Karst Landscape—Astonishing Beauty and Hidden Hazards

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What is karst?

Fifty-five percent of the state of Kentucky has landscape characterized by karst, yet the term "karst" is unfamiliar to many people outside of the community of geoscientists. The *Glossary of Geology*[1] defines karst as "A type of topography that is formed on limestone, gypsum, and other rocks, primarily by dissolution, and that is characterized by sinkholes, caves, and underground drainage." The term is derived from a Slavic word that literally means "barren, stony ground." It is also the name of a region in Slovenia near the border with Italy that is well known for its sinkholes and springs. In Kentucky, limestone and dolostone rock units are susceptible to developing karst topography, which has formed over hundreds of thousands of years.

Distinctive karst landscape in Kentucky

Much of the scenic beauty in the state is related to karst. Kentucky is one of the most famous karst areas in the world. Mammoth Cave in western Kentucky is the longest surveyed cave in the world, with more than 350 miles of passages. Another cave system in the same region is over 100 miles in surveyed length. Two other caves in the state stretch more than 30 miles, and nine Kentucky caves are among the 50 longest caves in the United States. Karst landscape is one of the reasons why the world-famous thoroughbred horse industry is located in the Inner Bluegrass. The combination of fertile soil and spring water containing dissolved calcium and phosphate from the limestone rock contributes to a unique environment for strong bone growth in horses. Much of the rich agricultural land that supports the historically distinctive Kentucky burley tobacco and bourbon industries, and a substantial amount of the Daniel Boone National Forest, are underlain by karst.

Hidden hazards of karst landscape

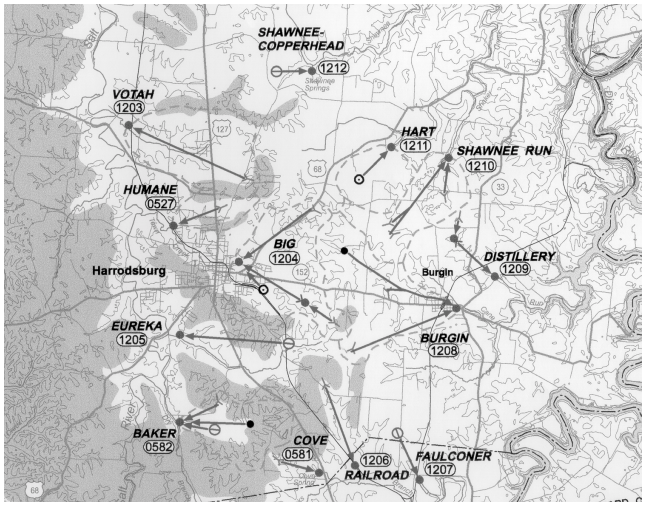
The same landscape, while offering economic and recreational opportunities, can pose geologic hazards. As water moves underground, from hilltops toward streams through tiny fractures in limestone bedrock, limestone and dolostone rock is slowly dissolved away by weak acids found naturally in rain and soil water. This dissolution of rock can create different karst hazards, including sinkhole flooding, sudden cover collapse, collapse of lagoons resulting in waste spills, and infiltration of radon gas. The economic losses of karst hazards are largely hidden because they are distributed across the state, and although frequent, they typically affect small numbers of people in each incident. The economic costs are often indirect. They are absorbed by local government, and reflected in higher taxes required to repair roads and extend public water lines to serve communities whose groundwater supplies from karst aquifers have been polluted.

Sinkhole flooding—A sinkhole is an internally drained depression in a karst area. Its shape is circular, and it is bowl-shaped in cross section. Water drains to the subsurface through the soil and cracks in the bedrock that have been enlarged. Flooding can result when the outlets of sinkholes are clogged by the accumulation of trash, or when the water table rises. This will inevitably cause flooding, either at the site of the sinkhole or at another sinkhole somewhere along the flow path. Researchers at KGS are compiling data about sinkhole collapses. A sinkhole collapse occurs when soil collapses into an underlying crack that has been enlarged as water dissolves limestone. If you know where and when a sinkhole collapse occurred, you can fill out a reporting form on the KGS Web site at www.uky.edu/KGS/announce. If enough data are obtained, KGS will develop maps showing the probability that a sinkhole will form. The maps will show the average number of cover-collapse sinkholes that will form in a unit area within a specified period of time (for example, two sinkholes a year per square mile).

Radon gas—Radon is considered one of the causes of lung cancer. When constructing homes and other buildings in central Kentucky, keep radon in mind. The Tanglewood Member of the Lexington Limestone, and other geologic units, can pose a problem if proper precautions are not taken. The phosphate minerals in the limestone contain traces of uranium, which releases radon when it decays. Radon can accumulate in karst cavities underneath a home, and rise up into the home as a result of changes in atmospheric pressure. If homes or other buildings are built on the Tanglewood Limestone Member, care should be

One of the hidden karst hazards: this highway near Bowling Green caved in as a result of sudden cover collapse.

[1]Jackson, J.A., 1997, Glossary of geology [4th ed.]: American Geological Institute, 769 p.



Part of the 1:100,000-scale karst groundwater basin map for the Harrodsburg 30 x 60 minute quadrangle.

taken to make sure that the buildings, basements in particular, are well ventilated so that radon gas will not accumulate.

The expertise of hydrogeologists at KGS, along with topographic and other maps published by KGS, are resources available to the public to identify geologic hazards, and mitigate the risks associated with those hazards.

Karst and protecting groundwater quality

Pollution of groundwater has become an environmental concern, particularly for rural landowners, because groundwater supplies a large percentage of rural drinking water and water for agricultural use. One-quarter of Kentucky's population depends on groundwater for its drinking-water supply. Information from geologic maps can be used to identify areas that may be susceptible to groundwater contamination. This is particularly important in areas with karst. Contaminants or pollutants such as pesticides, fertilizers, animal waste, waste leaking from landfills and septic tanks, runoff from parking lots in urban areas, or chemical spills from vehicle accidents drain in passageways below the surface with little filtration or chemical changes.

Much of the groundwater in Kentucky is stored in karst aquifers. To promote greater awareness of the need for environmental protection of this valuable resource, KGS has published a color poster, "Protect Kentucky's Karst Aquifers from Nonpoint-Source Pollution," by Jim Currens. The poster defines karst aquifers and nonpoint-source pollution, explains how karst aquifers become polluted, and outlines suggestions for protecting karst aquifers. This information will be of interest to environmentalists, naturalists, teachers and students, and the general public. The poster is available free at the KGS Publication Sales office on the University of Kentucky campus; copies are also available by mail for the cost of shipping and handling.

Hydrogeologists use groundwater dye-trace experiments to determine the general direction of groundwater movement in karst areas and identify the location, size, and shape of watersheds draining to specific springs. In these experiments, environmentally safe dyes are poured into a spring or sinking stream (a small stream that disappears underground). Packets of material that absorb the dye are attached to anchors and placed in springs at which the dye might reappear.

The results of dye-trace experiments allow hydrogeologists to map groundwater flow paths. This information is used to determine the locations of karst groundwater basins, which are plotted on 30 x 60 minute quadrangle maps (1:100,000 scale). These maps, published by KGS, can be used by emergency-response personnel to minimize the damage to karst aquifers and drinking-water supplies, if hazardous-waste spills or other accidents introduce contaminants into a groundwater system.

Karst groundwater basin maps are available for the Beaver Dam, Bowling Green, Campbellsville, Harrodsburg, Lexington, and Somerset 30 x 60 minute quadrangles. In a forthcoming publication, *Kentucky Is Karst Country,* author Jim Currens discusses, in nontechnical language, karst landscape, sinkholes, springs, and geologic hazards, and offers advice for protecting karst groundwater resources.

The karst groundwater basin maps and other relevant publications are available online at www.uky.edu/KGS/pubs/lop.htm. From this site, a map or publication can be downloaded as a PDF file and viewed using Acrobat Reader (available free online from Adobe). To order a publication, please contact the Publication Sales office at 859.257.3896 or call toll free 1.877.778.7827.

For more information about the karst research program at the Kentucky Geological Survey, contact Jim Currens at 257-5500 or by e-mail at currens@kgs.mm.uky.edu. ❖

Nontoxic, colored dyes are added to springs to trace the flow paths of groundwater. Dark area in water is dye.

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