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Sinkholes

Catastrophic Sinkhole Collapse in Missouri

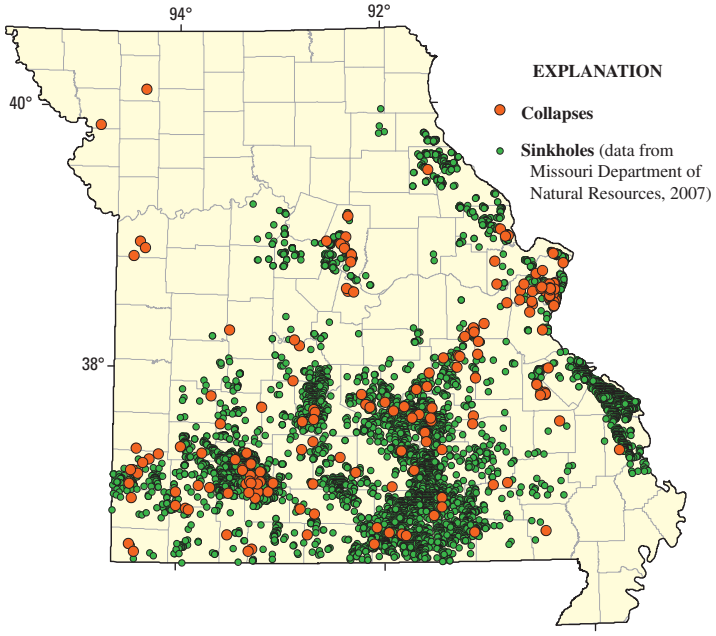
Sinkholes are a common feature in Missouri where limestone and dolomite outcrop. Though often considered a benign nuisance, sudden, catastrophic collapses can destroy property, delay construction projects, and contaminate ground water resources.

What is a "Sinkhole"?

A sinkhole is an area of ground that has no natural external surface drainage—when it rains, all of the water stays inside the sinkhole and typically drains into the subsurface. Sinkholes can vary from a few feet to hundreds of acres and from less than 1 to more than 100 feet deep. Some are shaped like shallow bowls or saucers whereas others have vertical walls; some hold water and form natural ponds. Two historic sinkhole ponds in southern Missouri are Tupelo Gum Pond and Cupola Pond. Typically, sinkholes form so slowly that little change is seen in one's lifetime, but they can form suddenly when a collapse occurs. Such a collapse can have a dramatic effect if it occurs in an urban setting.

Where do sinkholes form?

Sinkholes form in what geologists call "karst terrain." Karst terrain is a region where the bedrock can be dissolved by ground water. Bedrock in a karst area typically is limestone, dolomite (a rock similar to limestone but with magnesium along with the calcium normally present in the minerals that form the rocks) or gypsum. Karst areas are characterized by special features not present elsewhere: springs, caves, dry streams that lose water underground, and sinkholes.



Sinkhole distribution in Missouri.

These features all form because water that is slightly acidic from absorbing carbon dioxide from the air and soil dissolves the bedrock and forms pathways and channels in the rock. These pathways, called conduits, are like underground plumbing that carries water from the surface to springs located in valleys. Eventually, these conduits become exposed by erosion and, if large enough, become caves.

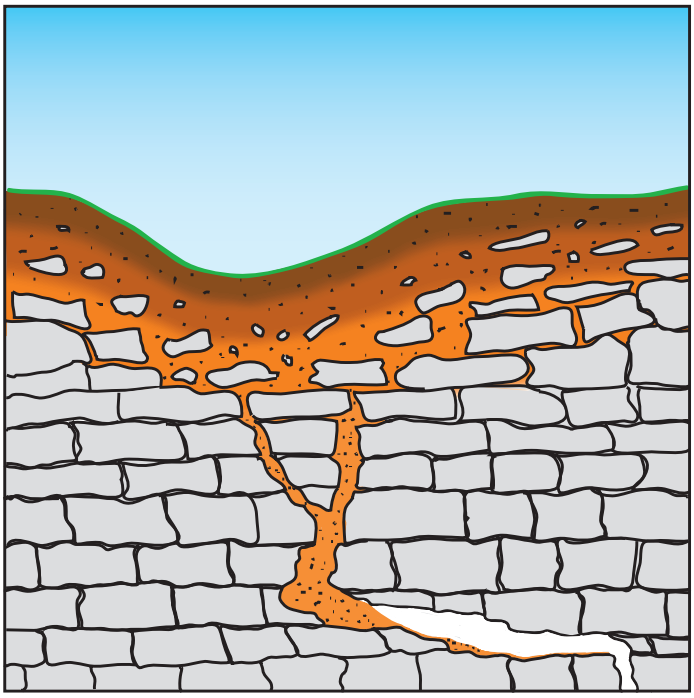
Sometimes conduits are called underground rivers. Like a river system, they have an area where the water collects and supplies the flow. For a surface river, this is called the basin; for a conduit, it is called the "recharge area." Conduits collect and transport surface water (runoff) from the recharge area—which can range from a few hundred square feet to hundreds of square miles—to springs where it rises to the surface to join the more typical stream and river system. Sinkholes form in the recharge area where the surface water is flowing into the subsurface and entering a conduit.

How do sinkholes form?

When water from rainfall moves down through the soil and encounters bedrock in karst terrain, the bedrock begins to dissolve along horizontal and vertical cracks and crevices in the rock. Eventually, these cracks and crevices, which are the beginning of a conduit system, become large enough to start transporting small soil particles. As these small particles of soil are carried off, the surface of the soil above the conduit starts slumping down gradually, and a small depression forms on the surface of the ground. This small depression acts like a funnel and gathers even more water, which makes the conduit larger and washes more soil into the conduit. Not all of the soil particles get carried into the conduit; if the soil contains a large amount of clay, the conduit can become plugged and the sinkhole may start to hold water and form a natural pond.

What makes a sinkhole collapse suddenly?

Catastrophic collapse sinkholes are more rare than the bowl-shaped type, but they are not uncommon. Between 1970 and 2007, the Missouri Department of Natural Resources examined more than 160 collapses reported by the public. Most of these collapses were small—less than 10 feet in diameter and 10 feet deep; some, however, are quite large and spectacular. Sinkhole collapses drained a lake in the St. Louis, Missouri, area, drained the West Plains, Missouri, sewage lagoon, and another in Nixa,



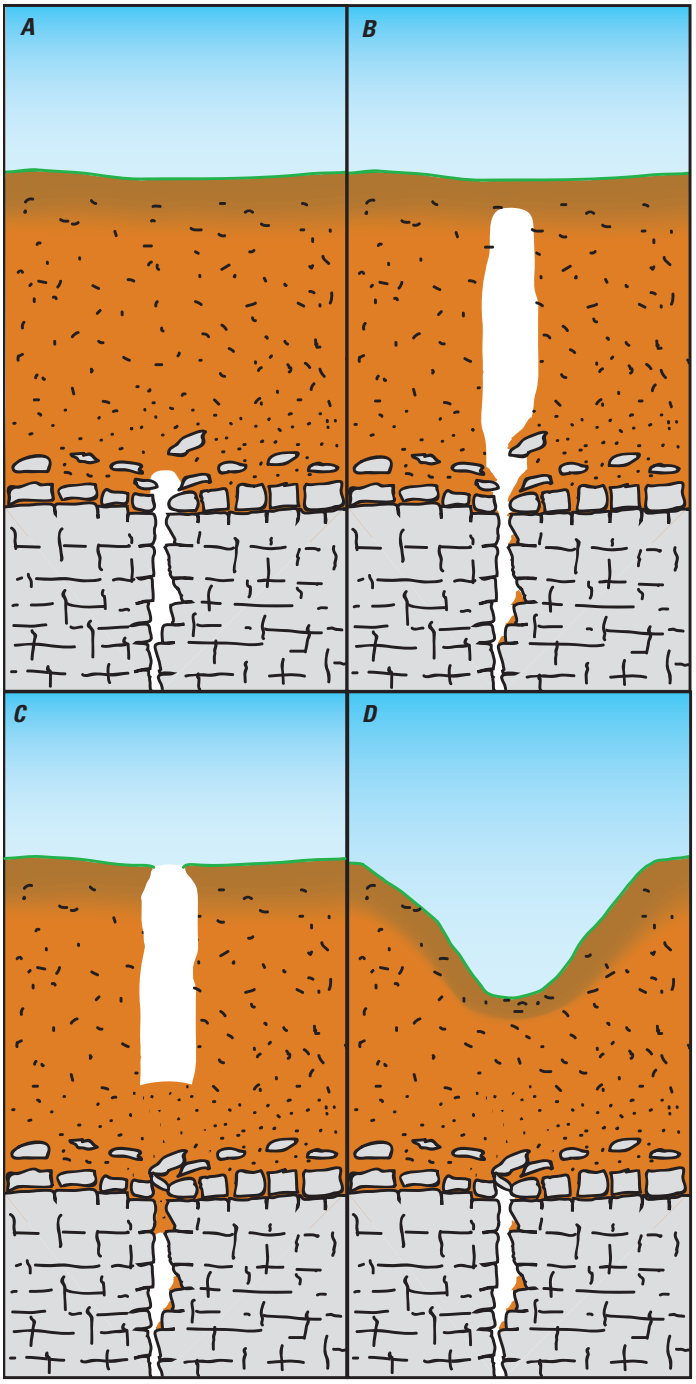
Bowl-shaped sinkhole.

Missouri, swallowed a car along with the garage that it was parked in!

Collapses form in essentially the same way as the more common bowl-shaped sinkholes. When the soil particles start washing into the conduit, the soil closer to the ground surface does not slump down, but starts forming a bridge. A void forms where the soil keeps washing into the conduit and, eventually, this hole grows large enough that the soil above it can no longer bridge it. The soil bridge then suddenly collapses into the void below and a sinkhole forms.

The process of forming a conduit and a soil bridge typically takes many years to decades to form and can be aggravated by human activities. Since the process of forming a sinkhole depends on water to carry away soil particles, anything that increases the amount of water flowing into the subsurface can speed up this process. Parking lots, streets, altered drainage from construction, and roof guttering are some things that can increase runoff; even weather can make a difference.

Collapses are more frequent after intense rainstorms, and there is some evidence that droughts play a role as well. Areas where the water table fluctuates or has lowered suddenly are more prone to collapse formation. Collapses are not limited to karst areas as they can form above old mines and even from leaky pipes—though they are much more frequent in areas that have significant karst development.



Formation of collapse—Soil bridges gap where sediment has been washing into a solution enlarged fracture, *A*. Over time, the void migrates upward through the soil, *B*. After the bridge thins, a sudden collapse, *C*, often plugs the drain and erosion will, after many years, transform the collapse into a more bowl-shaped sinkhole, *D*.

By James E. Kaufmann

Additional Information

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