Pattison State Park

Big Manitou Geology Walk

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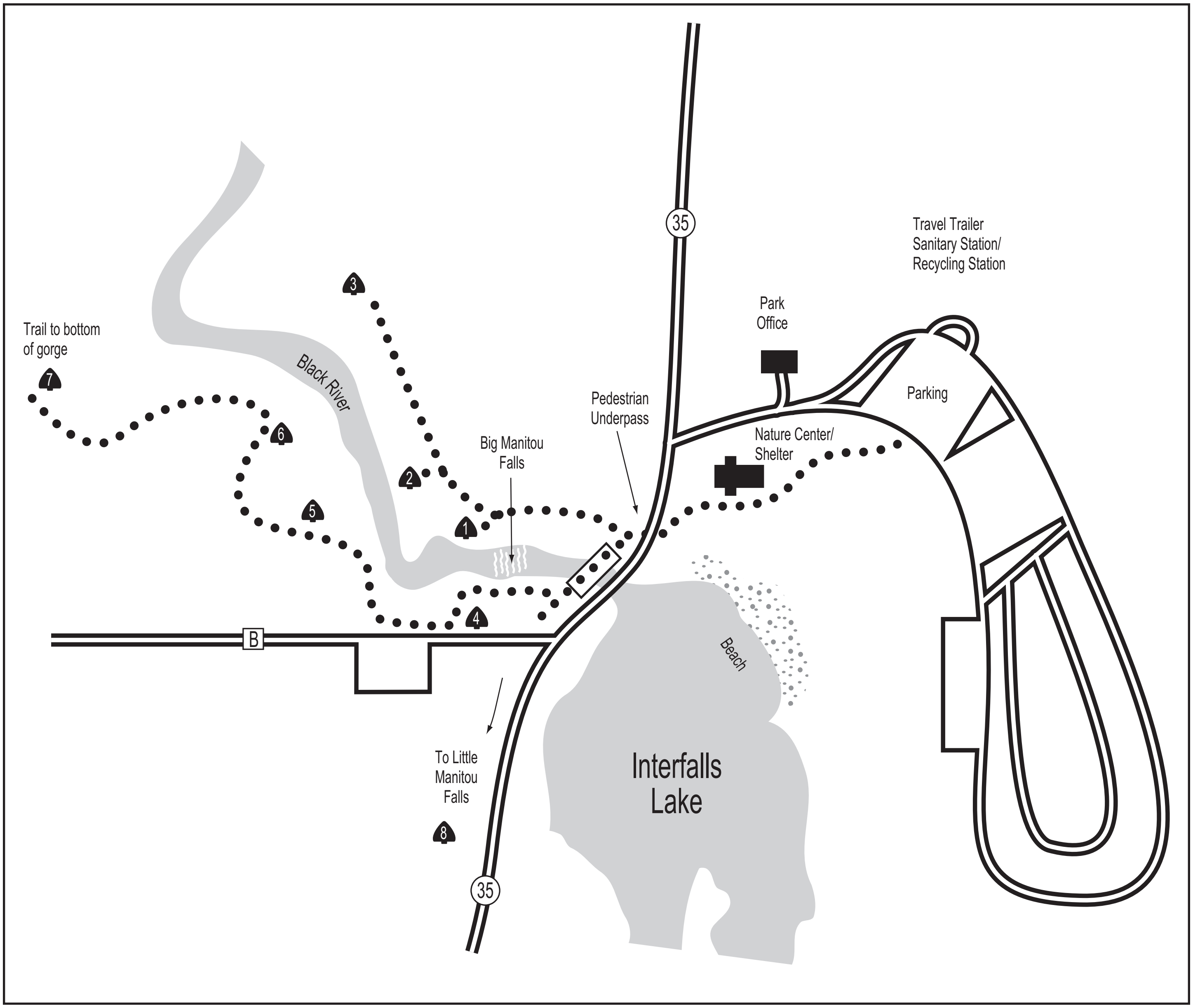

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Big Manitou Geology Walk

Pattison State Park is a special place. It has been established to protect the unique scenery of the waterfalls, while providing a place for visitors to relax, recreate and learn about our outdoor heritage. This field guide will lead you to vantage points where you can gain an appreciation for the tremendous forces that have acted for over a billion years to produce the beauty and splendor that exists today.

As you tour the park, refer to the map in the booklet for stops—identified by an arrowhead symbol. The best starting point is in the main parking area. The signed walk will lead you to the shelter where a display will provide you with an insight into the geologic history of this area.

From the shelter, the walk continues through an underpass, to the west side of STH 35. The first stop on your tour will be at the first overlook on the north rim of the gorge.

1

Big Manitou Falls is the highest in Wisconsin and at 165', is the fourth highest east of the Rocky Mountains. The dark brown rock it plunges over is called basalt or trap rock. Basalt is an igneous rock and represents solidified remnants of ancient lava flows which extended across the entire region about a billion years ago. The flows originated from deep fissures in the area now covered by Lake Superior and extend 100 miles south of the park. The extensive distribution of the flows and fine texture tell us the lava was very fluid and cooled rapidly enough to prevent the formation of crystals.

Note that the basalt is massive and lacks bedding, or stratification, so common in sedimentary rock. But, you can see places where the bedrock character changes. These are areas where flowing lava covered rock that had been deposited by previous flows. The top of an older flow is usually different in color than the bottom of a younger flow above it. Hundreds or thousands of years between lava flows allowed weathering and oxidation to change rock color and to produce broken rock and even soil-like material, depending on the time involved. Finally, the texture of the top of a flow is usually finer than the mid-portion due to more rapid cooling at the surface. With these facts in mind, try to locate flow contacts in the surrounding rock walls.

If you could look closely, you would see that the upper surface of a lava flow is marked by small pits left when bubbles of gas escaped during the cooling process. The majority of pits are but a fraction of an inch in diameter, but some of the larger ones were the original “homes” of agates which weathered loose and eventually washed up onto the shore of Lake Superior.

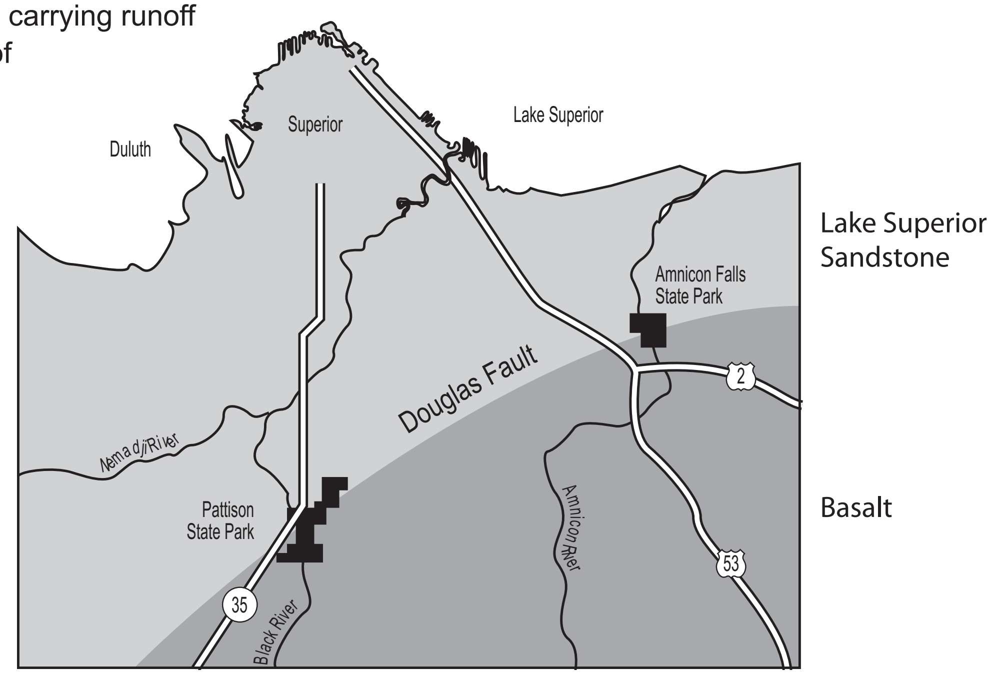
Your next stop is at the Cantilevered Overlook to your right.

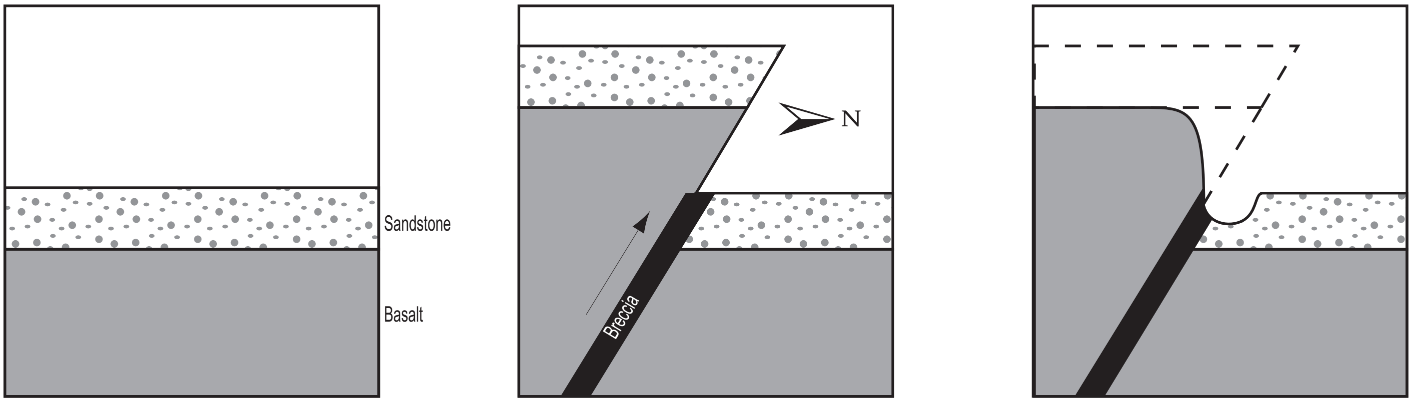
2

From here you can see evidence of a number of interesting events. As look downstream, you can see, on the right, an outcropping of light colored sedimentary rock known as Lake Superior sandstone. It was formed millions of years ago when great oceans covered this area. Streams carrying runoff into the ocean also carried grains of sand that settled to the bottom as great pressure over long periods of time cemented the grains into sandstone. You will see the sandstone up close at Stop #7.

Downstream on the left, almost across the gorge from the sandstone is basalt. The area between the two types of rock is the well-known Douglas Fault. The fault is the location of a huge crack in the basalt bedrock which extends from an area east of Ashland, Wisconsin, to the vicinity of the Twin Cities, Minnesota.

***Figure 1**. Location of the Douglas Fault showing its effect on the bedrock of northern Douglas County.*





Lake Superior Sandstone deposited on top of basalt.

Reverse-type fault occurred and breccia zone is formed.

Sandstone removed by erosion from top of uplift side of fault.

Figure 2. *Series of events that formed the bedrock at Pattison State Park.*

About a half billion years ago, the rock mass on which you are standing (south of the crack) was pushed upward by great forces within the earth. This movement, called a “thrust fault” is far less common than faulting when the rock mass moves downward. The high ridge to the north (located in Minnesota) is a similar fault resulting in the basin now occupied by Lake Superior. The rock beneath you moved slowly and at a 50-60 angle as shown in Figure 2.

The illustration above explains why you see sandstone lower than the basalt on which it was originally deposited. At Amnicon Falls State Park, and elsewhere, the location of the fault is exposed, but here it is covered with debris from the steep banks. Figure 3 will help you visualize the fault location.

Where the rock mass moved, great pressure and heat were created. These forces ground the basalt into sharp-angled fragments which were later cemented together. This material is called breccia. In addition, the great forces caused fractures to radiate deep into the bedrock. These fractures were filled with a variety of materials and became veins of quartz, calcite and other minerals.

You can return to the walk and turn left to find stop #3.

3

Another great force that shaped this area was the glacier. In Wisconsin, glaciation is a relatively recent event — taking place during the last two million years. Indeed, glacial ice was present here just 10,000 years ago. The effects of the glacier can be seen in many ways. For one, it helped remove the sandstone above the fault. That which you see downstream at the right was protected by the very hard basalt as the ice advanced from the north.

Another effect, was its influence on our soils (Figure 4). As the ice retreated, the great valley, stretching to the horizon, was once filled with water from the melting ice. Had you stood at this place then, the water of a great glacial lake would have been 100 feet above your head. (The fuel storage tank you see on the horizon is 15 miles away at Wrenshall, Minnesota.)

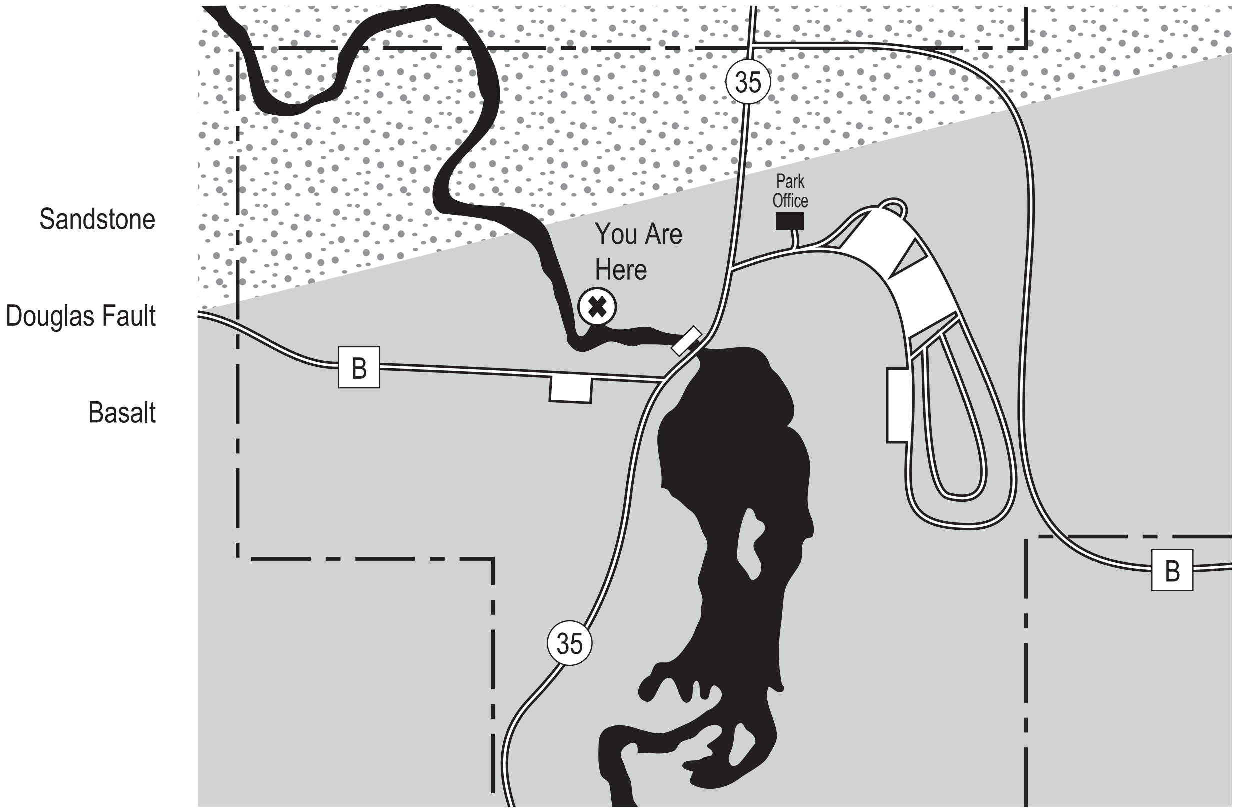


***Figure 3.** From where you stand, you can see the two kinds of bedrock that were exposed by the Douglas Fault.*

As the glacier melted, clay sediments carried by the ice or washed into the lake by glacial streams settled to the lake bottom. This blanket of heavy red clay ranges from very thin, here at the crest of the escarpment, to 600 feet deep at the center of the valley. This clay has very poor drainage and is easily eroded resulting in serious problems for building sites, trails and roads, septic systems, landfills and other developments

As shown in Figure 4, and as you will see in the sand pit as you travel later to Little Manitou Falls, the soils across the center of the park are of sandy origin. This belt (and a smaller area in the northwest corner of the park) is the beachline of Glacial Lake Duluth. Here, the soils are very dry and support greatly different plant communities than those found in the wet clay soil.

The third soil zone shown in Figure 4 is an area that is very hilly and composed of many stones and a mixture of soil particles. Here the forward movement of the glacier was at the same rate that the ice front was melting. Thus, debris carried in the ice was deposited in ridges and valleys and the area is called a recessional moraine. When you visit Little Manitou Falls watch for the large stones, not seen in other sections of the park.

The next point of interest is along the trail on the opposite rim of the gorge. Stay to the right after crossing the river and watch for the arrowhead symbol as you approach the boardwalk.

4

The pit you see here was made by copper miners over a century ago. Previously, you read that minerals filled the fractures resulting from the faulting action as well as the small pits at the surface of cooling lava flows. Among the minerals was copper and sometimes silver and gold. Early miners to the Lake Superior region had discovered these valuable minerals in northern Michigan and on Isle Royale. Knowing the rock formations along this escarpment on which you stand to be similar, exploration began here in 1846, but these early efforts were difficult in this rugged wilderness and abandoned after not being very successful.

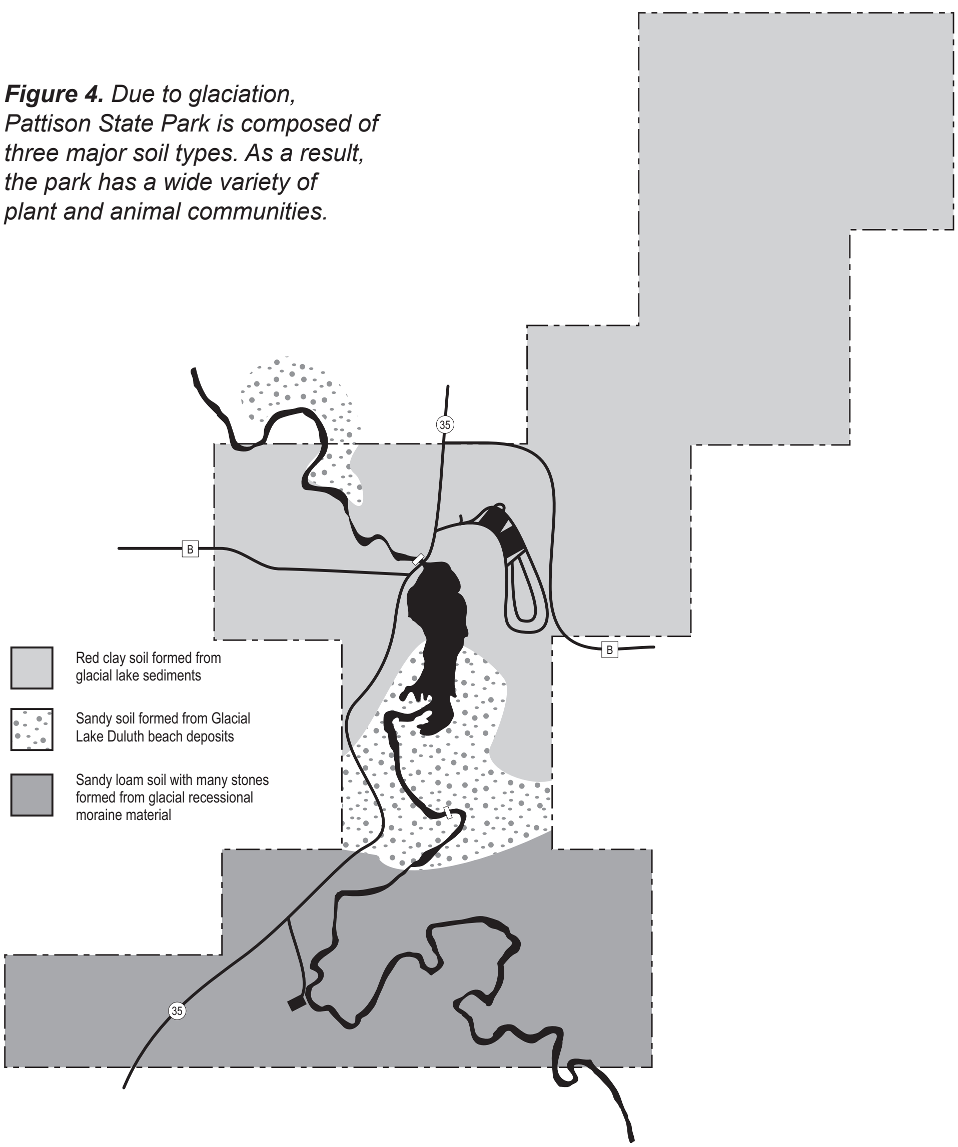


Figure 4. *Due to glaciation, Pattison State Park is composed of three major soil types. As a result, the park has a wide variety of plant and animal communities.*

During the Civil War, however, copper was in great demand and exploration was renewed here at Pattison Park as well as all along the rock outcroppings in Douglas County. This digging is one of dozens known to exist in the park. They show where miners broke apart a rock outcrop leaving a raw face, a shallow pit and a pile of fragments. Some still show bore holes used to blast the rock.

Your next stop is at the first overlook beyond the boardwalk.

5

From here you have the best view of Big Manitou Falls. As the glacier receded to the north, it opened new pathways for water to drain from Glacial Lake Duluth. Eventually, the lake level lowered and the discharge changed from flowing south through the Brule/St. Croix course and down the Mississippi River to an eastward flow out the other Great Lakes to the St. Lawrence River.

As the water drained away, it revealed a gentle slope from the crest of this ridge to the receding lakeshore. Running water from glacial melt-water stored south of the park and from rains and melting snows for the past 10,000 years then carved this gorge. A channel was quickly cut through the clay sediments and then easily carved through the soft sandstone. Upon reaching the hard basalt erosion slowed, but did not stop. Reluctantly, the stone gave way finally forming the splendid waterfalls you see today.

Copper mining was very active in the park in the 1860's and again at the turn of the century, and evidence of this work can be found in many places. There are rock walls that have been broken away, pits, trenches, shafts and tunnels. The triangular opening you see on the left at the base of the falls was a copper mine. Like most, it is small — only 21 feet deep.

Your next stop will be at the Stone Vista, a short distance down the trail to your left.

6

The Black River has been carving this gorge since the retreat of the glacier. Its flow can be a wild torrent or a quiet trickle depending on the amount of water flowing from its short watershed. Beginning at its source at Black Lake, on the Wisconsin — Minnesota border, the river meanders 22 miles through vast swamplands before reaching the park. The root beer color of the water is due to tannic acid derived from decaying vegetation it picks up from the swamps and bogs.

The Ojibwa Indians named the river Mucudewa Sebee, which meant Black or Dark River. These first visitors to the falls called it Gitchee Manido, which meant Great Spirit, and they believed they could hear His voice in the cascading waters. The tumbling rapids below the falls was called Bohiwin-Sasiqewon, meaning laughing rapids. Today, we too marvel at this spectacular creation and our spirits are enriched.

Six miles downstream, the Black River joins the Nemadji on its way to Lake Superior.

Stop #7 Is at the bottom of the gorge. The trail is one half mile long, and the walk back is steep and invigorating.

7

Proceed to the river's edge and observe the sandstone wall. The sandstone was formed through prolonged physical and chemical weathering that freed mineral and rock grains from older parent rocks. running water, wind, ice and other agents of erosion moved the liberated grains, or sediment, along until a depositional site such as a floodplain or basin was encountered.

The Lake Superior sandstone was transported into this region by streams and deposited many millions of years ago. One can gain an appreciation of the time involved by picturing billions of bits of sediment weathered slowly from older rocks, then carried by streams until deposited within a basin and eventually cemented into sandstone. Much of the Lake Superior shoreline around the Bayfield Peninsula and Apostle Islands is characterized by outcrops of sandstone. The total thickness is believed to be over four miles.

One of the most common features of sedimentary rock is the layering (bedding planes) readily seen here. The layering or bedded effect is similar to a pile of rugs, one stacked on top of another, with the oldest at the bottom and the newest at the top. Note that the layers are not all horizontal. The tilted layers, called "cross-bedding," are the result of changing currents depositing sand in sloping banks.

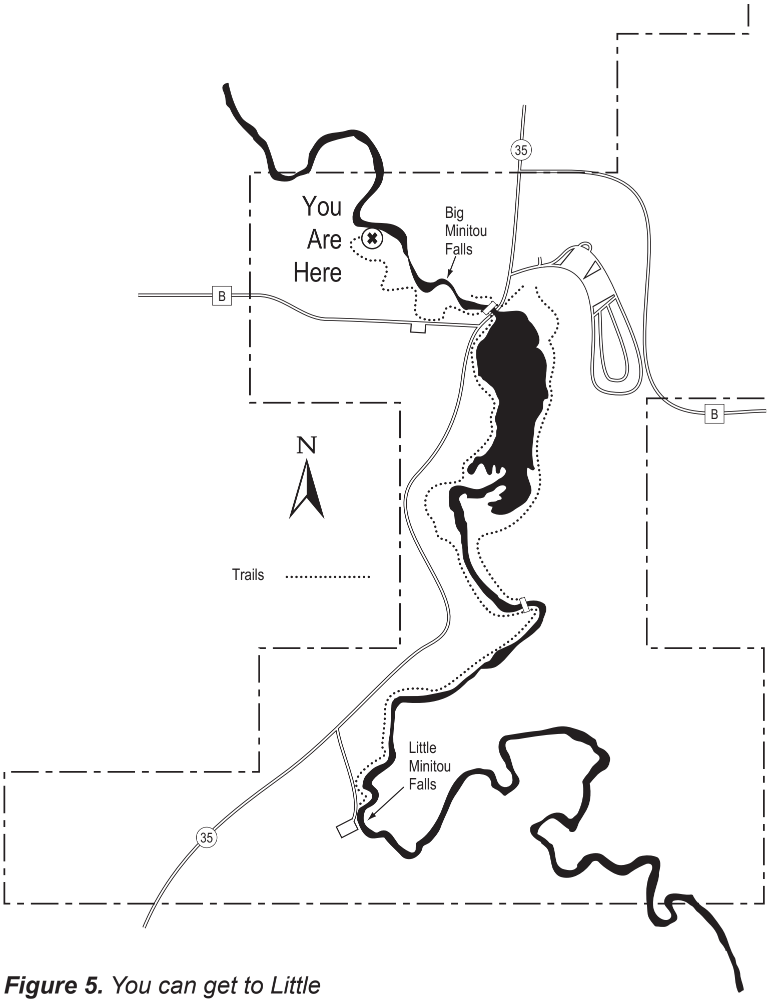


Figure 5. *You can get to Little Manitou Falls by driving one mile south on STH 35 or by following the hiking trail shown on the map. The hike to Little Manitou Falls and back is three miles.*

8 Little Manitou Falls is 31' high and has a special charm. Like Big Manitou, it flows over an outcropping of basalt. The Ojibwa Indians called this place Cacabeeca Bunghee, which meant Little Falls.

Long before the Ojibwa Indians roamed these forests, other Indian cultures lived here. Some found copper in the exposed rock walls and learned how to fashion it into tools. When the first surveyor, George Stuntz, came to this area in the early 1850's, he found a broken stone hammer and work sites where Indians shaped the metal here at the falls.

Later, when "copper fever" was high, others mined the mineral here, too. Note the shallow cave at the left of the falls. Here miners found an exposed, though weak, copper vein. Before they mined very far into the rock wall, the vein ran out. Of the many copper mining locations along the Douglas Fault, this site is the farthest away from the fault that copper was ever found.

We hope you have enjoyed this geology walk and have gained an appreciation for the tremendous forces that have acted over so many years to shape this scenic area.