

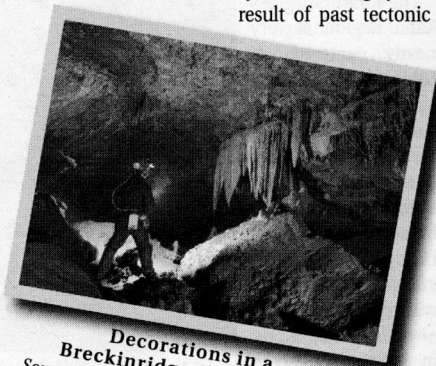
ENVIRONMENT & NATURAL RESOURCES

Caves & Karst

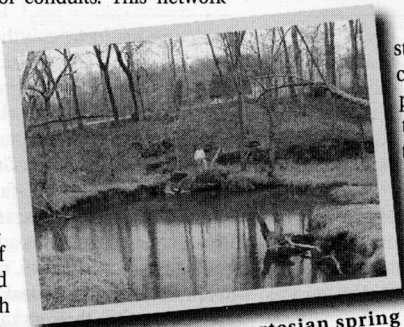
Dr. Gary O'Dell

In his 1784 book, "Discovery, Settlement and Present State of Kentucke," John Filson wrote: "Caves are found in this country amazingly large; in some of which you may travel several miles under a fine limestone rock, supported by curious arches and pillars: in most of them runs a stream of water." The size and splendor of Kentucky's caves are today still a source of amazement to visitors. Kentucky is home to Mammoth Cave, which, with more than 360 miles of mapped passageways, is the world's longest cave. Although Mammoth is certainly the most significant cave in the state, the geology of Kentucky has promoted the formation of many thousands of other caves contained within a distinctive landscape type known as "karst." Karst landscapes are characterized by subsurface drainage and landscape features such as sinkholes, sinking streams, caves and springs. In karst, the typical patterns of drainage by surface streams found elsewhere are absent or interrupted, since flow takes place underground through a network of conduits. This network develops as bedrock fractures are enlarged by the circulation of naturally acidic groundwater that slowly dissolves limestone, dolomite and other carbonate sedimentary rocks. Approximately half of Kentucky's land area displays such features and is considered karst terrain. Precipitation falling to the earth is naturally slightly acidic, the result of carbon dioxide and water vapor combining in the atmosphere to form carbonic acid. This acidity is increased as water filters through the soil and absorbs more carbon dioxide from organic matter. The relatively weak solution of carbonic acid in groundwa-

ter is capable of dissolving rocks such as limestone. Acidic water percolates downward through the soil cover and into the bedrock, following the network of joints and bedding planes. Vertical bedrock fractures, or joints, are largely the result of past tectonic



Decorations in a Breckinridge County cave
Source: Chris Anderson, Darklight Imagery



This "blue hole" or artesian spring in Allen County is one of the largest in Kentucky
Source: Gary O'Dell

stresses that have cracked the rock layers, providing pathways for downward penetration of groundwater. Bedrock structure is thus an important control upon the conduit pathways that develops as acidic groundwater dissolves the rock. As vertical fractures just beneath the soil cover are enlarged by removal of the rock, eventually the soil slumps downward to form an enclosed depression known as a sinkhole. Water enters a karst conduit system through direct inlet points

such as sinkholes and sinking streams, and by a more diffuse and widespread recharge that takes place beneath the soil. The enlargement of bedrock fractures creates an extensive plumbing system of tubes and conduits that carry groundwater to lower elevations, where it is discharged as springs. As the

channel of a surface stream becomes wider and deeper downstream as tributaries join, the conduits in an underground system increase in diameter in a downstream direction.

There are four distinct cave regions in Kentucky: the Pine Mountain Karst Region, Inner Bluegrass Karst Region, Eastern Pennyroyal Karst Region and the Western Pennyroyal Karst Region. These four regions are differentiated primarily by the age of the carbonate rocks in which the cave and conduit systems are developed and their geography.

The Pine Mountain Karst Region is a long narrow strip at the extreme southeastern corner of the state, representing a band of limestone of Mississippian age exposed at the northwestern edge of the Pine Mountain thrust fault.

The Inner Bluegrass Karst Region is very nearly centered on Lexington, a roughly circular area of limestones and dolomites of Ordovician age exposed by the weathering of the upward bulge of the Jessamine Dome. The rock strata are nearly horizontal, with a very slight dip away from the center in all directions except to the southeast where the Lexington Fault

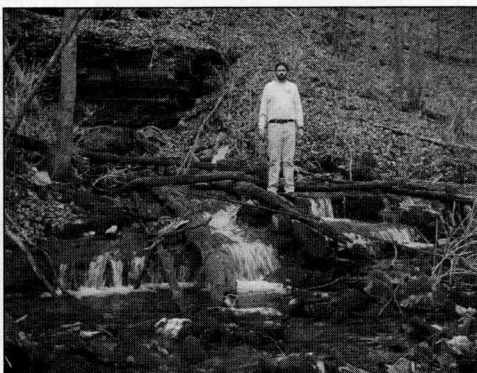
System comprises the boundary of the karst area. The rocks in the region tend to be rather thinly bedded, and often interbedded with shales, which tends to limit development of extensive cave networks. Although several hundred caves are known in the region, with few exceptions, most of these are short, low and wet.

The Eastern and Western Pennyroyal Karst Regions are both developed on carbonate sedimentary rocks of Mississippian age. These carbonate rocks are relatively pure, thickly bedded, and often of considerable vertical extent, allowing the development of multi-level cave systems and large passages. Carter Caves State Resort Park is located in the northern part of the Eastern Pennyroyal, and many large cave systems are found in the southeastern section. The most famous cave system in the world, Mammoth Cave, is found in the Western Pennyroyal Karst Region. The karst area stretches in an arc around the hilly, non-karst Western Coal Field region. The edge of the coalfield region is a dissected landscape of

ridges and valleys in which cavernous limestones are capped by non-soluble sandstones and shales. The Mammoth Cave system is located in this area. The area around Mammoth Cave is probably the best-known and most intensively studied karst region in the world, and has been designated a World Heritage Region by the U.N. Educational, Scientific, and Cultural Organization.

The first explorers and settlers of Kentucky, as Filson noted, were greatly impressed by the many caves and abundant springs of clear water in this land. Spring water was then, as today, perceived as being the highest quality water supply, and the location of springs had a strong influence upon the early settlement pattern. As the land was surveyed,

claimed and settled, first priority was given to tracts containing a significant spring. Individual settlements or stations were often situated in close proximity to a significant spring. In the Inner Bluegrass Karst Region, for example, communities originally sited to take advantage of a particular spring include Lancaster, Georgetown, Versailles, Paris and Lexington. Early deeds



"300 Springs" in Hart County

Source: Gary O'Dell

recorded in Kentucky courthouses exhibit a well-developed terminology describing karst features such as springs, "sinking springs," and "blue holes." Urban growth and land development upon a karst landscape also imposes certain problems not evident in other terrain types. Groundwater contamination by chemical pollutants and pathogenic organisms is a particular hazard. Karst aquifers exist at relatively shallow depths and are easily contaminated by a variety of causes, ranging from runoff of agricultural chemicals to leaking sewer lines. Since water flows swiftly through karst conduits and thus spends relatively little time underground there is only a slight reduction in potential pathogens, nor is there any filtration of the water flow as occurs in sand and gravel aquifers. Too often sinkholes are regarded by a property owner simply as a convenient place to dispose of trash or waste, unaware that what is dumped into a sinkhole today may show up in his neighbor's drinking water spring tomorrow.