GEOFACTS
OHIO GEOLOGICAL SURVEY • DEPARTMENT OF NATURAL RESOURCES

Rockbridge: An Ohio Geologic Wonder

Figure 1. Rockbridge as seen in Rockbridge State Nature Preserve in Hocking County, Ohio. The natural bridge is over 90 feet long and up to 20 feet wide.

The Hocking Hills Region is home to many diverse geological features, including the largest natural bridge in Ohio. This bridge, known as Rockbridge, spans 92 feet (ft; 28 meters [m]) long and towers 40 ft (12 m) over a rocky ravine (fig. 1).

What is a natural bridge?

Natural bridges and *natural arches* are narrow, continuous archways of rock, commonly spanning a ravine or valley. Though both terms describe a similar object and setting, the key difference between them is the presence (or absence) of water. Natural bridges are characterized by natural water flowing under the bridge, whereas arches have no natural water source flowing under the arch. Both features form over centuries to millennia (a geologically short period of time) as a result of weathering and erosion.

How did Rockbridge form?

The massive outcroppings of sandstone, known as the Black Hand Sandstone, that would eventually weather and erode into Rockbridge formed during the Carboniferous Period (Mississippian Subperiod), about 359–323 million years ago (mya). Some portions of the Mississippian-age Black Hand Sandstone in Hocking County are resistant to erosional forces, such as wind, water, and gravity. Other less-resistant portions erode more easily. The result is the formation of numerous cliffs and *rock-shelter caves*, or shallow, cave-like openings formed by overhanging cliffs.

Upper portions of the Black Hand Sandstone contain harder, more-resistant layers of cemented sand grains. This upper layer acts as a protective cap above the softer, poorly cemented layers below that erode more easily. Rain or surface water flows onto and through the lower, softer rock where natural *joints* (breaks in rock along which no movement has occurred) penetrate the rock, accelerating erosional processes within the Black Hand Sandstone (fig. 2). At Rockbridge, the softer layers of the Black Hand Sandstone became exposed, widening the shallow recess of the rock-shelter cave until the

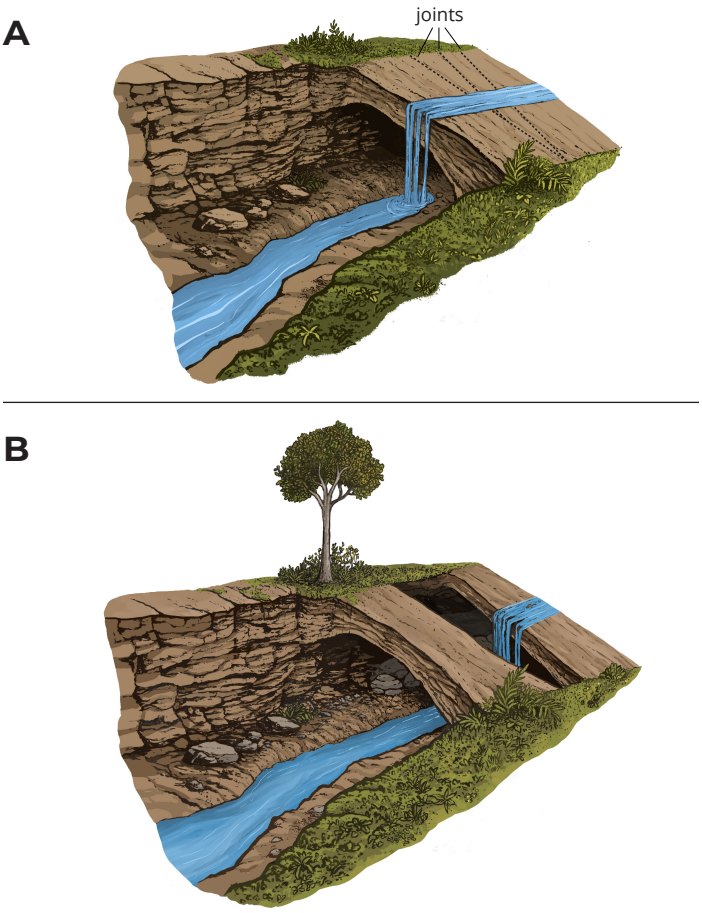

Figure 2. (A) An example of a rock-shelter cave or cliff with vulnerable joints. Water can penetrate these joints and erode portions of the bedrock. (B) Formation of a natural bridge or arch from water eroding at the joints labeled in (A).

roof inevitably collapsed along two joints, leaving behind the striking, 5-ft-thick section of sandstone we call Rockbridge.

Origins of Ohio's Black Hand Sandstone

During the Mississippian Subperiod, Ohio lay south of the Equator under a warm inland sea. Rivers flowed into this body of water from the Alleghenian highlands in the east and carried clay, silt, sand, and gravel that settled at the bottom of the shallow sea. When sediments that formed the Black Hand Sandstone were deposited, water currents washed away any silt and clay and left behind coarser-grained sand and gravel. Over millions of years, more sediments were deposited and layered over each other. These layers began compacting and cementing together. As dissolved mineral particles in groundwater precipitated and crystallized between grains, natural cements formed, binding the sediments together to form solid rock. This created the Black Hand Sandstone, which may be more than 250 ft (76 m) thick in certain areas of Ohio.

Features of the Black Hand Sandstone at Rockbridge

The Black Hand Sandstone derives its name from a cliff exposure east of Newark in the Licking River gorge. This exposure once featured a Native American *petroglyph*, or rock carving, of a giant, soot-scribed hand. Unfortunately, the petroglyph was destroyed by canal construction in the early nineteenth century.

As seen at Rockbridge, the Black Hand Sandstone contains an array of grain sizes and colors (fig. 3A). Grain sizes range from medium-coarse sand to larger, pebble-sized fragments. The larger, usually quartzite pebbles settled towards the bottom, while the smaller, lighter particles (silt and clay) remained on top, creating a feature called *graded bedding*. During each depositional event, streamflow energy often decreased over time, leading to larger, heavier sediments deposited below smaller, finer sediments to create graded beds.

Interesting colors originate from the natural cements, mineral accumulations, and staining that occurred after deposition of the sediments. While the Black Hand Sandstone at Rockbridge is predominantly tan or brown, it can also contain layers of red, black, or orange. Cements containing iron provide a reddish-orange color, while cements with manganese create darker, almost black stains.

Pores in the cement between the sand and pebble particles foster favorable environments for the growth of various species of plants (fig. 3B). Ferns and trees often root themselves and grow out of the face of the sandstone. Mosses and lichens also anchor themselves to the Black Hand Sandstone, giving it a green appearance in certain areas.

Other noteworthy features observed in Black Hand Sandstone throughout Ohio include bedding features that formed during deposition, banding features that formed after deposition, and weathering features that formed once the rock was exposed at the surface. In some places, layers are not flat or neatly stacked on top of one another but rather intersect at angles. This depositional pattern is called *crossbedding*, which indicates that high-energy streams once crosscut stream or river valleys carrying significant loads of sediment. After sediments were deposited and solidified into rock, mineral-rich groundwater flowed through the rock, depositing minerals in patterns or rings of color unlike the surrounding rock. The resulting unique tapestries of shapes and colors are known as *Liesegang bands.* In places where Black Hand Sandstone is exposed at the surface, weathering and erosion can create an irregular, patchy surface with pockets, similar to the structure of a honeycomb and thus is referred to as *honeycomb weathering* (fig. 3C). This type of weathering is believed to be caused by a variety of processes, including cyclical wetting and drying of the sandstone rock.

Many geologically prominent features throughout Ohio have formed in Black Hand Sandstone. In addition to Rockbridge, the Hocking Hills Region is home to Ash Cave, Conkle's Hollow, and Rock House, all formed in the Black Hand Sandstone. Outside of Hocking Hills, other notable landmarks comprised of Black Hand Sandstone include Big Lyons Falls in Mohican State Park and Blackhand Gorge.

Visiting Rockbridge

Rockbridge is located in Rockbridge State Nature Preserve in Hocking County, Ohio, about 40 miles (mi; 64 kilometers [km]) southeast of Columbus. The preserve includes a trail system nearly 3 mi (5 km) long with two main trails adjacent to the Hocking River.

References & Further Reading

Angle, M.P., 2016, The geology of Black Hand Gorge State Nature Preserve: Columbus, Ohio Department of Natural Resources, Division of Geological Survey, 4 p.

Hansen, M.C., 1975, Geology of the Hocking Hills State Park Region: Columbus, Ohio Department of Natural Resources, Division of Geological Survey Guidebook 4.

Snyder, T.A., 2020, Ohio's natural arches: Columbus, Ohio Department of Natural Resources, Division of Geological Survey Educational Leaflet 18.

Figure 3. Characteristics of Black Hand Sandstone as observed at Rockbridge. (A) Sandstone conglomerate with fine sand particles towards the top and larger particles towards the bottom. (B) Plant and moss growth through pores in sandstone. (C) Honeycomb weathering in the Black Hand Sandstone.