INTRODUCTION TO THE KARST HYDROLOGY OF THE MAMMOTH CAVE AREA

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LIMESTONE AQUIFERS

Karst in Carbonate Terrains

Scattered widely over the Earth is a rather peculiar landscape known as “karst.” Karst landscapes are often pocked and pitted lands of sinkholes, limestone towers and steep-sided hills, underground drainage, and caves. Most karst is formed on carbonate rocks such as limestones or dolomites, sometimes on gypsum, and more rarely on rocks of other lithologies. Limestone karst is the most extensively developed, has the broadest regional extent, and has the most elaborate and highly integrated underground drainage and cavern systems.

Karst landscapes have attracted human attention since the dawn of recorded history. Many karst lands are difficult to put into agriculture; sinkholes are not easy to plow. In contrast, some of the richest farmlands on Earth are thick, mildly alkaline limestone soils on landscapes that are also called karst. However, soils are easily lost to the subsurface through solution cavities, and some of the most inhospitable terrains on Earth are located in karst. The Burren of western Ireland is a bleak rocky plain, barren of trees, bushes, or shrubs, with only sparse blades of grass on a shingly rubble of solution-carved limestone rock. In the Mediterranean, overgrazing thousands of years ago destroyed the soil-holding plants, which allowed soils to be flushed down solution cavities; a land that might once have been rich and
fertile is now essentially a desert. In the tropics (Cuba, Jamaica, Puerto Rico, Borneo, New Guinea, and South China) massive limestones have been carved by solution into residual towers, conical hills, and intermediate deep bowl-shaped depressions.

Karst landscapes can include underground rivers. Streams that flow from island interiors; streams that flow from borderlands on clastic rocks; streams that flow down the mountains of the Rockies, the Alleghenies, the Cumberlands, or the Ozarks sink into open cave entrances or into swallow holes at the contact between the clastic rocks and the underlying limestones. The sinking streams then reappear many kilometers away as huge limestone springs. Underground water in karst, unlike groundwater in nonkarstic rocks, is concentrated in natural pipes dissolved from the solid rock. When water tables are lowered, these water-filled conduits drain, dry out, and fill with air, and some develop entrances that become the caves accessible to human exploration.

Cave exploration has been a booming pastime in North America since the 1950s. With improved equipment, new types of rope and devices for descending deep pits, and wet suits and scuba equipment for exploring water-filled passages, the well-trained, motivated, and dedicated explorers of today are pushing far beyond the limits of what would have been possible only a few years ago. Indeed, the decade of the 1980s might well be called the “golden age” of cave exploration in North America. This growth of exploration has added to our knowledge of the hydrology of karst aquifers.

Sometimes developed to dramatic extents, sometimes visible only to the trained professional eye, karst terrains make up, according to several estimates, about 15% of the Earth’s land surface. Of these, few have attracted more attention than the doline karst and the great limestone caves that lie under and around Mammoth Cave National Park in south-central Kentucky.

**Land-Use Hazards in Karst**

Development of karst terrains runs into hazards that result from three unique characteristics of the karst landscape.

1. The soil-bedrock contact is often irregular. Deep solution along joints and fractures produces a cutter-and-pinnacle topography that can be completely masked by the soil cover.
2. The network of solution cavities extending downward from the surface permits the efficient transport of clastic material by groundwater infiltration. The phenomenon of soil piping is extremely efficient in transporting soils from the surface to the subsurface.
3. The presence of shallow solution cavities makes subsidence and bedrock collapse a very real possibility.