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Sinkhole Science

Written by Sean McCollum

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A house slides into a giant sinkhole in San Francisco in 1995.

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Two Huge Holes

For a few weeks in 2007, people in a neighborhood of Guatemala City felt the ground tremble and shake. No one knew what was causing it.

Then on February 23, a huge hole suddenly opened in the street. A dozen houses tumbled into the pit, and several lives were lost. The hole was more than 330 feet (100 m) deep—deep enough to swallow two Statues of Liberty.



The 2007 Guatemala City sinkhole

In 2010, it happened again, fifteen blocks from the first hole. This time, the hole swallowed a three-story clothing factory and left another gaping **chasm** in a major intersection. Miraculously, no one was injured.

Sinkholes happen all over the world, in the middle of cities and in the middle of nowhere. Though sinkholes take years to form, each time a new sinkhole opens up in the earth, it takes people by surprise.

What Causes Sinkholes?

The ground we stand on feels solid. Underground, however, a lot is happening. Water trickles and flows, slowly **eroding** rocks and soil. This creates underground spaces. These result in sinkholes.

Sinkholes don't happen just anywhere, though. Most natural sinkholes form where there are certain kinds of soft **bedrock**. *Bedrock* is a layer of underground rock. The ground above it and on the surface is called the **overburden**.

Rain or underground water drips and flows into this bedrock and erodes it. This creates open spaces such as underground caves or caverns. Over time, these spaces get bigger.

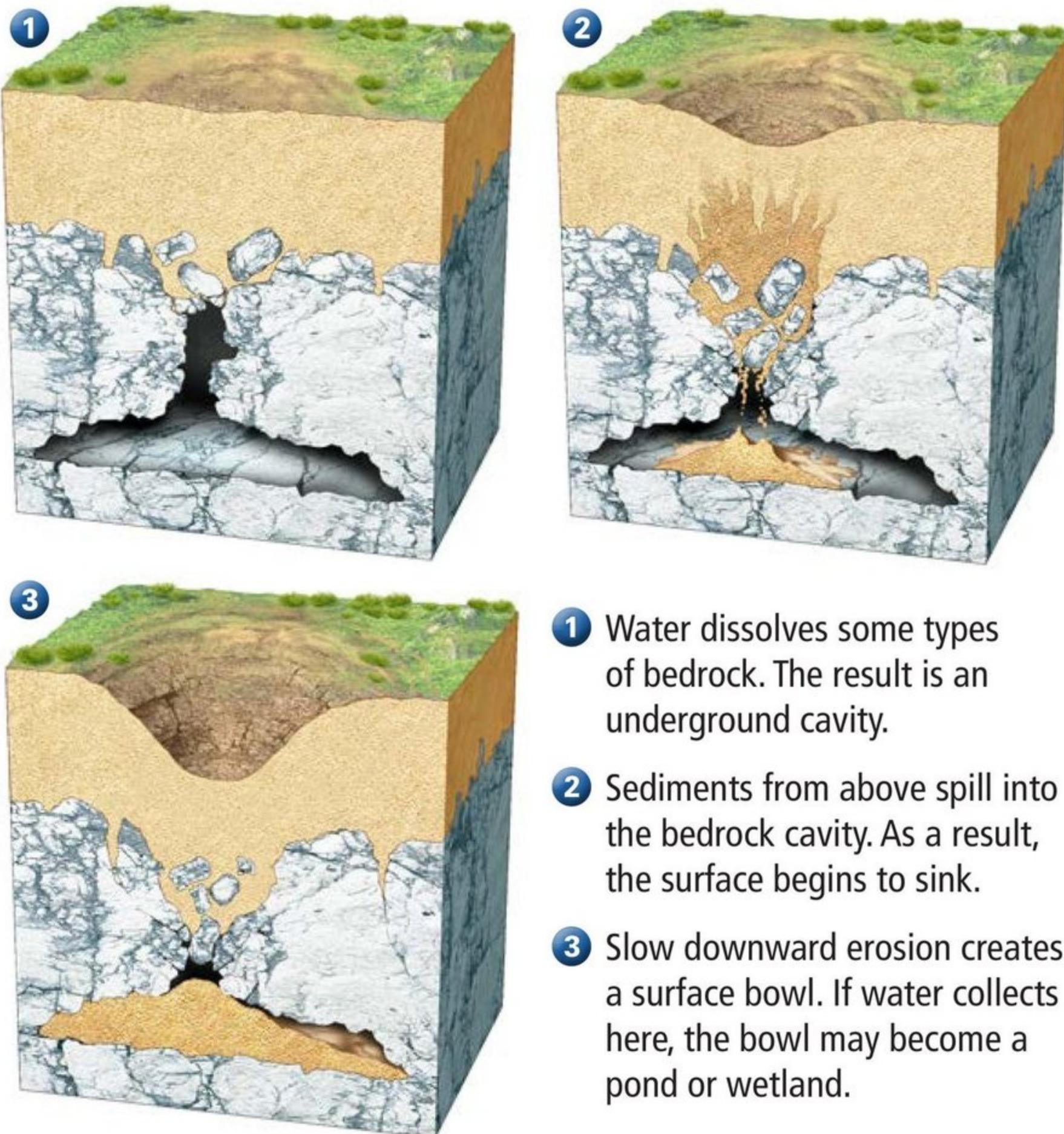
Eventually, the overburden may slowly drop down to form a sinkhole. Sometimes, though, sinkholes can open suddenly and swallow buildings, cars, and people.

Two Types

There are two main types of sinkholes. The first is a *cover-subsidence sinkhole* (*subside* means to sink or settle). A cover-subsidence sinkhole forms when water wears a space in the underground bedrock. The overburden above the bedrock then shifts downward.

Most sinkholes of this kind form slowly and may measure only a few yards across. The overburden may contain a lot of sand that easily slides into the underground space. These sinkholes often create a bowl shape on the surface. They may become ponds or wetlands if water has no way to drain out.

Cover-Subsidence Sinkhole



- ① Water dissolves some types of bedrock. The result is an underground cavity.
- ② Sediments from above spill into the bedrock cavity. As a result, the surface begins to sink.
- ③ Slow downward erosion creates a surface bowl. If water collects here, the bowl may become a pond or wetland.

The second type is a *cover-collapse sinkhole*. This sinkhole forms when a space gets bigger and bigger under the surface. The overburden gets thinner as dirt, sand, and other **sediment** fall into the space. The ground around this kind of sinkhole may contain a lot of sticky clay. Clay helps hold the overburden together. Without warning, though, the surface may collapse into the underground space.

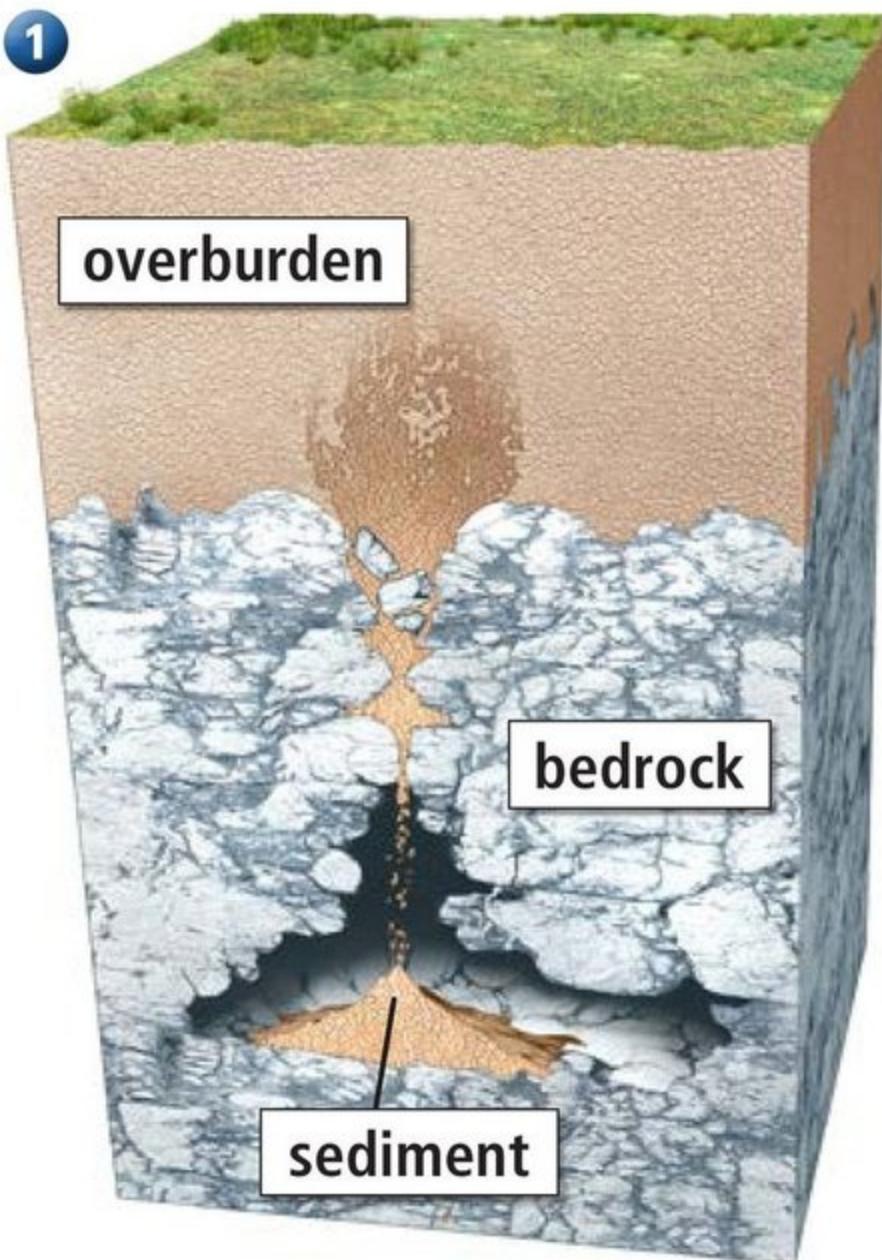
Areas that get a lot of sinkholes usually have bedrock made of **karst**. Karst is made of any type of rock that **dissolves** easily, such as limestone. Karst can also be formed of gypsum, dolomite, salt, or other minerals and rocks. Karst has many holes and cracks that water can flow into.

When rainwater soaks into the earth, it picks up a mild acid from leaves and plants. The mild acid dissolves karst. This helps create the underground spaces that cause natural sinkholes.

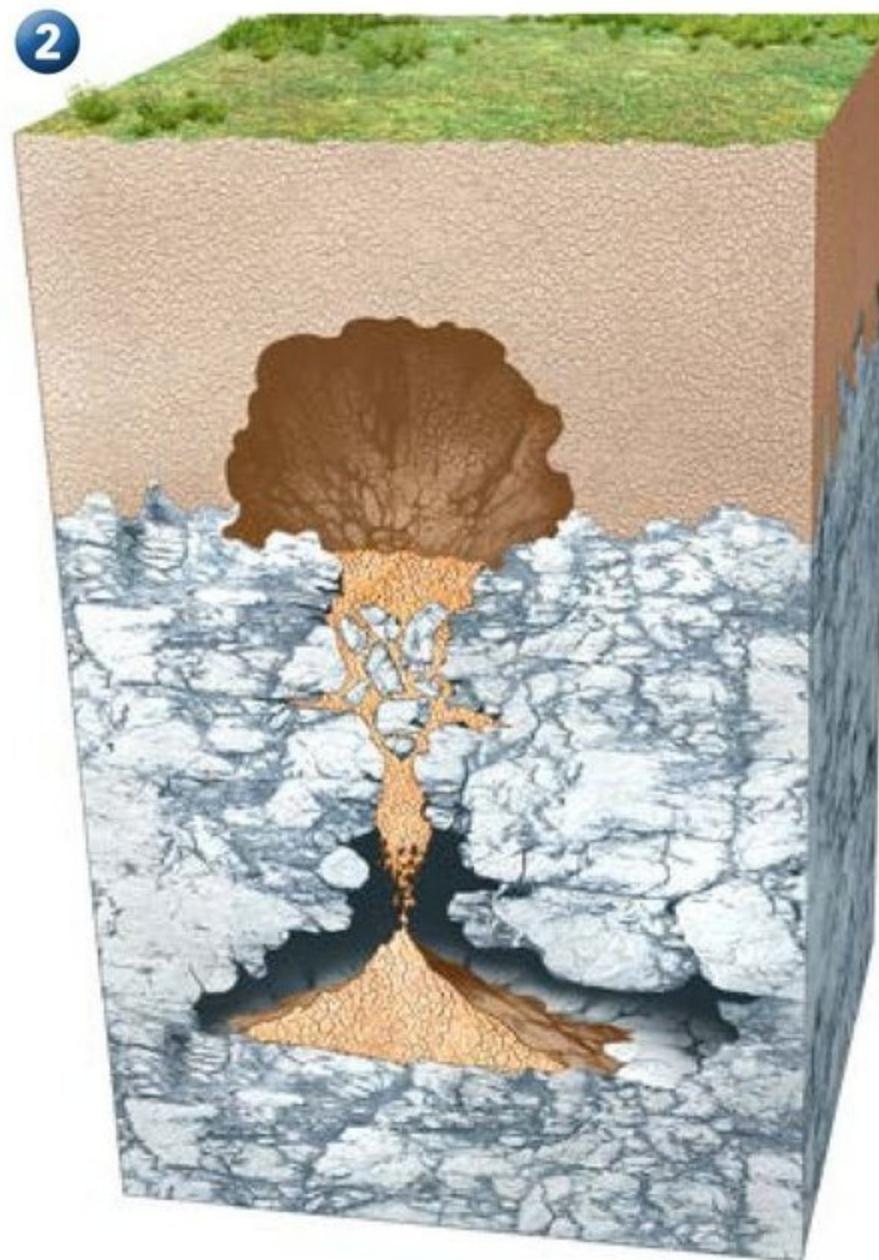


Sinkholes that collapse without warning sometimes pull buildings and vehicles into them, as did this sinkhole in Duluth, Minnesota, in 2012.

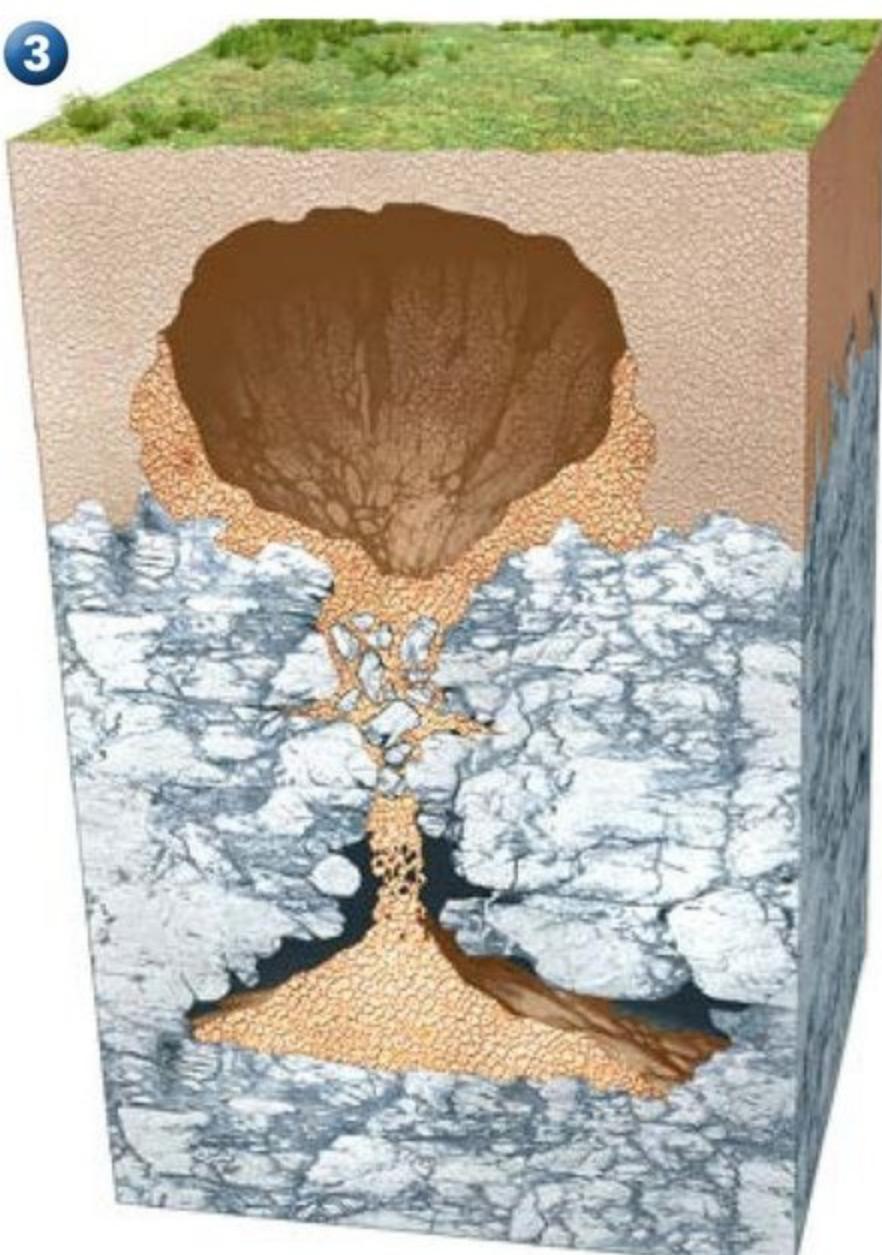
Cover-Collapse Sinkhole



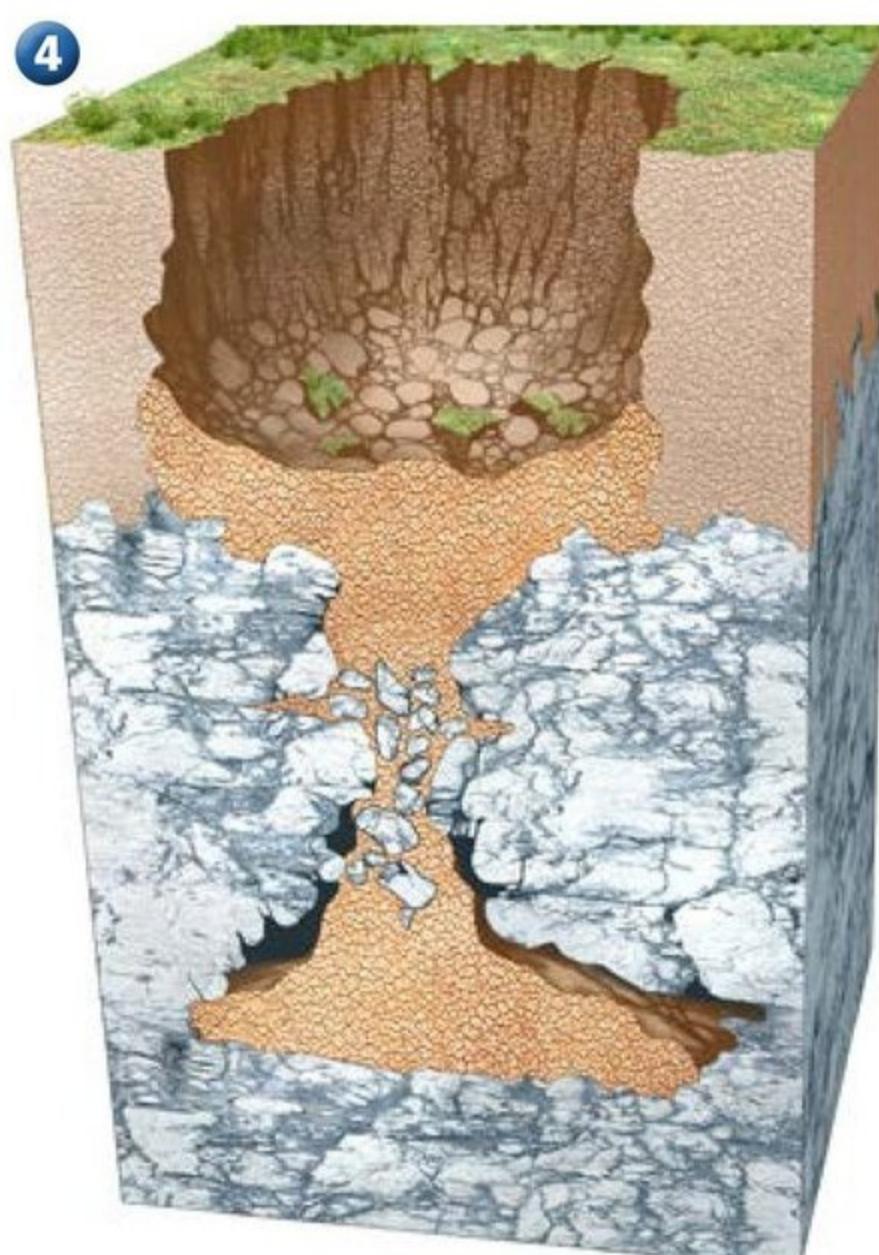
Sediment spills into a cavity in the bedrock.



The fallen sediment leaves an arch-shaped hollow in the remaining overburden.



The arch-shaped hollow continues to grow until very little overburden remains above it.

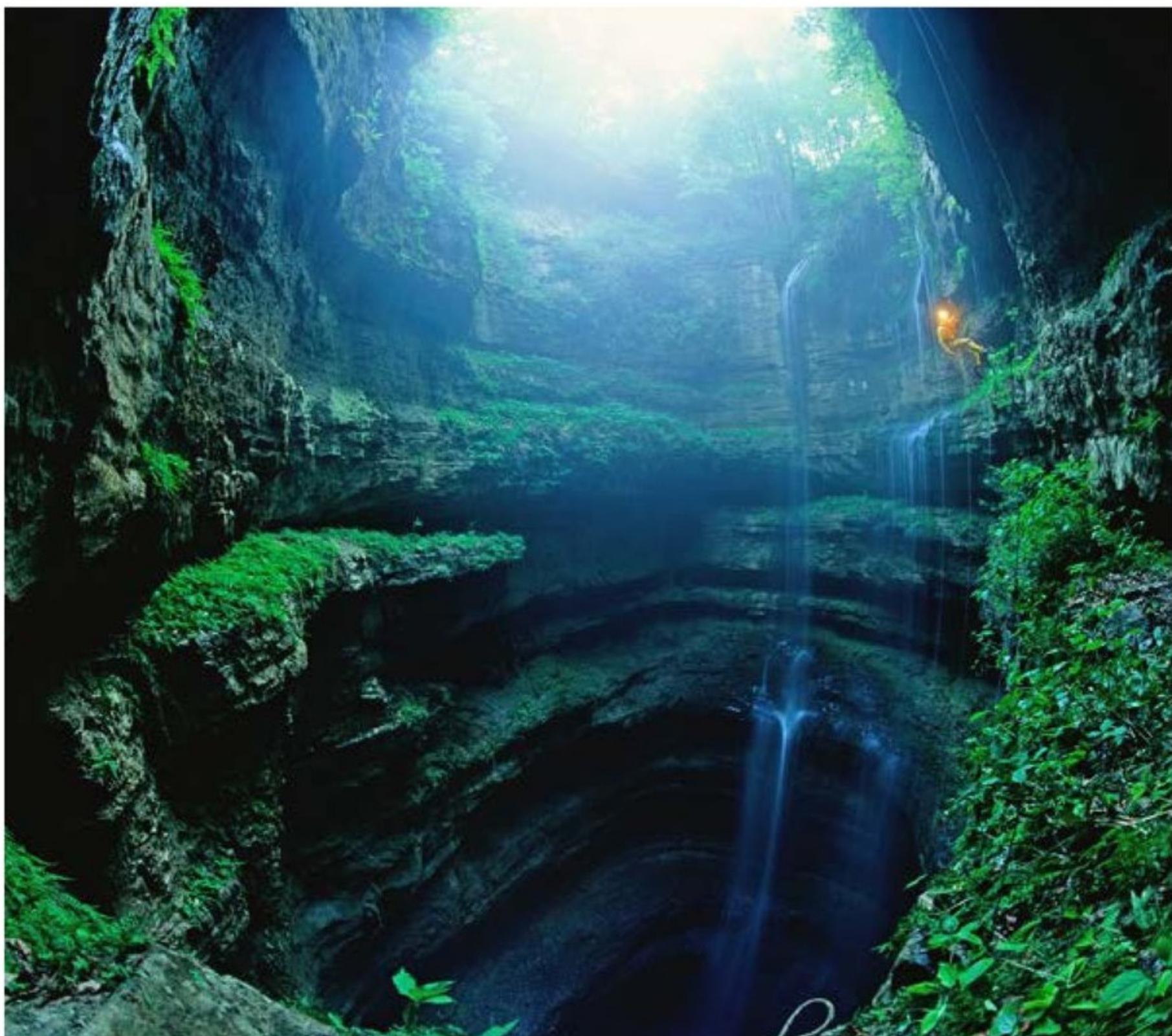


Eventually, that thin layer of overburden collapses. The result is a sudden and dramatic sinkhole.

Amazing Natural Sinkholes

Sinkholes fascinate geologists. They study them to learn more about how water and earth affect each other. Here are three amazing natural sinkholes from around the world.

The Qattara Depression is the world's largest natural sinkhole. It is located in Egypt and is 137 miles (220 km) long and 75 miles (120 km) wide. That is twice the area of the state of Rhode Island.



A caver drops into Alabama's Neversink Pit, another one of the world's amazing sinkholes.

China's Xiaozhai Tianskeng is considered the deepest sinkhole in the world. More than 2,165 feet (660 m) deep, this sinkhole could swallow a 200-story skyscraper.

The Sarisarinama sinkholes in Venezuela were discovered in 1961. Scientists have discovered plants and animals inside that are found nowhere else.

Sinkholes Caused by Humans

Some sinkholes result from underground construction. In cities, tunnels and pipes crisscross under many buildings and streets. If those pipes get old and worn out, they can collapse, allowing liquid to escape and eat away at the ground. Eventually, the pavement caves in.

Work crews must check these underground spaces regularly to make sure they are solid. If a sinkhole forms in a city it can do a lot of damage, as in Guatemala City, where leaking pipes may have triggered the gaping holes in the city streets.

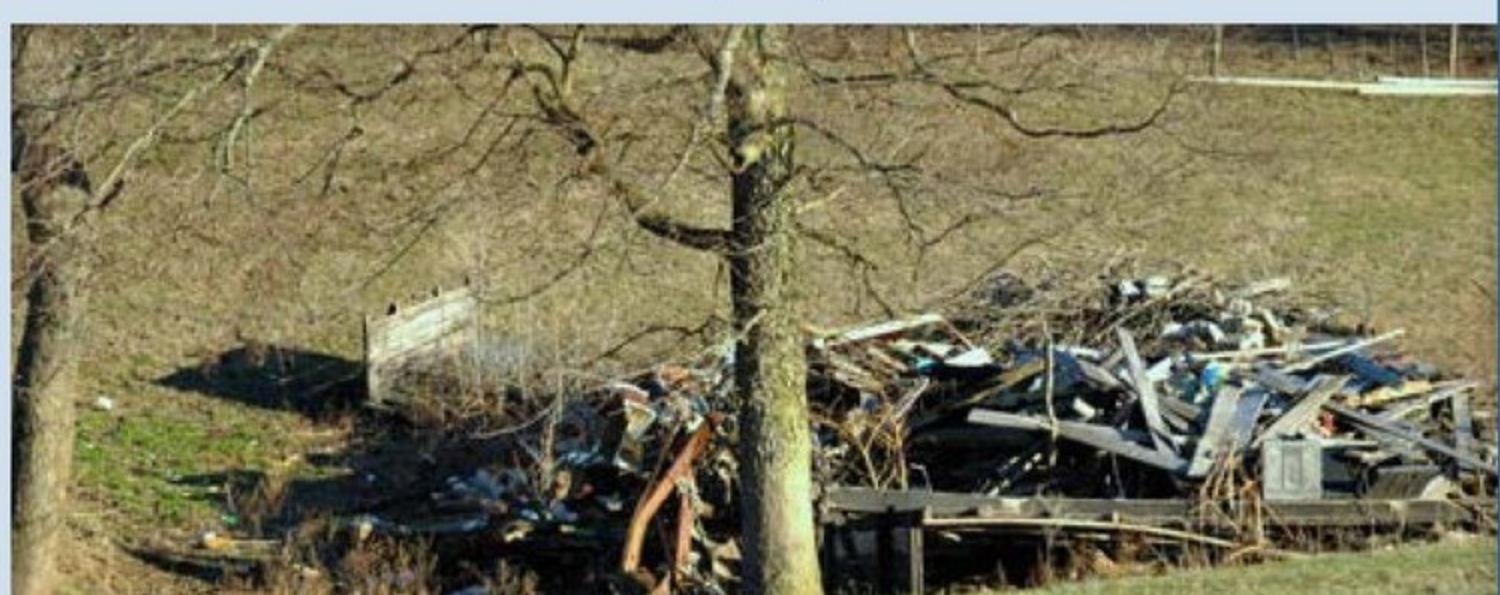
Underground **mines** can also cause sinkholes. Near one Russian city, underground water filled an old mine. The bedrock of salt began dissolving. In 1986, a huge sinkhole opened up. It grew to 780 feet (238 m) deep and covered more area than 25 football fields. It is still growing, and new sinkholes are opening up. Hundreds of people have had to leave their homes. To be safe, the entire city may need to move.

Some geologists argue that holes caused by human activity shouldn't be called sinkholes because true sinkholes result from natural processes.

Garbage In, Garbage Out

People sometimes treat sinkholes like garbage dumps. They will throw in junk, trash, even animal waste.

This is a terrible idea. Many sinkholes drain into underground water sources. This is the same water that people drink. It is the water that farmers use to water their crops. The result is pollution in our food and drinking water.



Loads of garbage hauled from a sinkhole.

Dealing with Sinkholes

Predicting where natural sinkholes will form is tricky. The erosion that creates them is usually hidden underground. The type of bedrock is the most important factor in whether or not sinkholes form.

Areas with soft bedrock that also get heavy rains are at even greater risk. The rainwater adds weight to the overburden. The draining water can also speed up underground erosion.





Sometimes cracks like this one in the wall of a house are a warning that a sinkhole is forming.

Tilting trees or signposts can be early clues that the ground is shifting. Growing cracks in walls and sidewalks can also warn that a sinkhole is getting ready to cause trouble.

If a sinkhole forms under a house, homeowners can pour tons of dirt and concrete into

the hole. This is called *grouting*. The goal is to plug the hole. Sometimes, though, the dirt and concrete just disappear into the underground space.

Another method uses steel rods. These long, strong rods are pushed into solid bedrock deep underground. The rods are then joined to the base of the house. This helps keep the building stable and safe.



People swim in a cenote (seh-NO-tay) in Yucatan, Mexico. A cenote is a deep natural sinkhole with a pool at the bottom.

Conclusion

Sinkholes can be **destructive**, but they are rarely dangerous. In some places, they are even beautiful. In parts of Mexico, for instance, sinkholes form lovely pools full of cool, clean water.

Sinkholes are also interesting to study. They show water's powerful effects on soil and rock. Even on solid ground, amazing things are happening beneath our feet.

Glossary

bedrock (<i>n.</i>)	the layer of solid rock underneath the ground's surface (p. 5)
chasm (<i>n.</i>)	a deep crack or pit in a planet's surface (p. 5)
destructive (<i>adj.</i>)	causing great damage or harm (p. 15)
dissolves (<i>v.</i>)	breaks down or disintegrates, usually because of contact with a liquid (p. 8)
eroding (<i>v.</i>)	wearing away rock or soil by water, wind, or ice (p. 5)
geologists (<i>n.</i>)	people who study the origin, physical nature, structure, and history of Earth (p. 10)
karst (<i>n.</i>)	an area of rock, such as limestone, that dissolves easily and that often has sinkholes, underground streams, and caverns (p. 8)
mines (<i>n.</i>)	places where minerals are taken from the ground by digging or blasting (p. 12)
overburden (<i>n.</i>)	the dirt, soil, and rocks above the bedrock or something of interest, such as minerals or artifacts (p. 5)
sediment (<i>n.</i>)	particles of dirt and rock that are carried by water, wind, or ice and deposited elsewhere (p. 7)
sinkholes (<i>n.</i>)	holes or land depressions that result from underground collapse, usually caused by water erosion (p. 5)
triggered (<i>v.</i>)	caused something to take place (p. 11)

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Title page: Umpherston Sinkhole Gardens, South Australia

Back cover: The Great Blue Hole is a sinkhole off the coast of Belize in the Caribbean Sea. It is the largest ocean sinkhole in the world. Its depth creates its deep blue color.

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