GEOFACTS
OHIO GEOLOGICAL SURVEY • DEPARTMENT OF NATURAL RESOURCES

Ohio Karst

Karst is a little-known but important term that describes potentially hazardous landforms that can be found throughout Ohio. Regions that contain sinkholes and other solutional features, such as caves, springs, disappearing streams, and enlarged fractures, are known as *karst terrains*. Sinkholes are the main hazard associated with karst landforms in Ohio, and there are thousands of them in the state. Sinkholes form as bedrock dissolves and surface materials erode (fig. 1) or collapse into the resulting voids.

Karst features form in carbonate rocks—limestone and dolostone—that are soluble in soil acid and carbonic acid (an acid that forms when rainwater and CO_2 mix). Karst may also develop in evaporite rocks containing the minerals halite (salt), anhydrite, and gypsum. When water drains into it, a sinkhole likely will grow over time, since the water carries away or dissolves material. A stream that is captured by and drains into a sinkhole is known as a *disappearing stream* or *sinking stream*. The water that flows into and through karst systems continues to enlarge fractures which may eventually become caves. As water moves through a karst system, it may reemerge at the land surface, forming a spring (fig. 2).

While there are more than 200 known solutional caves in the karst terrains of Ohio, only a few are open to the public. Many other caves do not offer public access or have been closed to restrict the spread of white-nose syndrome, a highly contagious fungal disease fatal to bats throughout North America, and to protect other sensitive cave-dwelling species. Other caves preserve Native American artifacts and the bones of extinct animals. Animals can become trapped in steep-sided sinkholes or pit caves; for example, Sheriden Cave in Wyandot County contains the remains of short-faced bear and giant beaver skeletons about 10,000 years old.

Figure 1. Significant erosion resulting from sinkhole formation in a farm field in Highland County, Ohio.

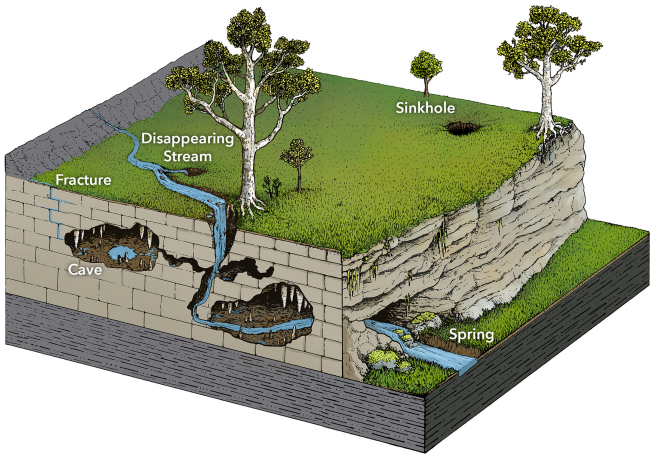

Figure 2. Block diagram showing the relationships between karst features. Illustration by Madison Perry.

Geology

In general, the surface bedrock in the western half of Ohio is dominated by thick limestones and dolostones, while the surface bedrock in the eastern half is primarily shale, sandstone, and some thin carbonates. Therefore, karst is much more common in the western half of the state where the rocks are susceptible to dissolution (fig. 3). However, many of the features on the Bass Islands of Lake Erie and around Bellevue in north-central Ohio are also influenced by evaporites; this is especially evident in the caves of the Bass Islands, which are formed around the perimeter of pop-up domes created by the hydration of anhydrite into gypsum. Karst features in Ohio occur within specific formations of three distinct geologic time periods: the Ordovician-aged (485–444 million years ago [mya]) limestones in southwestern Ohio found within formations such as the Grant Lake, Miamitown, and Waynesville; the Silurian-aged (444–419 mya) Salina Group (dolomite) and Lockport Dolomite in northern Ohio, the Cedarville and Springfield Dolomites in west-central Ohio, and the Peebles, Lilley, and Bisher Dolomites in southern Ohio; and the Devonian-aged (419–359 mya) Columbus and Delaware Limestones in central and northern Ohio. Occasionally, karst features are found in eastern Ohio, though there is less data on the karst in this region.

Though Ohio's karst features are primarily found in carbonate bedrock across the western portion of the state, sinkholes are not found at the land surface when the bedrock is buried beneath more than about 25 feet of sediment (typically glacial till in Ohio). This is because either the sediment has isolated the bedrock from dissolution or existing voids were filled in by glacial sediment and have not had time to dissolve or wash out and thus collapse further. In general, Ohio sinkholes are relatively slow growing and, except in the densest and most active karst areas, they deepen or widen only a few inches per year. Most known sinkholes have likely been present for thousands of years.

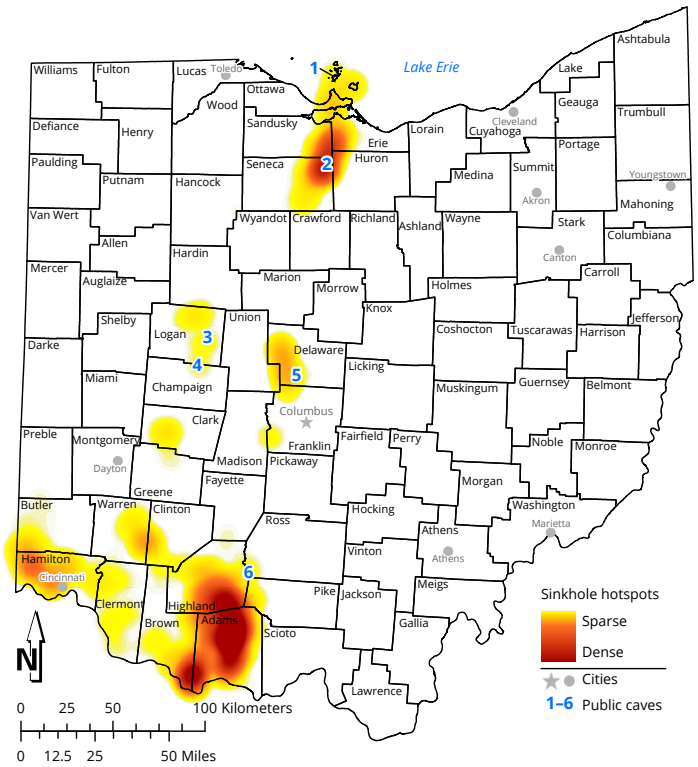

Figure 3. Heat map of Ohio showing sinkhole hot spots. The densest karst areas are shown in red. Blue numbers indicate the locations of publicly accessible caves: (1) Crystal Cave and Perry's Cave, (2) Seneca Caverns, (3) Zane Shawnee Caverns, (4) Ohio Caverns, (5) Olentangy Caverns, and (6) Marble Cave and McKimmie's Cave at the Highlands Nature Sanctuary.

Risks associated with karst

The presence of karst features may have a notable impact on the potential pollution in an area. For example, in non-karst areas, soil and rock layers near the surface filter and slow contaminants. Conversely, sinkholes funnel water and contaminants directly into the water table and can contribute to groundwater pollution. Surface contaminants, such as excess fertilizer for field crops, drain into sinkholes and in some areas return to the land surface via natural springs. It is common to see springs with algae and watercress blooms fed by fertilizer-rich water (fig. 4). Waterways and houses with a water well in a karst area are at risk from anything that enters a sinkhole, including disease-causing bacteria such as *E. coli*, pesticides, animal carcasses, and other waste. In rural settings, farmers often allow portions of fields with sinkholes to remain wooded and unfarmed, reducing erosion and limiting the growth of sinkholes. On the other hand, many sinkholes are used to drain fields. Unfortunately, this practice encourages karst development and sinkhole growth as water carries away soil and exposes rock surfaces to continued dissolution.

Knowing the locations of karst features is important for planning purposes as karst features may pose a threat to current or future infrastructure, including roads, railways, pipelines, foundations, and other structures. During unusually high rainfall events, typical sinkhole drainage can reverse and cause flooding. One such event happened in Bellevue, Ohio, in 2009 when the water table rose above the land surface. The extensive karst in Bellevue results in a limited amount of surface drainage. Without nearby streams to drain away excess water, the flooding in 2009 was extensive and persistent, blocking roads and flooding basements.

Figure 4. A flowing natural spring overgrown by a vibrant plant community. The plants are enriched by the fertilizer-laden water flowing from the spring.

Subsurface karst is present in many areas of Ohio and can be a construction concern. For example, karst can be filled with sticky clay that is difficult to drill or tunnel through. Karst is also a source of secondary porosity and can lead to unexpected water input in subsurface excavations and the loss of water on the surface, a significant problem in a reservoir. Geothermal systems also can be hampered by karst when there is more subsurface connectivity than otherwise expected.

Mapping and documenting karst features helps monitor the growth of known sinkholes and the development of new ones. Ohioans living and working in karst regions of the state should always consider the potential for karst-related issues, especially developers, farmers, public planners, and homeowners. When sinkholes cannot be avoided, methods such as diverting away water, building low berms, or lining sinkholes with filter fabric can potentially reduce their negative impacts. Access to high-quality and up-to-date maps will ensure that land-use decisions near karst-prone areas are properly informed and contribute to better stewardship of Ohio's natural resources.

References & Further Reading

For more information about karst in Ohio, including data, publications, and maps, please visit **ohiodnr.gov/karst**.

Hobbs, H.H., III, 2009, The Glaciated Central Lowlands—Ohio, *in* Palmer, A.N., and Palmer, M.V., eds., Caves and Karst of the USA: National Speleological Society, p. 136–140.

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