Figure 6. Clifton Gorge State Nature Preserve is adjacent to John Bryan state park; see the map from the John Bryan State Park website at parks.ohiodnr.gov/johnbryan. Added to the map are blue octagons at the corresponding unit locations of the cross section illustrations in figure 5. Unit 1 is located about one half mile upstream to the east, outside of the map area. Unit 8 is located about a mile downstream, to the west, outside of the map area.
Paleogeography

During the Silurian Period, about 430 million years ago, Ohio was covered by a warm and shallow sea (fig. 1), similar to the modern Bahamas. Most of Ohio was covered by a large coral reef at that time, and cyclical environmental changes caused sea level to rise and fall. Fluctuations in sea level can be observed when looking at rock type, or lithology. When sea level falls, shelves, siltstones, and sandstones typically are deposited. When sea level rises, water conditions become clearer, allowing for reef development and deposition of limestone. Dolomite is a rock similar to limestone. It is formed when a previously deposited limestone cement and deposition of limestone. Dolomite is a rock similar to limestone. It is formed when a previously deposited limestone comes into contact with water rich in magnesium, through a chemical process known as dolomitization. Calcite fossils in the original limestone often dissolve during dolomitization, creating small voids known as vugs.

Bedrock Geology

The dense and resistant Cedarville, Springfield, and Euphemia Dolomites are cliff-forming rocks of Clifton Gorge (fig. 2). The softer Massie and Osgood Shales erode more easily, which causes the gorge to widen further downstream, and gentle, broad slopes to form at the base of the dolomite cliffs.

Niagara Escarpment

Figure 3 is a profile of the bed of the Little Miami River. The Cedarville, Springfield, and Euphemia Dolomites form a cliff over the Osgood Shale called the Niagara Escarpment, so named because these are the same bedrock formations that cap the top of Niagara Falls at the border of western New York and Canada. In the past, Clifton Gorge may have had more dramatic falls with large volumes of water flowing over the escarpment (see C & D in fig. 3). The remaining units of the Niagara Escarpment are responsible for the rapids near the Falls of the Little Miami (Unit 3). The gorge remains narrow as the river cuts down to the slightly softer Springfield Dolomite, but the water slows and collects in a pool (Unit 4). The gorge widens when the river reaches the much softer Osgood Shale (Unit 5). The Little Miami River cuts through the Osgood Shale much faster than the dolomite units above. When the underlying shale is removed, there is less rock to support the overlying dolomite. This allows for large blocks of dolomite to either slowly slump down into the gorge, or fall down from the cliff in an instant (Unit 6). There are numerous examples of these mass wasting events, but the most famous is Steamboat Rock situated in the middle of the river. The shape of this large block of Cedarville Dolomite and the way water rushes around it give it the appearance of a boat steaming forward.

Further downstream in John Bryan S.P. (Unit 7) and south of Yellow Springs (Unit B), the widening of the gorge is easily observed. Here, the Little Miami River has eroded below the rocks of the Niagara Escarpment, and into older geological units.

Glacial Geology

About 18,000 years ago much of western Ohio was covered by a massive glacier. The glacier continued, however, creating the highest point in Ohio, known as the Bellefontaine Outlier, in Logan County. The glacier split into the Miami Lobe and the Scioto Lobe as it flowed around the outlier (fig. 4). As the ice age was ending, a massive amount of meltwater was funneled between the lobes toward the village of Clifton, creating the 33-mile long Kennard Outwash Terrace. As the water drained into the Little Miami River Basin, it eroded down through the bedrock and created the precursor to the modern Clifton Gorge.

Gorge Evolution

Locally, the Little Miami River flows through eight distinctive landforms (figs. 5 & 6). East of Clifton and upstream from the gorge, the valley is wide and filled with sand, gravel, and cobbles from the Kennard Outwash Terrace (Unit 1). Downstream, to the west of Clifton, the meltwater worked its way into fractures and vugs within the Cedarville Dolomite and created a narrow gorge (Unit 2). The remaining units of the Niagara Escarpment are responsible for the rapids near the Falls of the Little Miami (Unit 3). The gorge remains narrow as the river cuts down to the slightly softer Springfield Dolomite, but the water slows and collects in a pool (Unit 4). The gorge widens when the river reaches the much softer Osgood Shale (Unit 5). The Little Miami River cuts through the Osgood Shale much faster than the dolomite units above. When the underlying limestone is removed, there is less rock to support the overlying dolomite. This allows for large blocks of dolomite to either slowly slump down into the gorge, or fall down from the cliff in an instant (Unit 6). There are numerous examples of these mass wasting events, but the most famous is Steamboat Rock situated in the middle of the river. The shape of this large block of Cedarville Dolomite and the way water rushes around it give it the appearance of a boat steaming forward.

Farther downstream in John Bryan S.P. (Unit 7) and south of Yellow Springs (Unit B), the widening of the gorge is easily observed. Here, the Little Miami River has eroded below the rocks of the Niagara Escarpment, and into older geological units.

Figure 5. Cross sections of the Little Miami Valley in the Clifton region. See map on back cover for site locations. Modified from Carmen (1946).

Figure 6. Map showing glacial lobes created by the Bellefontaine Outlier and resulting Kennard Outwash area.

Further Reading


