KENTUCKY GEOLOGICAL SURVEY
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UNIVERSITY OF KENTUCKY, LEXINGTON

MAP AND CHART 187
SERIES XII, 2008

Kentucky Terrain

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10 0 10 20 30 40 Miles
10 0 10 20 30 40 50 Kilometers
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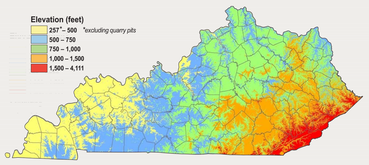
terrain: *the physical features of a region—slope, elevation, landforms, geology*

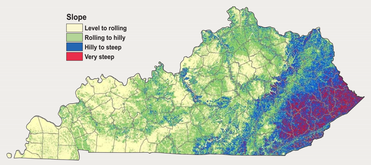
The terrain of Kentucky has been shaped by geologic forces and the underlying rocks. Tectonic forces lifted, bent, and buckled the rocks—originally formed from sediments on shallow sea floors or swampy lowlands. Weathering and erosion shaved the hills and dissected the plains, exposing at the surface a cross section of rocks 250 to 500 million years old. The sands, gravels, silts, and clays of the Jackson Purchase Region are younger, remnants of a time when the sea lapped at the confluence of the Mississippi and Ohio Rivers.

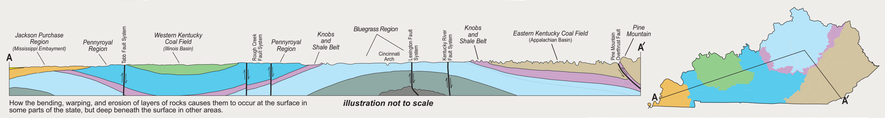
The landforms in Kentucky are the result of the differential weathering of interbedded sandstones, siltstones, shales, and limestones. Sandstones and siltstones resist erosion, limestones dissolve along cracks and crevices, and shales break down quickly when exposed to air and water. Areas dominated by sandstones and siltstones tend to have hills with steep sides. As the shale content increases, the landscape becomes more rounded, with wide stream valleys. Areas underlain by limestone may have few surface streams (karst topography) and gently rolling land. As the shale content in the rocks increases relative to limestone, the land becomes hillier.

Natural resources—coal, oil, natural gas, soils—are the products of geologic history and vary from region to region. In turn, the ecology and economy of the different regions of Kentucky are distinctive.

To learn more about the rocks and terrain typical of your area, find the region you live in on the map and then go to the associated text and picture group for that region (color-coded frame and header block matches the map region color).







How the bending, warping, and erosion of layers of rocks causes them to occur at the surface in some parts of the state, but deep beneath the surface in other areas.

illustration not to scale

Explanation for primary map in center of map sheet

- Alluvial valley
- Bluegrass Region
- Knobs and Shale Belt
- Pennyroyal Region
- Eastern Kentucky Coal Field
- Western Kentucky Coal Field
- Jackson Purchase Region
- Sinkholes
- State capital
- County seat
- Incorporated city
- Parkway or Interstate highway
- U.S. highway
- State primary highway
- County boundary
- State boundary
- 10 Photograph location

Regional and subregional delineations adapted from GIS data developed by William Andrews, Kentucky Geological Survey.

Thanks to Kim and Kent Anness, Kentucky Division of Geographic Information, for base map data.

For information on obtaining copies of this map and other Kentucky Geological Survey maps and publications call:

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Alluvial Valleys


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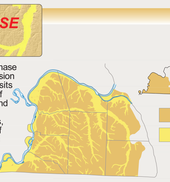
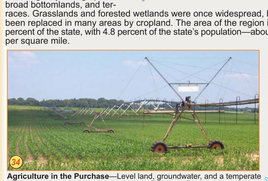
While not a region as such, alluvial valleys—deposits of silt, sand, clay, and gravel along large streams—form an important landscape across Kentucky. From the wide Ohio River floodplain *(left top, Maysville)* that provides level land, water, and transportation for communities and industry, to the narrow valleys of eastern Kentucky *(left bottom, Johnson County)*—which are often the only areas available for homes, communities, and agriculture— alluvium has played a significant role in Kentucky's development.

Jackson Purchase Region



Subregions
Uplands—Loess, gravel, sand, silt, and clay
Aluvium—Loess, silt, clay, and gravel

In recent geologic time, the Jackson Purchase Region was covered by a northern extension of the Gulf of Mexico. Most of the deposits are unconsolidated sediment instead of rock; therefore they are easily eroded, and consequently this part of Kentucky is relatively flat-lying, with numerous lakes, ponds, sloughs, and swamps. Local relief is generally less than 100 feet. The loess plains—windblown deposits of silt from the Great Plains—provide a productive agricultural area of gently rolling uplands, broad bottomlands, and terraces. Grasslands and forested wetlands were once widespread, but have been replaced in many areas by cropland. The area of the region is about 6 percent of the state, with 4.8 percent of the state's population—about 75 people per square mile.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Agriculture in the Purchase—Level land, groundwater, and a temperate climate provide the eight-county Jackson Purchase Region with a strong agricultural economy. Seventy percent of the land is in farms that produce more than 36 million bushels of corn and soybeans and 115 million chickens annually. *Calloway County photo by Glynn Beck, Kentucky Geological Survey.*


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Below the Surface—Ball clay has been mined in Graves County since the 1820's. It has a high percentage of aluminum, which makes it suitable for the manufacture of toilets, sinks, floor tile, bathtubs, and fine dinnerware. *Photo by Glynn Beck, Kentucky Geological Survey.*


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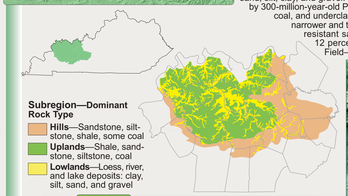
Wetlands—A typical cypress swamp in the Obion Creek drainage, Hickman County *(right)*. *Photo by Glynn Beck, Kentucky Geological Survey.*

Western Kentucky Coal Field



Subregion—Dominant Rock Type
Hills—Sandstone, siltstone, shale, some coal
Uplands—Shale, sandstone, siltstone, coal
Lowlands—Loess, river, and lake deposits; clay, silt, sand, and gravel

The topography of the Western Kentucky Coal Field ranges from nearly level bottomlands to forested hills. The poorly drained floodplains and terraces along the Ohio River and the wide valleys of the interior streams are underlain by loess, sand, silt, clay, and gravel. Outside the valleys, low hills predominate, underlain by 300-million-year-old Pennsylvanian shale, sandstone, siltstone, limestone, coal, and underclay. Around the boundary of the region the valleys are narrower and the terrain more rugged, with hills capped by erosion-resistant sandstone. Eight percent of Kentuckians live on the 12 percent of Kentucky that is the Western Kentucky Coal Field—about 60 people per square mile.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Bedrock—The 300-million-year-old shale, sandstone, siltstone, and coal that shape the region are exposed at this roadcut on the Natcher Parkway in Ohio County. *Photo by Dave Williams, Kentucky Geological Survey.*

Uplands


2

Upland Topography—Loess deposits, underlain by shale, sandstone, siltstone, and coal, form the rolling uplands of Webster County. *Photo by Glynn Beck, Kentucky Geological Survey.*

Lowlands


1

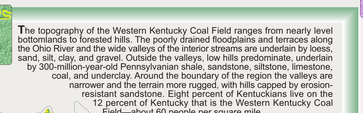
Alluvial Bottomland—The Ohio River bottomland, seen here in Henderson County, is composed of nearly level, poorly drained floodplains and undulating terraces. The lowlands are used extensively for cropland. Seasonal flooding limits land use. Terraces on the left, formed of eroded loess deposits, and provide land for crops, pasture, and residential and commercial development. Sixty percent of the Western Kentucky Coal Field is in farmland, 35 percent in cropland, producing 75 million bushels of corn and soybeans. The region also produces 105 million chickens annually. *Photo by Glynn Beck, Kentucky Geological Survey.*

Hills


3

Sandstone Hills—The fishing is good below the outlet spillway of Lake Malone in the Sandstones Hills Region. The lake is surrounded by 50-foot sandstone bluffs and hardwood forests with hiking trails. Constructed in the late 1950's, the lake covers 825 acres in Muhlenberg, Todd, and Logan Counties. The lake was made possible by local game and fishing clubs.

Knobs and Shale Belt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The Knobs consists of hundreds of isolated, steep-sloping, often cone-shaped hills lying at the outer edge of the Bluegrass Region. The hills are monadnocks or erosional remnants that were originally part of the Mississippian Plateau (Pennyroyal Region), but were separated from the plateau by stream erosion. Many of the knobs are still capped by erosion-resistant limestones or sandstones. The sloping sides of the Knobs are mostly composed of shales of the 350-million-year-old Mississippian Borden Formation, which are more easily eroded than the overlying limestones and sandstones. The Knobs are associated with the outcrop belt of Silurian and Devonian black and clay shales. Bernheim Forest (south of Louisville) and Berea are located in the Knobs Region. Streams that flow through the Knobs and Shale Belt, such as the Rolling Fork River (above) and Red River in the east, carve wide valleys with fertile alluvium deposits. *Marion County photo above.*

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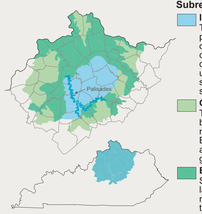
Black Shale—Slopes of black shale erode quickly and become unstable when exposed, as seen in this roadcut on the AA Highway in Lewis County. The shale contains pyrite, which causes it to shrink when dry and swell when wet. The shale contains enough organic matter to burn, and the extraction of shale oil may someday become economically viable.

Bluegrass Region


22

Porous limestone in the Inner Bluegrass is laced with solution channels, cracks, and crevices. Contaminated water and septic effluent can travel quickly through underground openings and pollute surface and groundwater.

The Bluegrass Region is bounded by the Knobs and the Ohio River. Bedrock in most of the region is composed of Ordovician limestones and shales 450 million years old. Younger Devonian, Silurian, and Mississippian shales and limestones lie beneath the perimeter of the region. Much of the Ordovician strata lie buried beneath the surface. The oldest rocks at the surface in Kentucky are exposed along the Palisades of the Kentucky River. Limestones are quarried or mined throughout the region for use in construction. Water from limestone springs is bottled and sold. The Bluegrass, the first region settled by Europeans, includes about 25 percent of Kentucky. Over 50 percent of all Kentuckians live there–an average of 190 people per square mile, ranging from 1,750 people per square mile in Jefferson County to 23 people per square mile in Robertson County.



Subregion—Dominant Rock Type

Inner Bluegrass Region—limestone
The Inner Bluegrass is characterized by rich, fertile phosphatic soils, which are perfect for raising thoroughbred horses. The gently rolling topography is caused by the weathering of limestone that is typical of the Ordovician strata of central Kentucky, pushed up along the Cincinnati Arch. Weathering of the limestone also produces sinkholes, sinking streams, springs, caves, and soils.

Outer Bluegrass—limestone and shale
The Outer Bluegrass is mostly composed of interbedded Ordovician limestones and shales that are more easily eroded than the limestones of the Inner Bluegrass. It is less karstic, with fewer sinkholes and rolling hills. The shales impede the flow of groundwater, and there are fewer springs and wells.

Bluegrass Hills—Shaly limestone
Shale is more dominant in the Bluegrass Hills. The land is hilly, with limited agriculture. Slope stability may be a problem in development, particularly in the Greater Cincinnati area.

Inner Bluegrass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Inner Bluegrass—Limestone in the Bluegrass provides rich soils and level terrain, spring-fed ponds, and rock for construction. Mile after mile of historic stone fences made from local limestone by Irish immigrant stonemasons grace the highways and byways of the Bluegrass.


Inner Bluegrass—Sinkholes are a common feature of the Inner Bluegrass terrain. Using sinkholes for waste disposal, even in rural areas, can threaten valuable water resources.

Outer Bluegrass


21

Shaly limestone typical of the Outer Bluegrass is exposed in a roadcut along Ky. 646 in Montgomery County. The terrain of the Outer Bluegrass is, in general, more rolling than that of the Inner Bluegrass. The shale impedes underground flow and there are fewer sinkholes.


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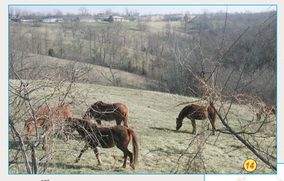
The Outer Bluegrass terrain, as typified in central Washington County, provides rich soils for agriculture, attractive sites for rural residential living, habitat for wildlife, and industrial sites.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Bluegrass Hills

The bedrock of the Bluegrass Hills has a higher shale content than that of the Inner and Outer Bluegrass. The shale breaks down quickly when exposed, leaving the limestone without support. Collapsed limestone rubble slips down the shale at this roadcut *(below)* on Ky. 53 in Washington County. Cedar trees quickly reclaim a slope. The terrain of the Bluegrass Hills is characterized by rolling, knobby hills that provide pasture for livestock, as seen in Grant County *(left)*, and narrow ridgetops than provide limited level land for crops and development.


18


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Bluegrass Hills—Rural residential development on high-level terrace deposits of clay, silt, sand, and gravel deposited in the Bluegrass Hills region of southern Pendleton County by an ancient stream.

Pennyroyal Region

Subregion—Dominant Rock Type
Clifty Area—Sandstone, limestone
Western Pennyroyal—Shale, sandstone, siltstone, coal
Eastern Pennyroyal—Limestone, shale, and siltstone
Land between the Lakes—Limestone and gravel

Clifty Area

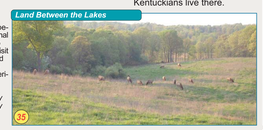

30

Sandstone overlying limestone is exposed along the Western Kentucky Parkway *(above)* in Grayson County. The erosion resistant sandstone caps the hills *(below)* of the Clifty Area in Warren County (Mammoth Cave Plateau).


29

The Pennyroyal Region stretches from the Eastern Kentucky Coal Field and the Bluegrass to the Jackson Purchase, surrounding the Western Kentucky Coal Field. It is primarily characterized as a limestone plain containing tens of thousands of sinkholes, sinking streams, streamless valleys, springs, and caverns. Sinkholes are depressions on the land surface into which water drains underground. Usually circular and often funnel-shaped, they range in size from a few feet to hundreds of feet in diameter. Springs occur when water emerges from underground to become surface water. Caves are solution-enlarged fractures or conduits large enough for a person to enter. This terrain, called karst, occurs because the bedrock in the region is dominated by thick deposits of Mississippian limestone. This limestone is soluble, which means it can easily be dissolved by water moving through the ground. This groundwater can form miles of passages beneath the surface, from tiny conduits only inches wide to large caverns and rooms more than 100 feet wide. The Mammoth Cave–Flint Ridge cave system is the longest cave in the world (by far), with 365 miles explored to date. The Pennyroyal includes 26 percent of Kentucky and one in six Kentuckians live there.

Land Between the Lakes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Elk herd in the Land between the Lakes National Recreation Area. Two million visitors a year visit the 170,000 acres and 300 miles of undeveloped shoreline to experience the beauty and wildlife of the region. *Trigg County photo by Glynn Beck, Kentucky Geological Survey.*

Western Pennyroyal


27

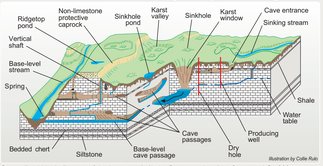
Limestone is exposed along the Natcher Parkway in Warren County *(above left)*. Water seeps into cracks and crevices, dissolving the limestone, and forming underground conduits that may extend for miles. When the ceiling of an underground conduit becomes too thin to support the overlying soil, a sudden–collapse sinkhole will form. A landscape in Hart County dimpled with sinkholes and sinkhole ponds *(above right)* is typical of the karst plain. *Aerial photo by the U.S. Department of Agriculture, Farm Services Administration, National Agricultural Imagery Program, 2004.*


26

Looking across the karst plain in Hart County toward the Dripping Springs Escarpment.


28

Hidden River Cave entrance below Main Street in Horse Cave, Hart County, was once billed as the "World's Largest Cave Entrance."



Generalized block diagram of the karst terrain in the Pennyroyal region. Currens, J.C., 2001, Generalized block diagram of the western Pennyroyal karst: Kentucky Geological Survey, ser. 12, Map and Chart 16, 1 sheet.

Eastern Pennyroyal


24

Dark shales are interbedded with limestone beneath this silt-stone-capped hill along Ky. 61 in Cumberland County.


25

Where siltstone is thin or missing, the terrain in the Eastern Pennyroyal is rolling. Otherwise, it is more rugged, with level ridgetops and steep wooded hillsides as in the Taylor County photo above.


23

The Eastern Pennyroyal is home to all or parts of four man-made lakes—Dale Hollow *(above)*, Cumberland, Barren River, and Green River—providing over 70,000 acres of water recreation and miles of shoreline for outdoor activities.

31

Limestone is abundant in Livingston County. The Reed Quarry *(above)*, now the third largest in the world, operates 24 hours a day, producing between 8 and 10 million tons of stone annually. The lowest point in Kentucky, 100 feet below sea level, is in the quarry floor. *Photo by Glynn Beck, Kentucky Geological Survey.*

Eastern Kentucky Coal Field

Mountain and Creek Bottom Area


8

Sandstone, siltstone, shale, and coal of the Mountain and Creek Bottom area is exposed along Ky. 302 near Dewey Lake *(above)* in Floyd County. Water penetrates cracks and crevices in the sandstone and flows downward until it meets the impermeable shale. When the shale is exposed to air and water, it breaks down quickly, leaving no support for the overlying rocks, which soon fall. Repeating the process for millions of years creates a completely dissected upland, with valleys and ridges occupying about equal amounts of land and elevation differences between ridgetops and valleys of as much as 900 feet *(Floyd County photo below)*.


9

Cumberland Escarpment/Mississippian Plateau

11

Fortress cliffs of sandstone dominate the landscape of the Cumberland Escarpment *(photo 11, Powell County)*. Along the way, natural erosion in sandstone creates amphitheaters, waterfalls, and graceful arches *(photo 12, Princess Arch in Wolfe County, photo by John F. Slockney)*.

12

13

Many low-lying areas along the Cumberland Escarpment/ Mississippian Plateau are underlain by Mississippian limestones that create a karst topography with sinkholes and caves. Carter Caves in Carter County is a popular attraction.

Pine Mountain

10

The sinuous pattern of ridges and ravines is interrupted along the southeastern border of the region by the northeast-trending linear ridges of Pine Mountain and Cumberland Mountain. The steep northwest face of Pine Mountain exposes the Pine Mountain Overthrust Fault. The rocks on Pine Mountain dip to the southeast and form jagged hogback ridges. To the southeast, these same beds dip to the northwest and underlie hogback ridges of Cumberland Mountain. Between these ridges are the Black Mountains and the Log Mountains, which include the highest summit in Kentucky, 4,150 ft.

Erosion-resistant sandstone conglomerate forms hogbacks on Pine Mountain *(above)*. The view of Pineville in Bell County from Chained Rock *(below)* shows the rugged hills and wide stream valleys typical of the Upper Cumberland Valley. The floodwall to the right of U.S. 25E that protects the city from Cumberland River floodwaters also symbolizes the threat of flooding to development in stream valleys throughout the region.

10

6

Cumberland Plateau

Shale is more dominant in the bedrock of the Cumberland Plateau area, as seen in the roadcut *(left)* along the Hal Rogers Parkway in Laurel County. This creates a less rugged landscape amenable to agriculture, as typified below in Morgan County.

7

The Eastern Kentucky Coal Field is a region of intricately dissected Pennsylvanian sandstone, siltstone, shale, and coal with Mississippian limestones along the western and southern perimeter. It is bounded on the western edge by the Cumberland (or Pottsville) Escarpment/Mississippian Plateau formed by resistant beds of Pennsylvanian sandstone overlying Mississippian limestone. Within the region, wooded mountain crests extend to the horizon in all directions. The mountain slopes are carved by ravines eroded through thick, flat-lying sequences of coal-bearing sedimentary rocks. The ravines are tributary to sinuous, narrow valley bottoms that wind between steep valley walls. Major rivers, including the Big Sandy, Licking, Kentucky, and Cumberland, meander through the mountains. Where shale predominates, their valleys widen to a mile or more; most of the human habitation is on the floodplains and low terraces. High terraces such as those in Ashland and southeastern Greenup County are remnants of earlier valley bottoms. Generally, the knife-edge crests of the mountains are as narrow and sinuous as the valley bottoms. Flatlands on either the ridgetops or the valley bottoms are commonly of small extent. Most of the terrain is steep-sided hills. Whether the local topographic relief of this region spans as little as 200 feet or exceeds 2,000 feet, the landforms are similar. The mountain slopes underlain by shale and sandstone are mantled by complex accumulations of rock fragments and weathered debris (colluvium) that move downslope by debris avalanche, landslide, creep, and sheet wash. Deeply weathered soils are uncommon and occur on isolated, nearly level ridge crests and high-level terrace deposits. Cliffs of resistant sandstone cap many ridges and spurs. Scenic erosion remnants include pinnacles or "chimneys," shallow eaves known as "rock houses," and arches or natural bridges. Less than 20 percent of the state's population lives on the 28 percent of the state encompassed by this region, or 65 people per square mile.

Subregion—Dominant Rock Type
Cumberland Escarpment/ Mississippian Plateau—Sandstone, limestone
Cumberland Plateau—Shale, sandstone, siltstone, some coal
Mountain and creek bottom—Sandstone, siltstone, shale, coal
Pine Mountain—Sandstone, siltstone, shale, coal