accepted, the stratigraphic displacement on the fault is about 175 feet, and the vertical throw is 250 feet.

Stop 1I: Twin Springs and Silurian, Devonian, and Mississippian Formations

One of the most prominent and famous geologic exposures in this part of the State is the outcrop at Twin Springs (figs. 3 and 8). Rubey (1952) Collinson et al. (1954) and Mikulic and Kluessendorf (2003) have discussed the Silurian rocks here and their role in revealing the structural history of the area. Silurian and Devonian rocks are exposed in the outcrop at Twin Springs (Stop 1I; figs. 3 and 8). This exposure, which is also part of the flexure, is cut by at least five faults that are nearly perpendicular to the bedding. Silurian strata, which are at road level here, dip nearly 30° to the south. Upslope is a small fault block of Mississippian Hannibal Shale and Devonian Cedar Valley Limestone (faults 3 and 4 on fig. 8). The springs at Twin Springs probably flow from the Ordovician-Silurian contact, which is covered at this locality. Groundwater that flows through Silurian rocks is impeded from further downward migration by the underlying impermeable Upper Ordovician Maquoketa Shale. This same relationship is found throughout the Midwest at the Ordovician-Silurian contact, which commonly marks the site of springs where these rocks are exposed at the ground surface.

Three different Silurian formations are present at Twin Springs. The oldest, the Bowling Green Dolomite (termed Edgewood in older publications), is poorly exposed at the north end of the outcrop. The contact between the Bowling Green and the overlying Kankakee Dolomite is not well exposed here. In contrast, most of the Kankakee and overlying basal Joliet Dolomite are well exposed in the main part of the outcrop. The contact between the Kankakee and Joliet is a prominent disconformity here and throughout the Midwest. The contact marks a time when a drop in Silurian sea level, accompanied by climatic and oceanic perturbations, resulted in major sedimentologic and biotic changes. The conodont *Pterospathodus amorphognathoides,* a biostratigraphically important microfossil, has been found in the basal Joliet at this locality.

Continuing north on Goat Cliff Trail, relatively horizontally bedded Silurian strata are prominent along Goat Cliff at a higher elevation than Twin Springs (fig. 3). The exposure at Goat Cliff is north of the flexure and relatively undisturbed, although the strata have been uplifted by tectonic movement. The basal portion of this cliff comprises Bowling Green Dolomite, which contains fossils such as brachiopods and rugose corals. Large blocks of Bowling Green have separated from the cliff and to various degrees have slid down the slope on the underlying soft Maquoketa Shale. A number of karst solution features, including small caves and enlargement of joint fractures, are present in the bluffs along Goat Cliff (fig. 9).

If you were to retrace the trail downhill, back past Twin Springs to the Visitor Center, using the Goat Cliff exposures as a starting point, the profound effects of the Cap au Grès Faulted Flexure could be observed. Following this path, the horizontally bedded Silurian strata at Goat Cliff dip abruptly and steeply downward to the south, as can be seen in the exposures at Twin Springs. The Silurian strata continue to dip steeply downward south of Twin Springs so that, at the location of the Mississippian outcrop, they are probably at a depth of 300 feet or more below the ground surface.

Stop 1J: Kimmswick Formation and Maquoketa Shale (Optional)

To visit the Kimmswick exposure, follow along the shoulder of Illinois Route 100. The oldest rocks exposed in Pere Marquette Park belong to the middle Ordovician Kimmswick Formation, which crops out in three small exposures along Illinois Route 100 at the base of the bluff. The formation is approximately 70 feet thick in the vicinity of the park, but only a few feet are visible at this location. The limestone is exceptionally pure and is grayish white. Upon weathering, the rock becomes quite rough-surfaced, allowing lichen to gain an easy foothold. The Kimmswick, on a fresh fracture, has a highly petroliferous odor. At Florissant, Missouri, located 18 miles to the southeast, the formation produces oil at a depth of 1,000 feet. The Waterloo and

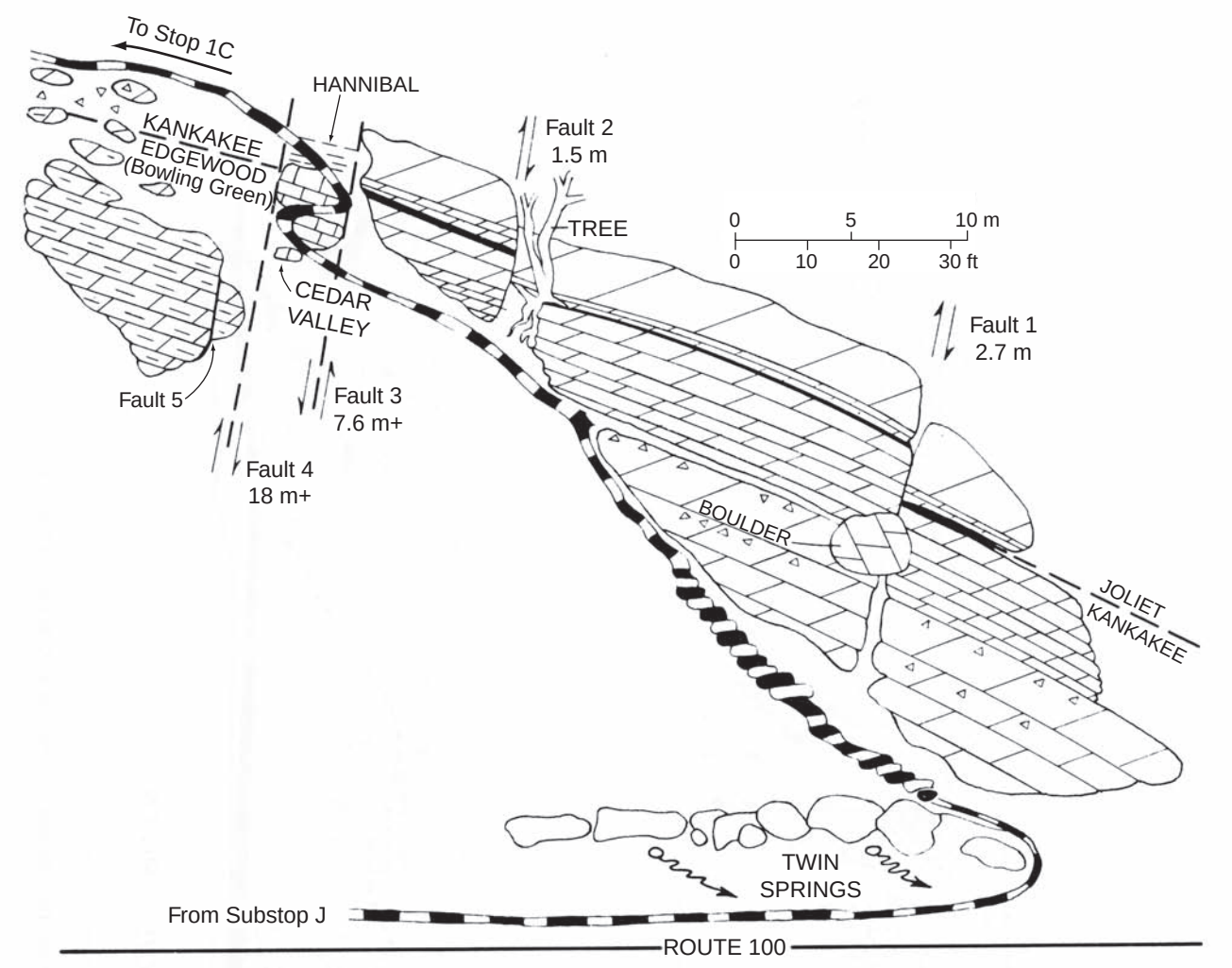

Figure 8 Diagramatic sketch of outcrop at Twin Springs, Pere Marquette State Park (Collinson et al. 1954).

Figure 9 Silurian strata along Goat Cliff Trail at Pere Marquette State Park. Note the karst solution features, caves, and enlargement of joint fractures present in the bluffs (photograph by W.T. Frankie).

Dupo Anticline oil production in Illinois, located just southeast of East St. Louis, is also from the Kimmswick Limestone.

Lying above the Kimmswick is the gray-green, weak, dolomitic, platy Maquoketa Shale. This shale weathers readily and gives rise to rather gentle, generally tree-covered slopes. The Maquoketa is unconformably overlain by an 80-foot section of Silurian dolomite exposed at Goat Cliff, which is unconformably overlain by the gray, silty Hannibal Shale.

From the Twin Springs outcrop, continuing north along the Goat Cliff Trail, you first come to an overlook located on the far northern end of the trail. This is a good place to view the farms within the Illinois River valley. Proceeding along Goat Cliff Trail, the trail loops around and heads south along the back side of the ridge line.

The trail cuts through several exposures of loess (fig. 10). Loess is windblown (aeolian) deposits of silt. Loess deposits were formed in areas bordering a glacier. Large volumes of meltwater flowed from the glacier's edges during the summer; the meltwater carried sediments that had been incorporated into glacial ice as it moved over bedrock. When the weather became colder, the glaciers stopped melting, exposing huge mud flats. Strong winds sorted the exposed sediments and swept the finer materials from the floodplain into huge clouds of dust. When the winds slowed, silt blanketed the area. The bluffs and hills in the Pere Marquette area are all covered with loess deposits.

A small trail off the main trail to the right leads to Goat Cliff Hill Prairie Overlook. Some confusion exists in the nomenclature used in previous guidebooks. McAdams Peak is the high knoll (elevation 828 feet above sea level) locally known as the Goat Cliff Hill Prairie. The McAdams Peak Shelter (Stop 1L, fig. 3) is along the same ridge, but located farther south at a lower elevation.

Figure 10 Exposure of loess along Goat Cliff Trail at Pere Marquette State Park (photograph by W.T. Frankie).

Stop 1K: Goat Cliff Hill Prairie Overlook

The following information was modified from the park trail guide.

This hill prairie is part of the McAdams Peak Hill Prairie Natural Area, a State-protected natural area that contains a variety of unique prairie plants and animals. At one time these hill prairies were fairly extensive, but the area's settlement and fire suppression have encouraged forest. Now these small remnants of prairie are all that remain.

In 1973, the Illinois Department of Conservation (Illinois Department of Natural Resources) began a prairie management program that includes periodically burning the prairie, cutting back woody plant growth, and controlling the invasion of non-native plants. These measures are designed to maintain and increase the size of these remaining prairie remnants.

Stop 1L: View of Landforms at McAdams Peak Shelter House

The McAdams Peak Shelter House is 791 feet above sea level and 372 feet above the Illinois River. The stone and log shelter was constructed by the CCC atop a Native American burial mound. From the marker at McAdams Peak, erected by the State of Illinois in 1934:

> The Illini Indians once inhabited these hills and the river valley. In 1892, 100 Indian skeletons were removed from this vicinity by Professor William McAdams for the Smithsonian Institute. He also obtained artifacts [that] are now [1934] exhibited at the Centennial Building, Springfield, and at the Monticello Seminary. Forty years [after the removal], his son John D. McAdams, of Alton, was instrumental in acquiring this property for a state park.

William McAdams, Jr. was a famous local late nineteenth-century amateur naturalist who specialized in studying the local geology, paleontology, and archaeology of the region. He assisted many professional scientists with their research in the area, supplying them with specimens from his large collections. In 1892, he undertook extensive archeological excavations in this area of the park. McAdams Peak in Pere Marquette State Park is named for him. William's son, John, was a major proponent of constructing the Great River Road between Grafton and Alton. The highway was built and named the McAdams Parkway in his honor.

The shelter house, built of local Silurian dolomite, looks over three prominent bodies of water:

> The nearest is Stump Lake, which was once bottomland forest. In the late 1930s, the forest was removed by the CCC prior to the construction of Alton Lock and Dam No. 26. It was feared that, once the forest was flooded, dead trees would float down the river and possibly choke the new dam. Currently, Stump Lake is partially drained during the summer to promote the growth of moist soil plants that attract many types of birds. Beyond Stump Lake is the main channel of the Illinois River and Six Mile Island, so named because it is six miles north of the confluence of the Mississippi River and the Illinois River at Grafton. Farther away is Swan Lake, which is part of the Two Rivers National Wildlife Refuge. Beyond Swan Lake is Calhoun County, and, on a clear day, the grain elevators at Hardin can be seen.

(http://greatriverroad.com/Pere/trGoat.htm)

From the shelter house, you can look directly west across the valley of the Illinois River toward the bedrock-controlled ridge that forms Calhoun County. The crest of this ridge rises over 400 feet above the Illinois River and separates it from the Mississippi River valley farther west. On the far side of the river, the Deer Plain Terrace of late Wisconsin age makes a low apron, about 1 mile wide, that slopes gently (15 to 20 feet per mile) away from the base of the bluffs. Above this terrace lies the Brussels Terrace of lllinoian age; it can be seen clearly in the middle of the large valley almost directly opposite. The valley, Greenbay Hollow, developed in the crest of the Cap au Grès Faulted Flexure. About 1 mile north of Greenbay Hollow, nestled at the base of the first bold cliffs your eyes encounter, is the village of Meppen for which the Mississippian Meppen Limestone is named. The steeply dipping beds of the Cap au Grès Faulted Flexure, on which we're standing, cross the valley and transect the opposite bluffs in the small conical hill on the left (south) side of Greenbay Hollow. From this point, the upland surface of Calhoun County north of the Cap au Grès Faulted Flexure is about 175 feet higher than on the south side.

Hill prairies once dominated the land leading to the bluff tops at Pere Marquette State Park, and fire was a friend to this ecosystem. Trees and shrubs are vulnerable to fire because they have living tissue above ground; most prairie plants are deeply rooted perennials that go dormant in the autumn and winter months, leaving only dead, extremely flammable tops. Fires would kill encroaching trees and other woody growth and eliminate the accumulation of dead leaves and stems of prairie plants, thereby helping the prairies to flourish.

Fires occur naturally with events such as a lightning strike and can also be caused by humans. Native Americans commonly used the "ring fire" hunting technique, setting the prairie ablaze and driving their prey into areas where hunters would be waiting. With the arrival of early American settlers, prairie fires were discouraged because they were seen as a threat to farms and livestock. The prairie began to disappear as most of Illinois was cultivated into farmland. Although Illinois is known as "The Prairie State," less than 0.01% of the state's original 21 million acres of prairie remains.

When Pere Marquette State Park was formed in the 1930s, a large area of prairie stretched from the Illinois River to the crests of the bluffs. Fire suppression policies were the norm for park services until recently, and this policy allowed trees and shrubs to take over. Before the formation of the park, the Ravine Trail terrain would have been mostly hill prairie instead of the young forest that currently exists. There have been efforts recently to restore some of the area to its original form. In April 2002, the park conducted a controlled burn in the area where the Ravine and Hickory Trails meet. Maintenance of this prairie area will give visitors an opportunity to experience a piece of Illinois' past.

The Goat Cliff Trail, at McAdams Peak Shelter, connects with the Ridge Trail, Ravine Trail, and Hickory Trail. Follow the Ridge Trail back to the Visitor Center.

STOP 2. Keller Quarry, Grafton Visitor Center (SE, NW, NW, Sec.14, T6N, R12W, 3rd P.M., Grafton 7.5-minute Quadrangle, Jersey County). On the day of the field trip, follow the caravan to the large gravel parking lot.

In addition to information on Keller Quarry, sections are included on the settlement and history of Grafton, a historical perspective on the Grafton Quarry, and background information on the significance of the Grafton trilobites, taken from Mikulic and Kluessendorf (1999, 2000, 2002).

Settlement of Grafton

Grafton is one of the oldest communities in this part of the state and one whose destiny has been controlled by geology. At the beginning of the nineteenth century, its location at the junction of the Illinois and Mississippi

Rivers was probably considered one of the most promising settlement spots along a burgeoning water-transportation network. With roads almost nonexistent at the time, rivers offered the only economical way to move materials and people over great distances. In particular, the Illinois River was becoming a major route connecting the rapidly developing regions of northern Illinois with St. Louis, then the most important city in the West. Discussion at the time of constructing a canal to connect Lake Michigan with the Illinois River and Mississippi River certainly suggested that Grafton would eventually become a prime location along one of the most important transportation networks in the nation.

In addition to its location at the confluence of two major rivers, Grafton possessed the right combination of features for a river port. Grafton was located at one of the few places in the area where the bluffs are located far enough back from the riverbank to provide space for a community to develop, but close enough to the bluffs to offer some high ground. More important, the concentration and size of the hollows that dissect the river bluffs at Grafton provided more high ground to build on compared with other areas. Confined to a limited area between the river bluff on the north and riverbank on the south, Grafton developed into a linear community. Unfortunately, the "high ground" at Grafton has not been high enough to avoid all large floods, and, every couple of decades, much of the community is underwater,

During its early settlement, Grafton was found to possess another geological feature that was to play a major role in its development. The steep bluffs lining the Illinois and Mississippi Rivers were an obvious source of lime and building stone needed by pioneer settlers. In the early 1800s, it was discovered that the bluffs at Alton were composed of limestone that made a high-quality lime when burned. More important, however, a small area around Grafton was found to contain beds of dolomite that produced an excellent building stone. This stone was very well bedded and easily quarried into large blocks. Found in outcrops all over town, the stone was readily available to anyone needing stone to erect a home or business.

Exactly when and by whom quarrying was started at Grafton has not been recorded, although 1836 is the date commonly cited. The first stone quarrying was probably not undertaken for commercial reasons, but for individual building needs. Several buildings constructed around 1840, which represent this early period of the town's stone industry, still survive in Grafton. Grafton quarries were mentioned in 1848 by the German Henry Lewis in his travels along the Mississippi River, indicating their early importance to the community. Furthermore, four stonemasons are listed in the 1850 census of Grafton, a very large number for such a small community unless commercial quarrying was under way. Grafton itself was not likely to have generated enough demand at this time, so some stone probably was being shipped to other towns. The late 1850s mark the true beginning of the Grafton stone industry, when Silas Farrington and John Loler founded the Grafton Stone Works, which was established to quarry and ship building stone to the lucrative St. Louis market.

Throughout the late nineteenth century, stone was the major business enterprise in Grafton. Hundreds of workers labored in the quarries to produce high-quality building stone. Very little of the stone was actually used in Grafton, and most of the companies located their main sales offices in St. Louis. Most of the major building projects in St. Louis utilized Grafton building stone, in some cases for facing, but, more typically, for load-bearing foundations. Prominent examples are the Eads Bridge, the first bridge across the Mississippi in the area, and the original Lindell Hotel, at one time the largest hotel in the nation. With the advent of poured concrete and internal steel supports in large buildings, the need for foundation stone had largely disappeared by 1900. After that, the Grafton stone industry continued to supply riprap for river construction and, to a lesser extent, building stone and crushed stone. The last quarry at Grafton closed in the late 1970s.

Little geologic study of the Silurian rocks was undertaken while the quarries were operating. The old quarry walls are now largely inaccessible and too dangerous to examine. Past core drilling has indicated that the Silurian rocks are about 130 feet thick near the old quarries on the east side of Grafton. Outcrop studies have suggested that these rocks thin toward the west because of erosional truncation of the Silurian rocks prior to deposition of the Devonian strata.

Grafton Quarry Company

The abandoned Grafton Quarry Company quarry, located west of the Visitor Center, is on private property and should not be entered without the owner's permission. The high quarry walls are extremely dangerous and should not be approached under any circumstance. Illinois Route 100 runs across the old quarry floor of the Grafton Quarry Company here. The docks and loading derricks that are illustrated in the 1872 lithograph of the quarry (then the Grafton Stone & Transportation Company; fig. 11) formerly were located south of the present highway. To the north, the old main working face of the quarry can be seen.

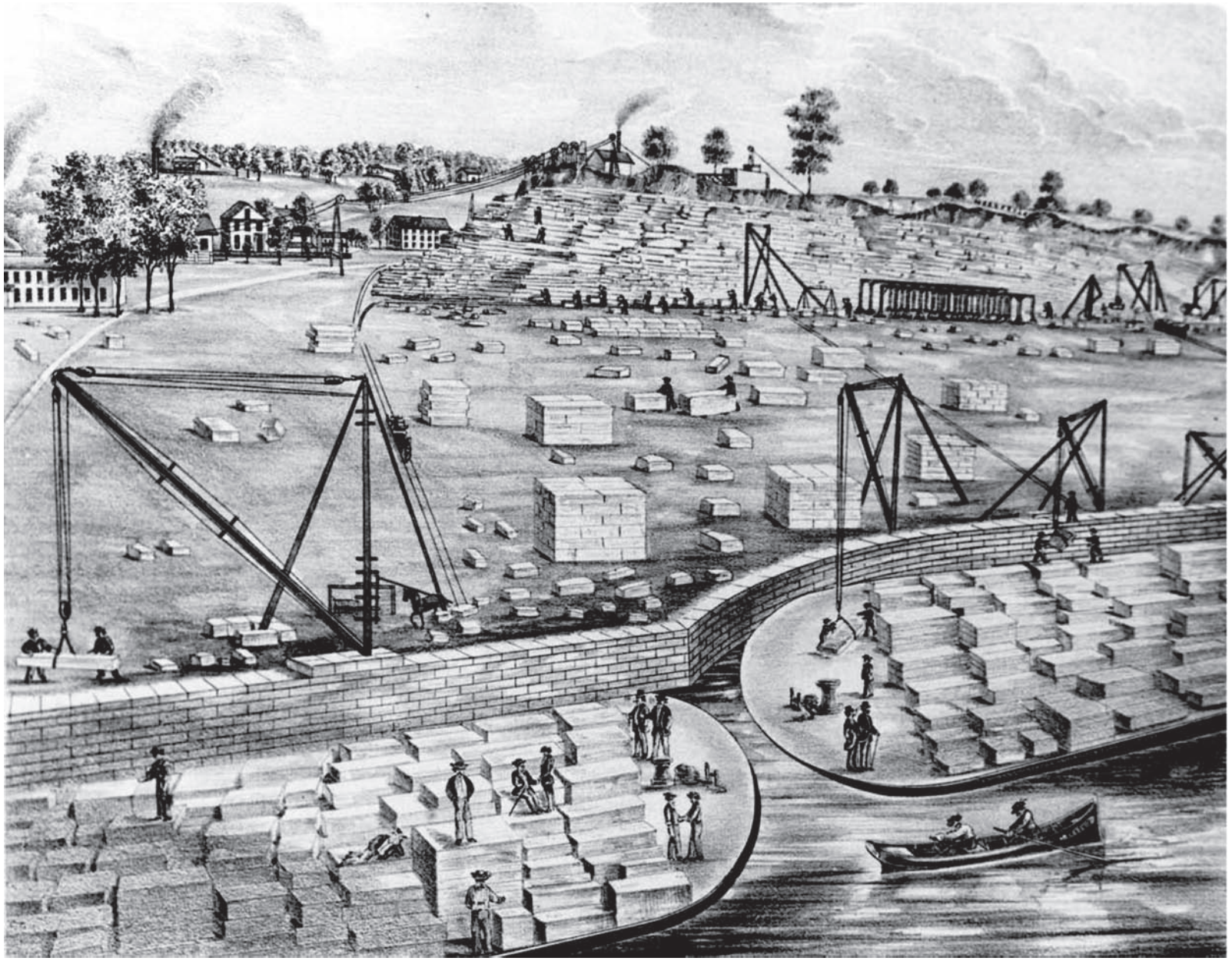

Figure 11 An 1872 lithograph of the Grafton Stone & Transportation Company quarry at Grafton, Illinois (Mikulic and Kluessendorf 2000). Original lithograph from 1872 Jersey County Atlas.

This quarry pit was the source for most of the Grafton building stone produced during the late nineteenth century. It is not known when the quarry first opened; however, in the late 1850s, Silas Farrington and John Loler operated the site as the Grafton Stone Works. In 1868, Farrington, Loler, William Allen, and Giles Filley ran the quarry as part of the Grafton Stone & Transportation Company, supplying stone for the Eads Bridge in St. Louis. Around 1875, the company closed because of financial difficulty, and the Grafton Quarry Company was incorporated to operate the quarry here. Primary owners of this company were J. Black, J.S. Roper, Charles Brainerd, E. Meysenburg, and the Allen family. The Allen family, major landowners around Grafton, actually owned the quarry property. Brainerd was the on-site superintendent, and Black and Roper operated the St. Louis sales office. This company stayed in business until about 1920. Even though this was the largest quarry in Grafton, there was little activity at the site after World War I.

The old quarry face exposes the principal strata that were quarried for building stone and illustrates some of the operational problems. As much as ten feet of soft, shaly and sandy Middle Devonian limestone, unsuitable for building stone, occur at the top of the quarry wall (fig. 12). These Devonian rocks probably had been eroded away nearer to the river where the quarries first started. As the quarries worked into the bluff toward the north, however, workers encountered increasingly thick Devonian strata. This waste rock had to be removed to access the underlying Silurian building stone. In addition, increasingly thick deposits of loess, which also had to be removed, were present above the Devonian strata. At various times, the loess was excavated hydraulically, washed directly into the river, or used as fill along the Grafton riverfront. Beneath the Devonian strata is approximately 60 feet of well-bedded rock (unit E, fig. 12) that yielded all of the building stone quarried here. This rock was once referred to as the Joliet Formation or the Racine Formation. In reality, however, the rock is stratigraphically equivalent and lithologically similar to the Sugar Run Dolomite of northeastern Illinois. The even texture, hardness, and well-bedded nature of these strata all contributed to their successful use as building stone; however, the thick nature of some of these beds made them especially valuable as foundation stone.

Grafton Trilobites

Fossils have been as much a part of Grafton's heritage as its stone quarries. For more than 150 years, Grafton has been one of the most famous collecting sites for fossil trilobites (fig. 13) in the Midwest. Thousands of specimens have been found in the Silurian rocks here by amateur collectors, professional geologists, quarry workers, and the general public. Most major natural history museums in the United States and many in Europe have Grafton trilobites in their collections. In particular, this locality is famous for the abundance of complete specimens of the trilobite *Gravicalymene celebra* (fig. 13) found in the building-stone beds. Although more than 20 trilobite species are known from here, only *G. celebra* is commonly found complete, and it is the most conspicuous fossil in these rocks. In 1916, Percy Raymond of the Museum of Comparative Zoology at Harvard University named this widely distributed species from specimens collected at Grafton.

As early as the 1860s, Grafton quarry workers were selling *G. celebra* specimens to interested parties as a way to supplement their income. Worthen (1876) reported

> These quarries have afforded fragments of some half dozen species of Trilobites only one of which, however, is abundant. This is the common *Calymene blumenbachii* of which the quarrymen obtain a great many, which they sell for a trifling sum. They call them stone dogs, but their resemblance to a dog is not very apparent.

In 1906, G. K. Greene described the same Grafton enterprise stating, "the quarrymen and boys carry them about in their pockets and sell them to visitors as 'rock dogs' (dawgs)." Some traditions have a long life, and, in 1976, the last of the Grafton quarrymen still called specimens of *G. celebra* rock dogs, but they no longer sold them. A few local residents continue to use the name.

Another less common but conspicuous trilobite, *Bumastus graftonensis* (fig. 13), was named from a Grafton specimen by Meek and Worthen in 1870. Unfortunately, trilobites are difficult to find now that the quarries have been abandoned, and the main productive layers near the middle of the quarry wall are inaccessible.

Keller Quarry

The high walls in the abandoned Keller Quarry are extremely dangerous and should not be approached under any circumstance (fig. 14). The Keller Quarry was the last-operating quarry in the Grafton area. Its opening date is unrecorded; however, in 1895, the Grafton Dolomite Stone Company was incorporated to operate at this site. Around 1930, the quarry was purchased by the Keller Construction Company. During the 1940s, the quarry was operated by Paul Berg and, later, by the Passelacqua Brothers. It operated under the name Grafton Quarry from 1956 until the late 1970s. A new Visitor Center, operated by the Grafton Chamber of Commerce, recently has been built in the quarry. The stone used in this building was quarried out of state.

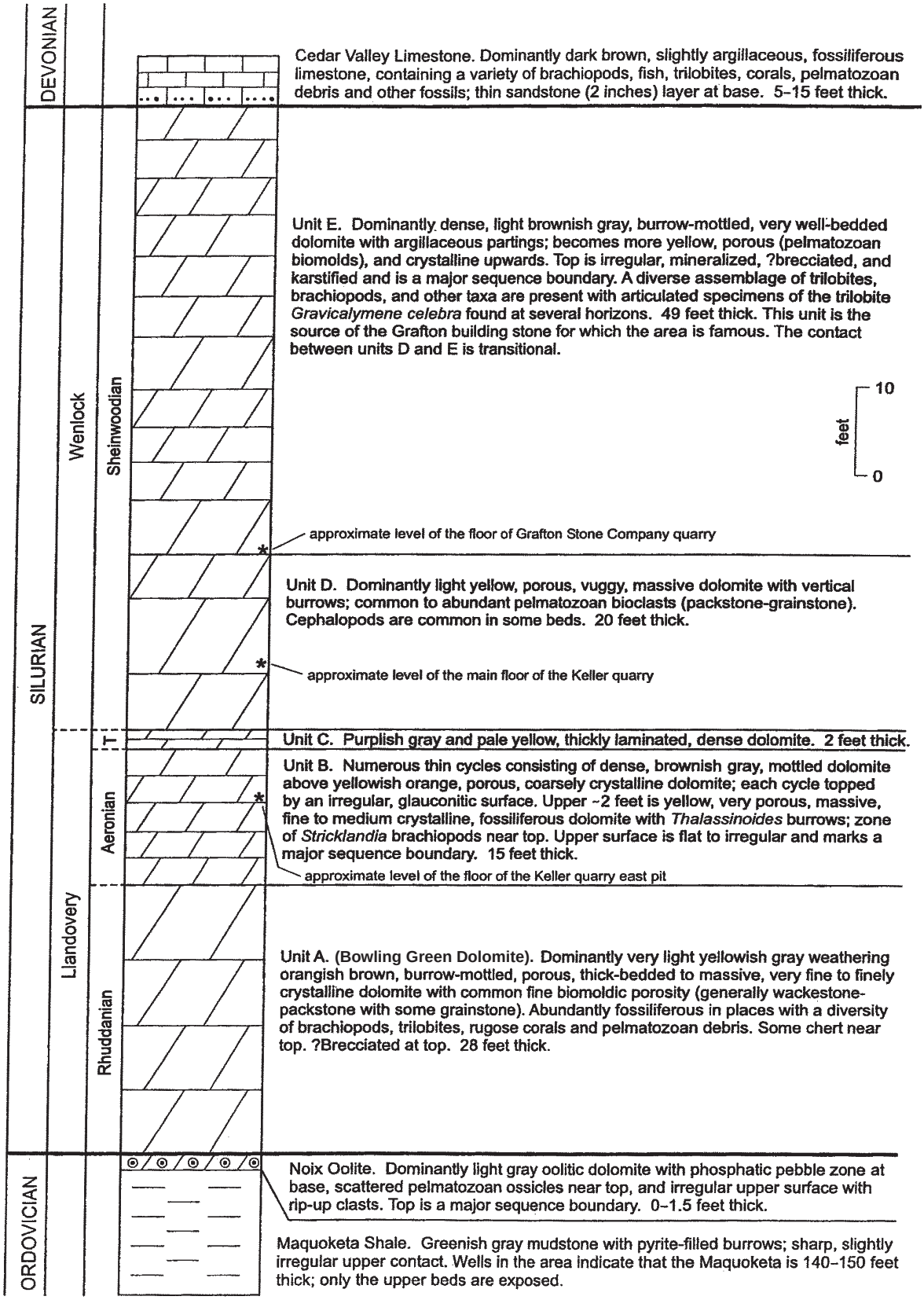

Figure 12 Stratigraphic section of Paleozoic rocks in the vicinity of Grafton quarries (Mikulic and Kluessendorf 2000). T, Telychian.

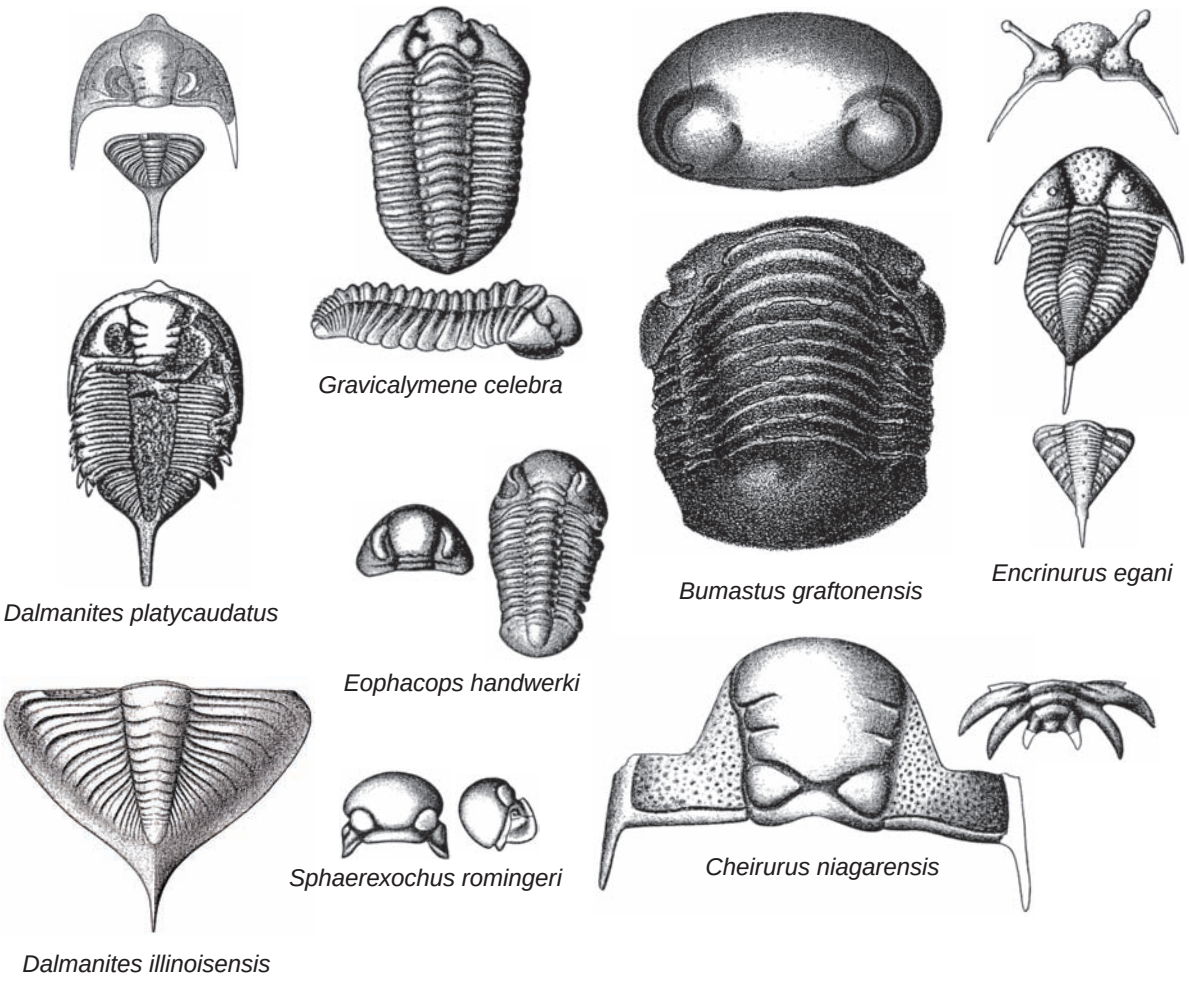

Figure 13 Typical Silurian trilobite fossils at Grafton, Illinois.

Figure 14 Abandoned Keller Quarry highwall at Grafton Visitor Center (photograph by W.T. Frankie).

The Romeo beds (unit D, fig. 12) exposed in the lower part of this quarry were used to make crushed stone and riprap, whereas building stone was obtained from the overlying well-bedded strata (unit E, fig. 12) equivalent to the Sugar Run Dolomite. Above the building stone is about ten feet of Devonian strata. The thick deposit of loess overlying the bedrock at Grafton is well exposed here. The loess, which was expensive to remove, is the primary reason the last quarry closed.

McAdams Parkway

Although the location of Grafton was ideal for river transportation, a lack of roads made it a relatively isolated river town throughout most of the nineteenth century. The surrounding high, steep riverbank bluffs made it very difficult to construct roads to any of the nearby communities, especially along the riverbank running east toward Alton. In 1882, the St. Louis, Jerseyville, and Springfield Railroad completed a route along the bluffs to Elsah. The railroad made it possible to ship Grafton stone to many more communities. By the late 1940s, the bluff line to Alton had been abandoned. In the 1950s, an effort to build a highway along the old railroad right-of-way was started at Alton. The highway reached Grafton in 1965, providing for the first time easy automobile access to the community from the Alton and St. Louis areas.

The McAdams Parkway (Illinois Route 100) runs along some of the most scenic river bluffs in Illinois and has recently been designated as part of the Meeting of the Great Rivers National Scenic Byway, America's newest scenic byway. The road is part of the much more extensive Great River Road, which runs the entire length of the Mississippi River. The Vadalabene Bike Trail is also located along the old Bluff Line right-of-way.

STOP 3. Lunch, National Great Rivers Museum, and the Melvin Price Locks and Dam (SW, SW, NW, Sec.19, T5N, R9W, 3rd P.M., Columbia Bottom 7.5-minute Quadrangle, Madison County).

National Great Rivers Museum

Each year millions of people travel to the Mississippi River to learn about its history and its impact on our nation. The National Great Rivers Museum at Melvin Price Locks and Dam (fig. 15) is dedicated to telling the story of the confluence of three great rivers—the Mississippi, the Missouri, and the Illinois—in a comprehensive and compelling way. Visitors learn about the rivers' historical and cultural significance; their ecological, transportation, and commercial importance; their power to inspire; and the natural forces that created and shape them to this day through the museum's more than 20 highly interactive and educational exhibits.

The National Great Rivers Museum opened in October 2003 and is one of 11 planned regional visitor centers operated by the U.S. Army Corps of Engineers. Located adjacent to the Melvin Price Locks and Dam, this 12,000-square-foot facility is the result of a collaboration of the Corps and the nonprofit Meeting of the Great Rivers Foundation.

Figure 15 Left photograph: Old Clark Bridge and old Mississippi River Lock and Dam No. 26 (modified from U.S. Army Corps of Engineers, Digital Visual Library photograph). Right: Mississippi River Melvin Price Locks and Dam No. 26 (under construction); note new Clark Bridge in the distance.

The natural ecosystem of the Mississippi River and human interaction with it is one of the major themes of the museum. A large model of the region's bluffs is in the center of the museum. Information is provided about the various plants and wildlife of the area. An aquarium displays the various species of fish that inhabit the Mississippi River. Also explained are the mechanics of the river, soil formation, and processes of erosion. Working models of the river help scientists make decisions affecting the river. Also explained are the causes of floods, with emphasis on the Great Flood of 1993, the methods the Corps of Engineers uses to fight these destructive acts of nature, and future strategies being developed to limit their impact.

Another theme is the human history along the Mississippi River, from the Mississippian culture near Cahokia to the advent of European settlers. The museum chronicles the different the types of river vessels used from canoes, keelboats, and steamboats to modern-day barges. The Pilot House simulator is based on software actually used to train river pilots at the Center for Maritime Education in Paducah, Kentucky. The software allows visitors to see what it is like to guide a 1,000-foot tow of barges under a bridge or through a lock.

Illinois Esplanade Park lies along the museum's entrance and has picnic facilities and bird-watching platforms. In the winter, the area is especially popular for watching bald eagles congregate below the locks and dam looking for easy food. The Confluence Bikeway runs by the complex and connects with Lock and Dam No. 27 in Granite City and the Lewis and Clark State Historic Site in Hartford to the south and Alton Riverfront and Pere Marquette State Park to the north.

Locks and Dam No. 26

The original lock and dam located near Alton, Illinois, on the upper Mississippi River was opened in 1938. Its largest lock was 600 feet long. The original lock and dam was located around River Mile 202.5, two miles upstream from the current Melvin Price Lock and Dam project. The early lock and dam experienced problems right from the start. The river quickly scoured the rock under the dam, creating large holes, which eventually became deeper than the depth of the wooden piles on which the dam rested, which led to settling of the dam walls and to large movements during high water. The only real solution to the problem at Lock and Dam No. 26 was replacement. The new Melvin Price Locks and Dam was started in 1978 and completed in 1994. The first lock opened in late 1989, and the old structure was removed in 1990.

Melvin Price Locks and Dam, named after Illinois Representative Charles Melvin Price, consists of a dam and two locks. The dam is located at River Mile 200, which is two miles downstream from the original Lock and Dam No. 26, near Alton, Illinois. The main lock is 1,200 feet long and 110 feet wide; the auxiliary lock is 600 feet long and 110 feet wide. The main lock has a vertical lift gate and a miter gate; the auxiliary lock has two miter gates. This structure is one of the few Mississippi River structures to have two locks. Its efficient design greatly speeds the locking process. Displays in the National Great Rivers Museum explain the structure and its engineering.

The dam is 1,160 feet long with 9 tainter gates, each 110 feet wide by 42 feet high. During the first year of its operation, 80 million tons of cargo passed through the locks and dam. River elevation upstream in the pool is 419 feet, and river elevation downstream (outflow) is 400 feet, with a water fall of 19 feet.

The U.S. Army Corps of Engineers-Rivers Project Office is responsible for the operation and maintenance of 5 dams, 7 locks, 300 miles of dikes, and revetment of the Mississippi from Cairo, Illinois, to Saverton, Missouri, and the lower 80 miles of the Illinois River covering nearly 110,000 acres of public lands and water for the authorized purpose of maintaining a nine-foot navigation channel. The Rivers Project Office recognizes and manages the multi-purpose use of these lands and waters, which include fish and wildlife management, recreation, flood control, hydropower, navigation, and water supply and quality. The Rivers Project Office is located at 301 Riverlands Way, West Alton, Missouri 63386 (Telephone: 888-899-2602 or 636-899-2600).

Security Awareness

As a federal facility of the Department of Defense, the museum and locks and dam must be vigilant in their observance of national security guidelines. Visitors need to be aware that security levels can change at anytime and can alter operating procedures at the museum and the lock. Please call ahead if you have any concerns or questions.

STOP 4. Piasa Park (SE, NE, SE, Sec.10, T5N, R10W, 3rd P.M., Alton 7.5-minute Quadrangle, Madison County). We will discuss the legend of the Piasa and present a historical overview of Alton's early quarrying and lime industry.

The relatively new Piasa Park is the current home of the Piasa Bird (also pronounced Pie′-a-saw) pictograph and a good location to view the local Mississippian rocks and discuss the local lime and stone industry. The park is at the western end of an extensively quarried portion of the bluff that runs east toward Alton. The bluffs from Piasa Park east to Lovers Leap in Alton are composed of Mississippian St. Louis Limestone and Ste. Genevieve Limestone, both of which are dominated by shallow-water marine carbonate sediments. In the past, these pure limestones were used primarily for making lime (fig. 16). At the west end of the Alton Bluff exposure, the upper part of the lower St. Louis is composed of highly brecciated limestone formed by dissolution of evaporites in a supratidal-intertidal depositional setting.

Stratigraphy and sedimentary features of the upper part of the St. Louis Limestone and the lower part of Ste. Genevieve Limestone are shown within the first mile of the Mississippi River bluff west of the Alton business district. Several small faults with throws from inches to about 3 feet and others with horizontal displacements in the order of a few tens of feet are also apparent (fig. 17). The bluffs include several types of faults and small karst solution features along some of the high-angle faults. Detailed information about the faults are beyond the scope of this guidebook but can be found elsewhere (Treworgy 1979, Devera and Denny 1999, 2000).

The exposure at Piasa Park is typical St. Louis Limestone: thin-bedded, fine-grained, and highly variable vertically but with little horizontal variation. Starting at the base of bluff, approximately eight cycles of deposition are apparent. Each cycle starts with relatively shaly limestone at the base; the partings between the thin limestone beds are prominent. The beds gradually thicken upward, and the shaly partings thin and become obscure. The change is commonly abrupt from the light-colored pure beds at the top of one cycle to the darker shaly beds at the base of the next cycle.

Structurally, this location is on the eastward extension of the Cap au Grès Faulted Flexure, here represented by a dip of 3° nearly due south. This southward dip separates the low east end of the Lincoln Anticline on the north from the Troy-Brussels Syncline on the south. As the northwest-southeast bluff line cuts the dip at an angle, the apparent dip is somewhat lower. The course of the Mississippi River upstream to Grafton follows the line of the Cap au Grès Faulted Flexure. As might be expected near the end of a major flexure, adjustment has involved minor faulting. At least four different varieties of minor faults are present in the bluffs.

Alton Lime Industry

The architecture, character, and development of Alton has been significantly affected by the geology of its setting. Its location on the Mississippi River system and its geomorphologic features are largely responsible for the location's development into an important nineteenth-century commercial center. Located between the confluence of the Mississippi and Missouri Rivers a short distance to the east and Grafton to the west (where the Illinois River joins the Mississippi River), Alton was sited at an excellent location to serve as an important river transportation center. Additionally, the community is located at the east end of the wall of high bluffs that form the north bank of the Mississippi River in Madison and Jersey Counties. At Alton, these bluffs begin to turn inland and are less prominent, which provided room for a large community and a gentle grade from the surrounding prairies down to the river. The geologic setting also provided an abundance of building materials that could be used locally or exported to other locations. Outcrops of Mississippian limestones are extensive in the area and were used during most of the nineteenth century to make both building stone and lime.

It was discovered early in the 1800s that Alton's limestones could be used to make some of the highest-quality lime in the region (fig. 16). Numerous quarries were opened along the bluffs at the edge of town, and kilns were erected to burn lime, most of which was shipped by boat to St. Louis and other sites as far south as New Orleans. Building stone was also produced from these strata for local use, and many examples of these limestone buildings can still be seen in the older parts of Alton. Because this stone could not be quarried in large blocks, however, Alton limestone never competed commercially with Grafton building stone in the St. Louis area. After the turn of the century, the market for lime decreased because of the increasing use of portland cement, which replaced lime used for mortar, and with the manufacture of concrete blocks. The local building stone industry also disappeared. The quarries continued

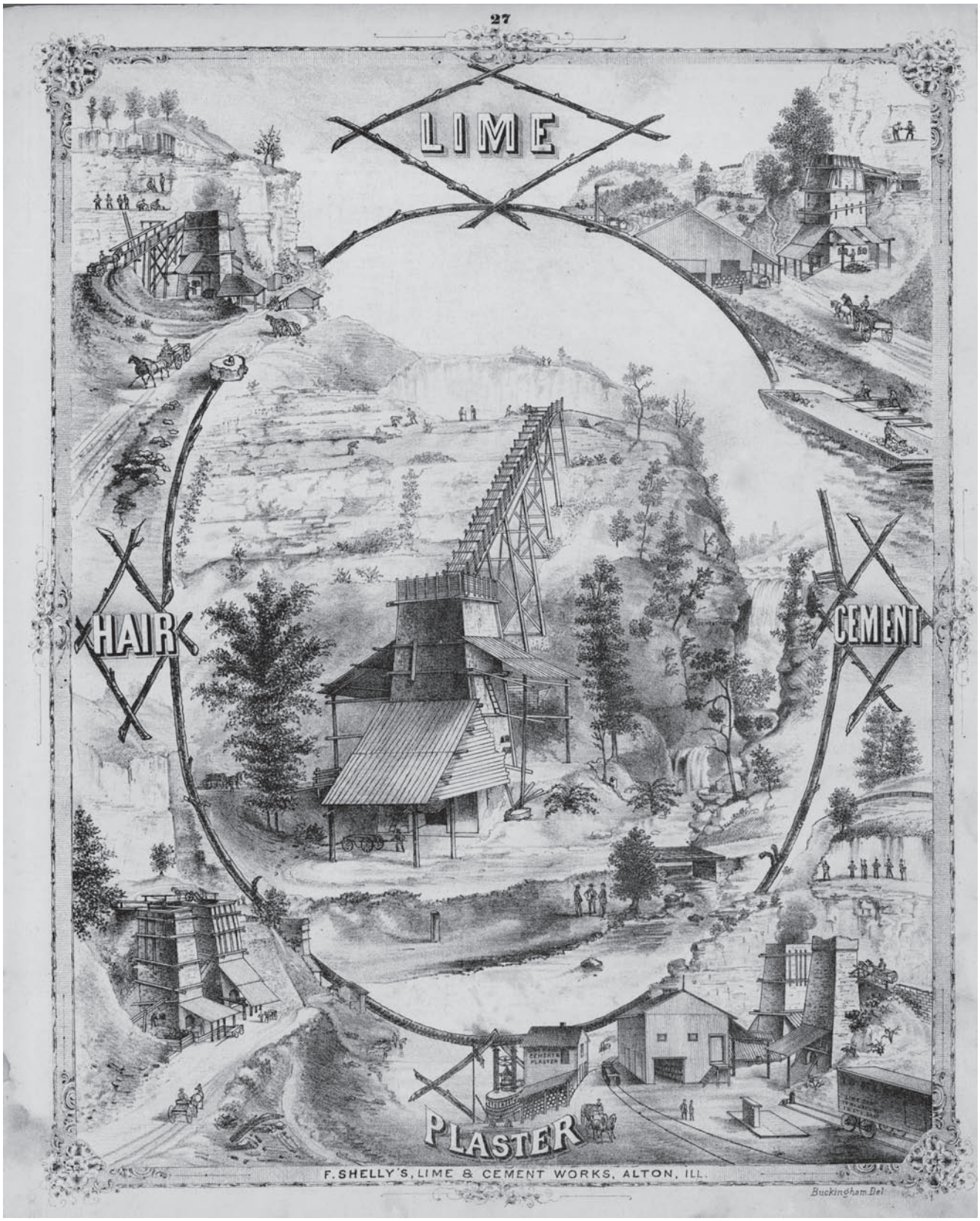

Figure 16 F. Shelly's Lime and Cement Works, Alton, Illinois (modified from original copy owned by D.G. Mikulic). Original lithograph from the 1873 Madison County Atlas.

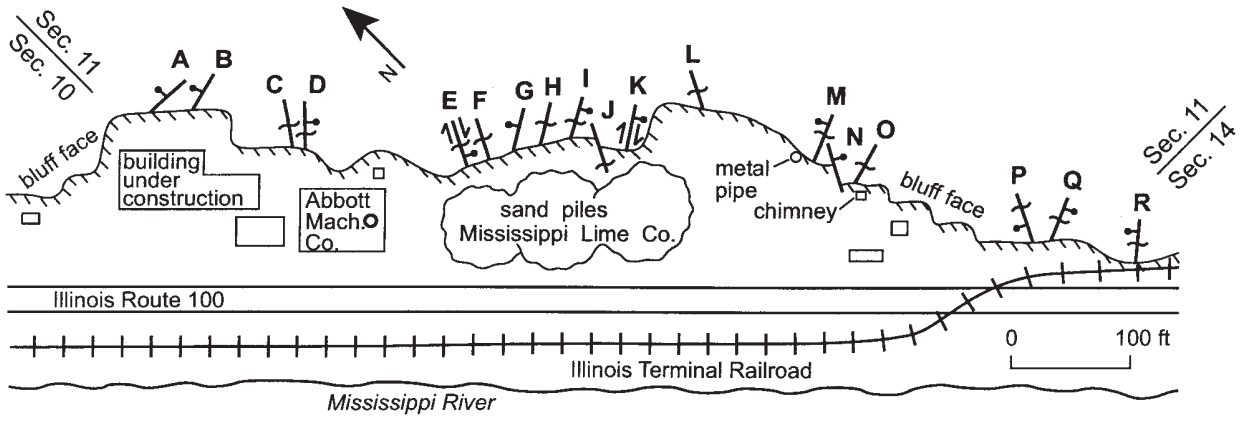

Figure 17 Map of the Alton bluff section on the west side of Alton, showing faults in the St. Louis Limestone, Sec. 11, T5N, R10W (Devera and Denny 1999, 2000).

to produce crushed stone until the 1950s. Quarrying finally ended here when it became too difficult to find adjacent property for quarry and mine expansion.

Piasa Park is located in an extensively quarried area of the bluff at Alton that was the center of the local lime industry. During the nineteenth century, a number of independent lime companies quarried stone and burned lime here. By 1895, they had been consolidated into one large operation called the Mississippi Lime and Materials Company. The production of lime ended at this site around 1921, but the increasing demand for crushed stone provided a market for new stone products. Eventually the company began to run out of room at this site as the city expanded over much of the unquarried portions of the bluffs to the north; it also became more difficult and expensive to strip the rock surface. The most economical solution was to develop an underground mine on property the company owned, and some of the 22 × 35-feet adits (tunnels) for these mines are prominent features of the park. By the 1960s, these mines had reached their limits and were closed.

The extensive quarry exposures extending from Piasa Park eastward have long been one of the most important sites for geological research in the Midwest. Known as the Alton Bluff Section, the Mississippian rock exposures here have been a destination of many geological field trips to the area and the focus of detailed stratigraphic studies. Visitors to the area commonly ask why there is no bluff on the south side of the Mississippi River in this region. Actually, there is a bluff, but it is located far to the south along the south bank of the Missouri River. An excellent view of the broad valley in which both the Mississippi and Missouri Rivers flow east toward their confluence is available at Alton's Riverside Park. Although not part of this field trip, we encourage a visit to this park, which is located on top of the bluff above Piasa Park. Unfortunately, the dangerous condition of the quarry walls and mine entrances precludes any close examination of Mississippian rocks at this locality.

The Piasa Bird

The Piasa, or Piasa Bird, is a local legend in the Alton area going back to 1673 when Father Jacques Marquette, in recording his famous journey down the Mississippi River with Louis Joliet, described the Piasa as a birdlike monster painted high on the bluffs along the Mississippi River, where the city of Alton, Illinois, now stands. The creature was given its name by the Illini tribe. One of the figures, drawn from Marquette's description, was illustrated in the 1887 *Records of Ancient Races of the Mississippi Valley* by William McAdams, Jr.; the author also interviewed eyewitnesses to the original pictographs and had rough drawings made from the originals.

Over the centuries, the original pictographs of the Piasa were defaced by rock falls and the pockmarks of thousands of bullets fired by Native Americans, who considered shooting at the image a religious ritual. The remnants were finally blasted away by quarrying nearly 150 years ago. A recreation of one of the pictographs has been painted on the bluff just west of Alton (fig. 18). This is not the site of the original pictograph.

There are many legends regarding its origin. One of the more popular accounts, taken from the Illinois Department of Natural Resources Web site (http://www.dnr.state.il.us/lands/Landmgt/Parks/R4/PRM/Piabrd.htm), is given here.

A

B

C

Figure 18 Piasa images: (A) Early version from Pere Marquette's description, located on a sign near Pere Marquette's monument (see Guide to the Route, mileage 4.4); (B) the version of the image originally painted on the bluff at Godfrey Park (see Guide to the Route, mileage 18.5); (C) current version at Piasa Park (photographs by W.T. Frankie).

The Piasa bird is said to have flown over the "Great Father of Waters" thousands of moons before the white man came, when magolonyn and mastodon were still living. The Piasa, or Piusa, means "the bird that devours men" or "bird of the evil spirit." Early drawings depict the Piasa as part bird, reptile, mammal, and fish. The colors used in early paintings symbolize war and vengeance (red), death and despair (black), and hope and triumph over death (green).

Marquette and Joliet recorded in their diaries a description of an image of this creature incised into the limestone bluffs 40 to 50 feet above the water near their historic landing site at the confluence of the Illinois and Mississippi Rivers. This image was later painted and has been relocated several times. Today a painting of the Piasa Bird can be seen on the bluffs near Alton, Illinois. The most enduring and fascinating legend about this bird was written by John Russell in 1836. It follows:

Before the village of the Illini, the mighty river swept to the south, clear and fresh. The surrounding woods were rich with game. The bluffs and the mighty trees shielded the Illini from the harsh winds that sometimes swept in from the north. Their village was a secure and happy place. Chief of the Illini was Ouatoga [pronounced Wah toga]. He was old and had led his tribe in the ways of peace for most of his lifetime. Ouatoga and his people loved their home and their way of life. Then one morning, as the sun began to climb towards the summit of its cloudless sky, terror touched the Illini. The village stirred. A number of younger braves were leaving on an early morning fishing expedition. Some were already on the river in their canoes, others preparing to embark, when suddenly the very earth seemed to shudder with the sound of an alien scream. Out of the Western sky came a gigantic flying monster. Its body was much the size and shape of a horse; long, white fangs stabbed upward from the protruding lower jaw and flames leaped from its nostrils; two white, deer-like horns angled wickedly from its head. Its huge wings pounded the air with such force the trees bent; its stubby legs held dagger-like talons and its spiked tail wound around the grotesque body three times. Almost before the braves realized their danger, the beast, soon to be named the Piasa Bird, swooped across the beach and carried one away. From that moment on, the Illini were terrorized by this incredible and bloodthirsty monster. Each morning and afternoon thereafter, the Piasa Bird came, shattering the peace of the village with its blood-chilling screams and the thunderous beat of its wings. More often than not, it returned to its lair with a victim.

The Illini looked to their chief, Ouatoga, for a solution to this menace. Time and time again he had led them through the trials of famine, illness, and the threat of warlike tribes. But Ouatoga felt helpless before this danger and the years weighed heavily upon him. The beast seemed invulnerable. His body was covered with scales, like a coat-of-mail. The best efforts of Tera-hi-on-a-waka, the arrow maker, and the tribe's finest archers were to no avail. Then Ouatoga appealed to the Great Spirit.

For nearly a full moon he prayed and fasted. Then in a dream he found the answer. The body of the Piasa Bird was not protected under the wings. After offering thanks to the Great Spirit, Ouatoga called the tribe together and devised a plan that could destroy the Piasa Bird. All that day Tera-hi-on-a-wa-ka sharpened arrowheads and painted them with poison while the tribe fasted and prayed. That night, Ouatoga and six of the finest braves crept to the top of the high bluff overlooking the Great Father of Waters. When dawn came only Ouatoga was visible, standing straight and firm in full view. The braves were hidden nearby behind a rock ledge, bows ready. Suddenly, the scream of the Piasa Bird broke the silence and the winged monster swept into view. Immediately it sighted Ouatoga and with what seemed a shriek of delight, it pounced. As it did, Ouatoga fell to the ground and grasped the strong roots that grew there. The pain of the talons sinking into his flesh inspired him to grip the roots even more tightly. As the Piasa Bird raised its great wings in an effort to carry off its victim, the six braves stepped from their hiding place and shot six poisoned arrows into the unprotected place beneath the beast's wings. Again and again the bird raised its wings to fly. But Ouatoga held fast and each time six poisoned arrows drove into the bird's vulnerable spot. Finally, the poison did its job. With a scream of agony, the Piasa Bird released its hold on Ouatoga and plunged down the bluff to disappear forever in the swift waters of the great river. Carefully, tenderly, the braves carried Ouatoga to his tepee where, in time, he was nursed back to health. Then a great celebration was held in the camp of the Illini. The next day, Tera-hi-on-a-wa-ka mixed paints and, carrying them to the bluff, painted a picture of the Piasa Bird in tribute to the victory of Ouatoga and the Illini. Every time an Indian passed the painting, he shot an arrow in salute to the bravery of Ouatoga and deliverance from the Piasa Bird.

STOP 5. Kimaterials, Inc. Lohr Quarry (NW, SE, SE, Sec. 5, T6N, R10W, 3rd P.M., Alton 7.5-minute Quadrangle, Madison County). We will discuss both the stratigraphy and the mining operation at this quarry.

The stratigraphy exposed in this quarry, the quarrying operation, and the use of this stone will be discussed, and then participants will have an opportunity to collect a variety of marine fossils and minerals (especially calcite and pyrite) at this quarry (figs. 19 and 20). Remember, this quarry is on private land and you must obtain permission to enter this quarry.

Above the bedrock, there is an overburden of about 11 feet of Wisconsin loess, underlain by about 12 feet of Illinoian glacial deposits and thin patchy pre-Illinoian deposits. Striations are often visible on the bedrock surface. See Grimley and Phillips (2001) for detailed descriptions of the Quaternary section exposed at this quarry.

This section was described and measured beginning at the bottom by Zakaria Lasemi and Rodney Norby on November 20, 1997.

Figure 19 Lohr Quarry (photograph by W.T. Frankie).

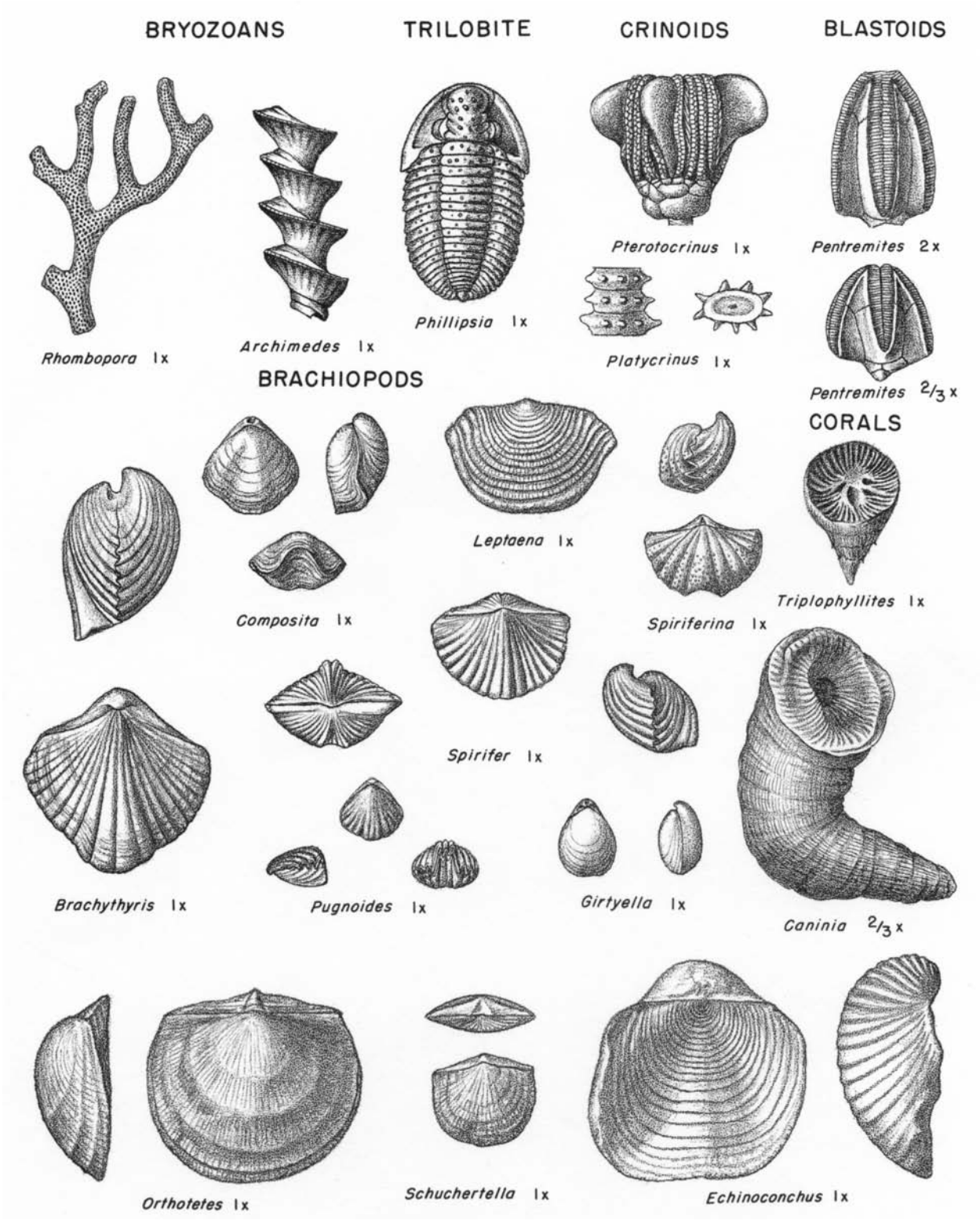

Figure 20 Typical Mississippian fossils

Thickness	Description
30+ ft	**Quaternary** Not sampled, described, or measured (see Grimley and Phillips 2001).
10.3 ft	**St. Louis Limestone** This part described along old dirt ramp road on north side of quarry. An additional approximately 10 to 15 ft of rock present above west wall appears very orange from a distance, indicating strong weathering; it was not examined at this time.
6.5 ft	Grainstone, light gray to light brownish gray (10YR 6/1 to 6/2), very fine-grained, peloidal to bioclastic in lower 3.5 ft, which changes laterally to a fine bioclastic grainstone containing coarse material including abundant brachiopods; this grainstone fines upward into mudstone/wackestone interbedded with multiple yellow-green shales; cherty limestone above.
	This part described on intermediate bench on the west face:
2.5 ft	Interbedded lime mudstone and very fine grainstone, with numerous bright green shale partings, thin-bedded.
1.3 ft	Lime mudstone, heavily brecciated (collapse?), light brown gray (10YR 6/1 to 6/2), slightly cherty; at base is local 0- to12-cm (0- to 5-inch)-thick grainstone lens with green shale above, below, and within the lens; some algal chips were noted in the lowest part of the basal grainstone.
52.5 ft	**Salem Limestone**
2.5 ft	Dolomite, brecciated in part and in many portions of the quarry may be dolomitic shale, very argillaceous and weathering like shale, buff to light tan with yellow and green tinges; green color is prominent in many places; green shale in middle of unit with several green shale partings throughout; lower 15 to 25 cm (6 to 10 inches) is rich in silica in irregular network. This rubbly zone is very prominent in the quarry and is similar to the green shale interval seen elsewhere.
5.0 ft	Dolomite, orange-brown (reddish yellow to strong brown) (7.5YR 6/6 to 5/6-dry), highly weathered, laminated in lower 1 to 2 ft, which is sometimes light brown (7.5YR 6/4); chert (2 to 5 cm thick; 1/4 to 2 inches thick) at its base and five additional approximately 5-cm (2-inch)-thick chert bands regularly spaced above.
7.0 ft	Dolomite, brown to light brown (7.5YR 6/4 to 5/4 to 6/6-dry), light brown in upper 1 ft, very fine-grained, heavily banded, very finely laminated (tidalite), massive unit; dense, very hard, probably fairly good-quality rock; from a distance, this unit generally weathers very dark gray.
	This portion described farther south along west face:
7.0 ft	Dolomite, light orange-brown (7.5YR 6/4), fine- to very fine-grained, very calcareous dolomite to dolomitic limestone; beds are difficult to follow to the south, but beds thicken toward north; moved to different location farther north along west face for part of this unit description and for some units above. At new location, this unit has chert beds of moderately uniform thickness, 8 to12 cm (3 to 5 inches) and several isolated cannon-ball (elliptical here) chert, 5 to 20 cm across (2 to 8 inches); on fresh face; chert is similar in color to the rock, but whiter when weathered.
7.0 ft	Limestone, but appears dolomitic and may grade to a dolomite in other parts of the quarry, light gray-brown (10YR 6/1 to 7.5YR 6/2 to 7/2); appears crystalline but may

be a fine-grained dolomitized grainstone; upper 30 cm (1 ft) is a cherty dolomite; quality of stone is fairly good, as it is relatively hard (at this point), but may be softer laterally. This unit does not seem to be present on the east face; it thins toward the southwest corner and then thins on south face toward east and appears to disappear midway along south face; beds also thin toward north along the west face.

10.5 ft Dolomite, medium dark brown (10YR 4/3) medium grained and crystalline appearing, laminated in part, except perhaps the upper part; approximately seven layers of irregular and banded chert, in part discontinuous; a large (30- to 40-cm; 12- to 16-inch) cannonball chert at top; cannonball chert seems to be common at this horizon around the quarry; here on the west wall, the lower grainstone of the Salem is absent; this unit is a little softer than the unit above, but overall the quality is still not too bad.

13.5 ft Grainstone, light brownish gray (10YR 6/2 to 6/1-dry), medium gray (10YR 5/1), medium to very coarse grained, bioclastic, with abundant bryozoans, crinoid fragments, and brachiopods in some places; cross-bedded; appears to dip to south or southwest, some cross-beds have wispy, very dark gray laminations that help to define the beds, both angular and planar; at the top of the unit is a dark gray, locally cherty and siliceous, slightly undulating horizon with dark brown to very dark gray, thin shale partings up to 2 to 3 cm (1 inch) thick; thickness varies from 12 to 13.5 ft; base is generally quarry floor, at least on east, south, and part of west walls, then essentially pinches out to 0 ft on most of west and north? walls and is replaced by a chert horizon (generally a few centimeters but may be up to 30 cm (12 inches) in some places), which occurs at the top of the thinned grainstone.

On the east wall above this grainstone, a very weathered, orange-brown dolomite (could not reach to sample) is present with cannonball chert throughout up to about 25 ft above grainstone. Rock above that is more laminated or bedded buff-colored dolomite? for about 10 ft; followed by a similar orange-brown dolomite (see more complete description above taken from information on west and northwest walls).

8.0 ft **Warsaw Shale**

8.0 ft Dolomite, medium to dark gray (10YR 5/1 to 3/1) to dark brown (10YR 3/3-dry), very fine grained, argillaceous, relatively soft; major calcite geode (irregular) horizon occurs at 4.5 to 5.0 ft above described base; geodes are up to 20 cm (8 inches) across and contain mainly calcite, pink dolomite, and, in some, sphalerite and pyrite; a few may also contain some silica; faintly laminated throughout. Upper 1 to 2 feet is thin-bedded, highly laminated, very fine-grained dolomite, a little harder than the dolomite below, some brachiopods along bedding horizons, 1 to 4 cm light brown-gray (10YR 6/2) beds in upper 5 to 15 cm (2-6 inches); some chert in places in Warsaw at contact with Salem, also thin shale partings up to 3 to 5 mm thick at the Salem contact. The lowest 5 to10 cm (2 to 4 inches) of the Salem grainstone above contains clasts of the Warsaw dolomite. In the immediate few feet laterally, the Salem grainstone varies from 0 ft to 3.0 ft thick; this grainstone is the same lower grainstone bed of the Salem that is as much as 12.5 ft thick on the east wall and 13.5 ft thick on the west wall with about 2.0 ft of dark gray dolomite of the Warsaw at the very bottom. As noted above, laterally to the dolomite of the Warsaw, the lowest grainstone bed of the Salem, appears to cut into the Warsaw like a channel (100 yards from the southwest corner along the north wall); however, the grainstone may have been compressed into the soft Warsaw sediments during compaction.

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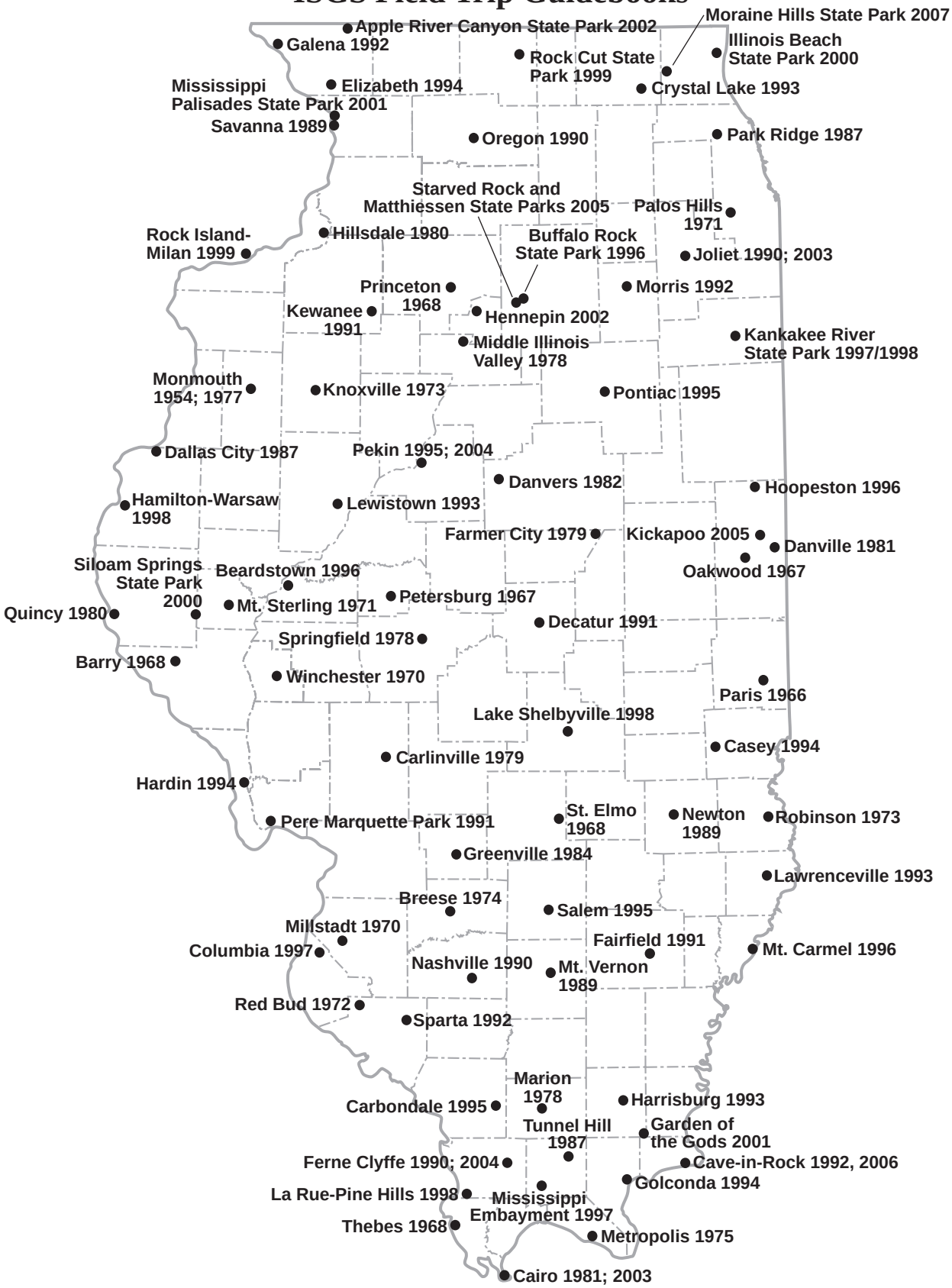

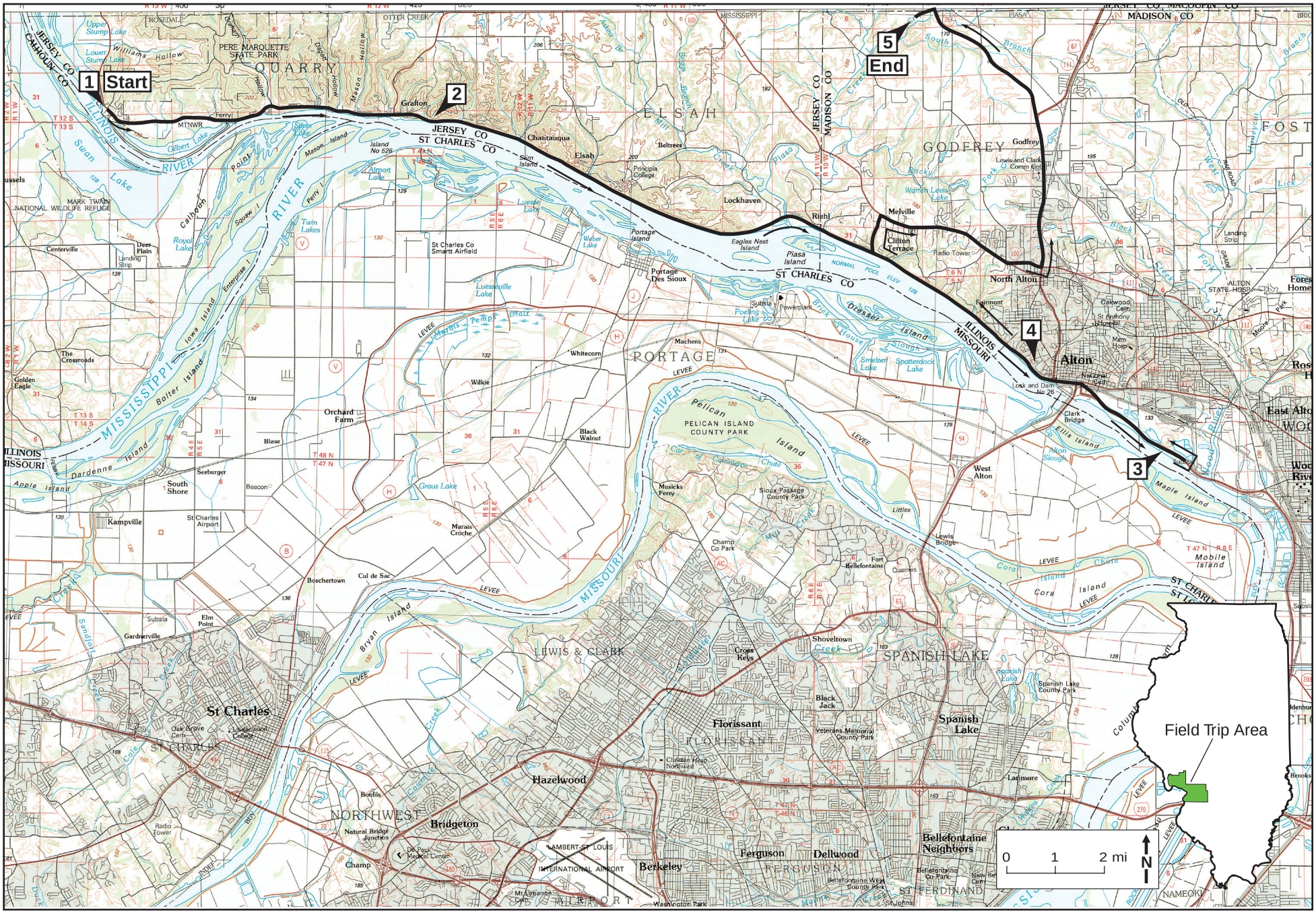
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