Karst

This giant sinkhole is the result of the dissolution of thick salt layers hundreds of feet below the surface. The size of this sinkhole can be judged by the truck in the background. *(Photo by Raymond C. Harris)*

What Is Karst?

Karst is the name applied to landforms that develop in areas underlain by comparatively soluble rocks such as limestone, gypsum, and salt. Karst terrain is characterized by solution features such as caves, sinkholes, depressions, enlarged joints and fractures, and internal drainage that can have a negative impact on use of the land. The name was derived from the Karst region of Slovenia (part of the former Yugoslavia), which is underlain by limestone.

The passage of water through soluble rocks results in the formation of cavities in the rock. If the ceiling of a cavity collapses, a sinkhole may form at the ground surface. Karst terrain is commonly characterized by highly uneven depths to bedrock; residual red, clay-rich soil; and surface drainages that disappear underground. Voids in bedrock can capture surface-water flow and disrupt the surface drainage system. Soil and other surficial material may be washed into the underground network of cavities.

Hazards from karst include the formation of sinkholes or collapse pits, as well as cracking of walls, foundations, roads, and other structures. Less obvious but equally important are the impacts karst can have on water quality. Networks of interconnected caverns and voids allow contaminants such as sewage, landfill leachate, or hazardous chemicals to travel unimpeded into shallow aquifers that may supply drinking water. The possible presence of solution features must be carefully considered when making land-management decisions, including protecting water supply, locating septic systems, and siting of waste disposal facilities.

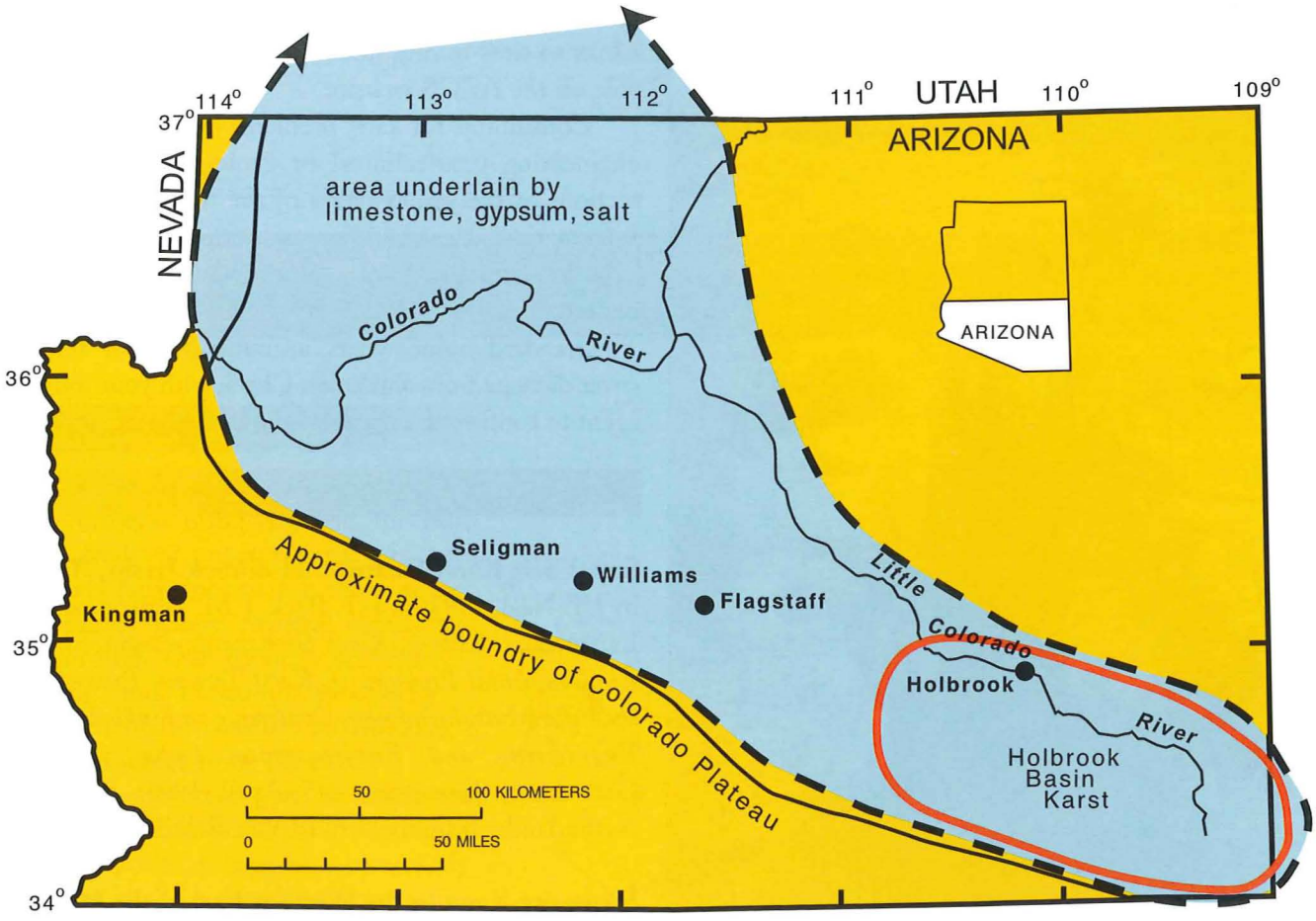
Areas In Arizona Affected By Karst

Karst terrain is common on the Colorado Plateau of northern Arizona. Because the Colorado Plateau has extensive areas of limestone at the surface and gypsum and salt in the subsurface, there is potential for property damage and severe water-quality problems related to dissolution of these soluble rocks. Karst features are particularly common south of Interstate 40, from the Springerville-Saint Johns area northwest to Winslow, and in the Grand Canyon region from Flagstaff to the Utah border.

Karst in the southern part of the Colorado Plateau resulted from the dissolution of salt and gypsum beds. Collapse propagated upward through the overlying sandstone and limestone. Minor karst features are also forming at the surface in limestone. More than 300 sinkholes have been identified in the area between Springerville and Winslow.

On topographic maps, sinks show up as small depressions that have internal drainage and commonly contain small lakes. In limestone terrane in northern Arizona, open caverns are encountered commonly when drilling water wells. In the Sedona area sinkhole collapse has occurred in historic times.

Karst features also are present in southern Arizona in areas underlain by limestone. Examples are Colossal Cave near Tucson, Kartchner Caverns near Benson, and numerous other caves in the mountains of southeastern



The Colorado Plateau of northern Arizona has large areas of karst features. Most of the karst in the Holbrook region is related to dissolution of thick layers of salt at depth. In other parts of the plateau, karst features result from dissolution of limestone exposed at the surface.

Arizona. Because exposures of limestone in southeastern Arizona are not as extensive as on the Colorado Plateau, collapse features are not as common. Solution features such as enlarged joints and small caves are numerous, however, and present the same concerns for water quality as those on the Plateau.

What To Do About Karst

Surface karst features

If you are planning to build in an area that has the potential for karst, we strongly advise that you thoroughly examine a property for signs of karst features before construction. When exposed at the surface, karst features are usually quite obvious. Depressions, holes, and fissures are readily apparent on the ground and, if large enough, can be distinguished on aerial photographs or topographic maps. Geologic maps show areas underlain by limestone.

The simplest method to mitigate a sinkhole or depression is to fill it in. However, this method works only if the sinkhole is inactive and is already mostly filled in at depth. If a sinkhole is still open at depth and connected to other voids, surface material may continue to wash into the voids. Filling an active sinkhole may be only a temporary solution. In any case, surface drainage should be directed away from karst features to avoid piping or collapse.

Hidden karst features

Problems can arise when solution features are hidden or are not obvious at the surface. The additional weight of a building may cause collapse if the roof of a cavern is close to the surface. A septic system installed over unidentified voids may result in water contamination.

To detect the presence of near-surface karst, several geophysical methods can be employed. These include ground-penetrating radar, electrical resistivity, spontaneous potential, gravity, and magnetic surveys. These methods rely on differences in physical properties between the caverns or their filling materials versus the surrounding rock.

Bending of rock layers above voids created by dissolution of salt at depth has caused giant cracks southwest of Holbrook. *(Photo by Raymond C. Harris)*

Differential settling is an indirect problem associated with building on karst. Because karst regions often have variable depth to bedrock, a building may sit partly on soil and partly on solid bedrock. Settling of the soil may occur, causing cracking of foundations and walls. Compounding the potential for fill-related structural damage is the abundance of expansive clay in soils on the Colorado Plateau, which may cause its own problems. (Expansive clay is discussed in the chapter on **Problem Soils**.)

Where To Go For More Information

U.S. Geological Survey topographic maps depict depressions and sinkholes in numerous areas on the Colorado Plateau. Topographic maps may be purchased at outdoor and sporting goods stores, map stores, and Arizona Geological Survey (AZGS). Geologic maps of karst areas are available from the AZGS and USGS. Links to sites having information about karst are available on the AZGS website.

Consultants for karst problems may be found in the engineering (geotechnical or geological), or geologist sections of the yellow pages of the telephone directory. Information about building restrictions in karst terrain may be available from county planning and zoning departments.

Standard homeowners insurance may or may not cover damage from sinkholes. Check with your insurance agent to confirm if karst-related damage is included.

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