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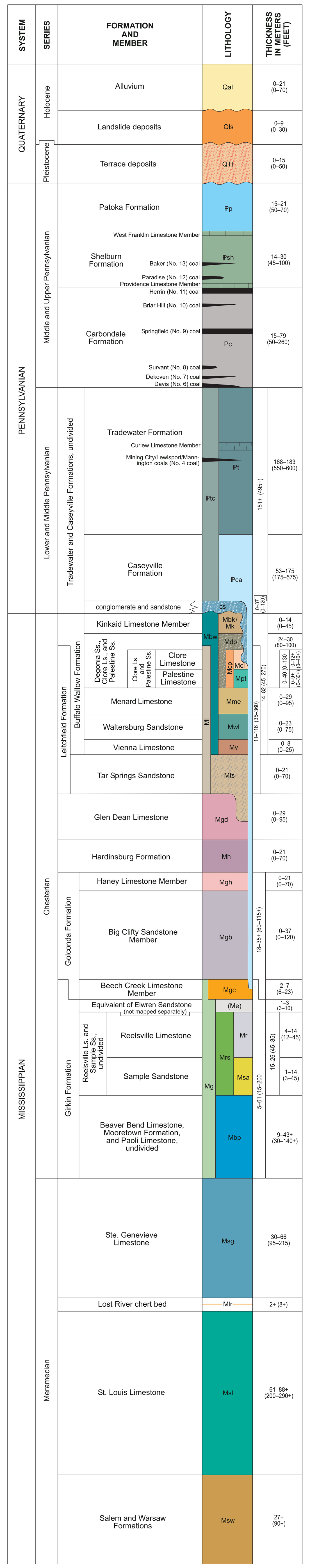

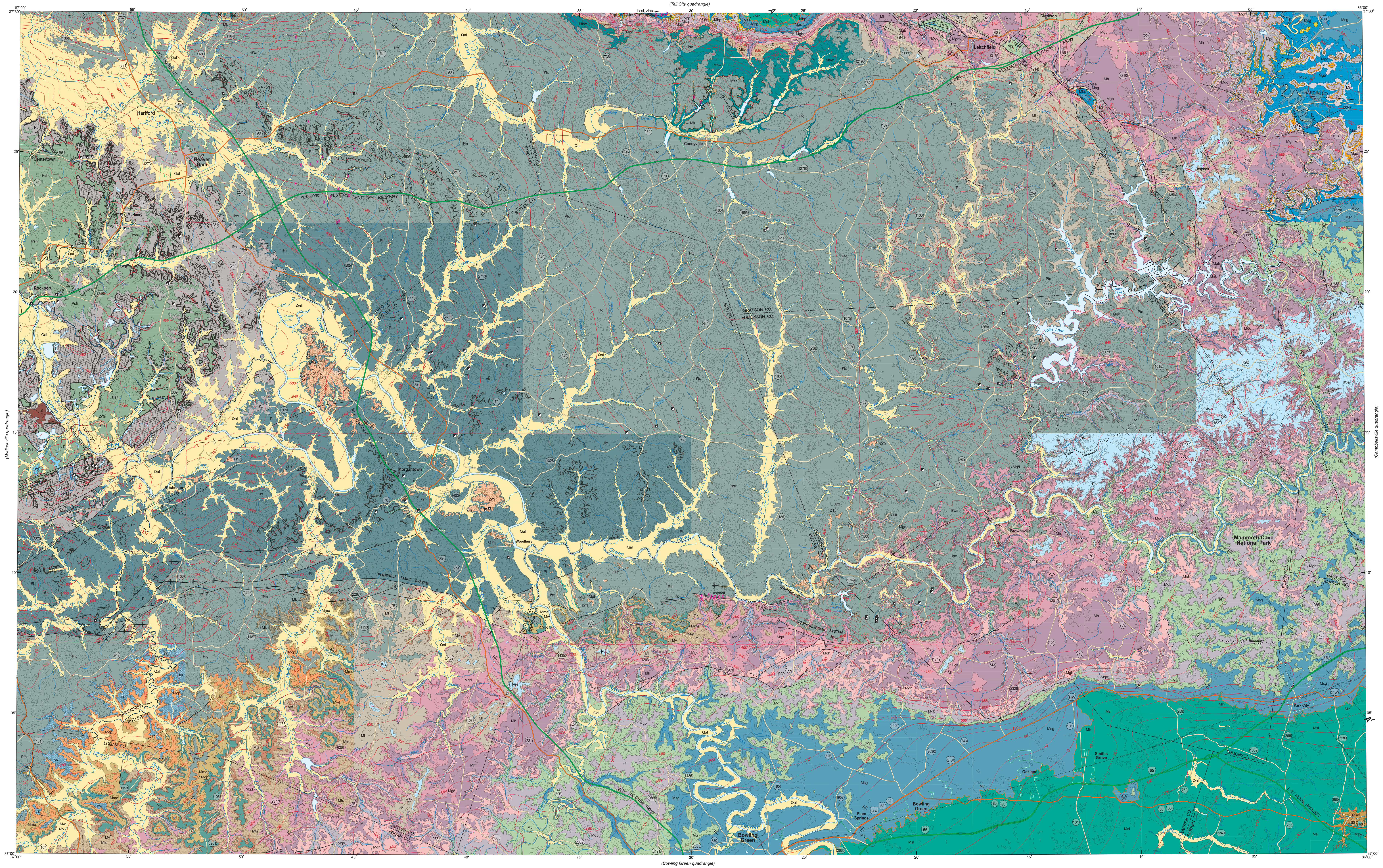

GEOLOGIC MAP OF THE BEAVER DAM 30 x 60 MINUTE QUADRANGLE, WESTERN KENTUCKY

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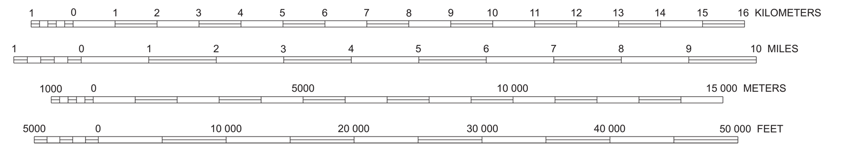
Cartography by Terry D. Hounshell



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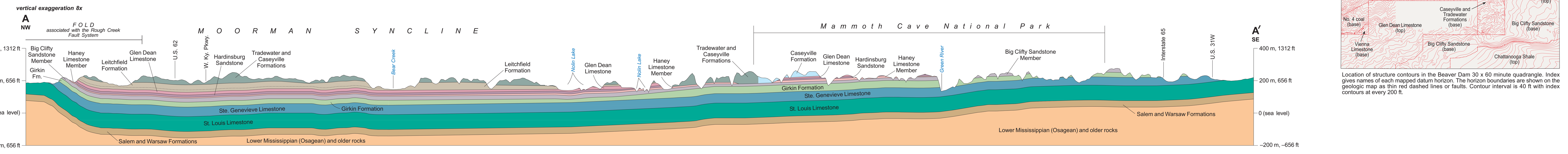

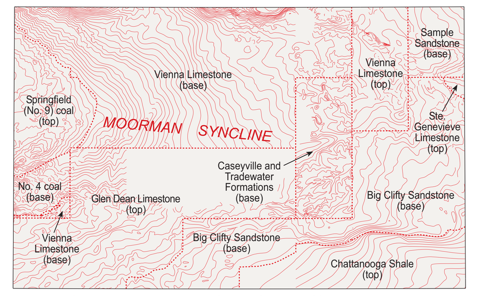

INTRODUCTION

This version of the geology of the Beaver Dam 30 x 60 minute quadrangle was digitally compiled mostly from U.S. Geological Survey 7.5-minute geologic quadrangle maps (GQ's), as cited in the references. The GQ's are products of a cooperative mapping project between the U.S. Geological Survey and the Kentucky Geological Survey from 1960 to 1978. The stratigraphy of the Pennsylvanian coal measures of the Western Kentucky Coal Field was agreed upon in the Kentucky-Illinois Agreement of 1991 (Greb and others, 1992). The stratigraphy of the Mississippian rocks has been described by Rice and others (1980) and Sable and Dever (1990). The data files resulting from the digitization of the GQ's are part of a comprehensive relational and spatial data set being developed by the Kentucky Geological Survey. The data files will be available on the KGS Web site in the near future (Anderson and others, 1999). Users will have at their disposal a spatial database from which to select any map or particular map themes to create custom maps and add supplemental oil, mineral, coal, or water information. This powerful database of geologic information can be used in a geographic information system (GIS) for analysis or manipulation of data.

PROCEDURE

The 7.5-minute geologic quadrangle maps were digitally compiled using a semi-automated data-capture technique to convert hard-copy geologic maps into digital format. Compiling 7.5-minute maps into a 30 x 60 minute map required the resolution of significant problems, such as (1) correlating geologic formations across quadrangle boundaries, (2) resolving nonuniform structure-contour datums or intervals, and (3) resolving discrepancies in formation boundaries and inferred contacts. The metadata portion of the digital file provides detailed information about the conversion process. Formation codes, which identify formations, were assigned using the American Association of Petroleum Geologists' standard stratigraphic code (Cohee, 1967), which was modified by the Kentucky Geological Survey for state-specific use. Formations and formation boundaries were not mapped the same way on each of the 7.5-minute quadrangle maps, since they were compiled by various authors between 1960 and 1978. Resolution of the differences between quadrangles was necessary for efficient topological analysis in a GIS environment. In addition, numerous small members mapped on individual 7.5-minute quadrangle maps are too small to be mapped at a scale of 1:100,000 on a 30 x 60 minute quadrangle map. These problems were resolved by adhering to geologic, cartographic, and GIS standards appropriate for the scale of the map.

This map is a compilation of existing maps, and no additional geologic field work took place. When there were problems in stratigraphic correlation between quadrangles, the best current data available were used to resolve these differences.

GEOLOGIC SETTING AND STRUCTURAL GEOLOGY

The geology of the Beaver Dam 30 x 60 minute quadrangle consists of sedimentary rocks of Mississippian through Pennsylvanian age and unconsolidated sediments of Quaternary age. The quadrangle contains the southeastern part of the Western Kentucky Coal Field and includes an escarpment on the Caseyville Formation sandstones, along the edge of the Illinois Basin. The cyclic depositional sequences in rocks of Pennsylvanian age generally coarsen upward (Greb and others, 1992) and consist of onshore channel, swamp, and marsh deposits and offshore deltaic, bar, and marine deposits. These deposits vary in thickness laterally (Greb and [illegible]

[illegible] Moorman Syncline. The graben is considered to be the eastern arm of a triple-junction rift feature (Nelson, 1990) and is a north-dipping half graben over 100 mi long ranging from 25 to 45 mi wide. Paleozoic sediments up to 30,000 ft thick are common along the northern extent of the half graben (Drahovzal, 1994). The Moorman Syncline is 125 mi long and 10 to 35 mi wide. It is an asymmetrical syncline with a gentle dip from the south and a steep dip from the north. The boundaries of the syncline are the Rough Creek Fault System to the north and the Pennyrile Fault System to the south. The Moorman Syncline approximately follows the Rough Creek Graben basement (Greb and others, 1992).

Two major fault systems, the Rough Creek and Pennyrile, bound the half graben. Initial tectonic activity resulted in normal, listric faults. Deposition of Lower and Middle Cambrian siliciclastic sediments followed (Bertagne and Leising, 1990). Continued deposition, combined with reactivation of the graben boundary faults by compressional stresses, resulted in reverse faults and flower structures. Some strike-slip displacement along some fault zones resulted from the compression. Later, extension and normal faulting took place, resulting in the Moorman Syncline (Bertagne and Leising, 1990). The Rough Creek Fault System, the northern boundary of the Rough Creek Graben, is an east–west-trending fault system with many faults that bifurcate and anastamose. Much of the Rough Creek Fault System is located just north of the mapped area, however, in the adjoining Tell City 30 x 60 minute quadrangle. Along the northern margin and into the northeastern corner of the mapped area, associated faults splay off the fault system in an arcuate pattern to the southeast in Grayson, Edmonson, and Hart Counties. Most of the faults that affect Pennsylvanian rocks are post-Pennsylvanian and most probably post-Paleozoic (Greb and others, 1992).

The Pennyrile Fault System is part of the surface faults that compose part of the southern boundary of the Rough Creek Graben. It is an east–northeast- to west–southwest-trending fault system. The southern boundary of the graben consists of a series of subsurface high-angle normal faults that coincide with the Pennyrile Fault System and the unnamed fault system farther south in the Bowling Green 30 x 60 minute quadrangle. Reverse faulting has been observed in outcrops and in borehole sections. Some of the faults also have some lateral movement (Nelson, 1990). In addition, the Pennyrile Fault System roughly traces the outcrop boundary between Pennsylvannian rocks to the north and Mississippian rocks to the south. This fault system was mapped in the Rochester, South Hill, Morgantown, Riverside, Hadley, Reedyville, Bowling Green North, Brownsville, and Bristow 7.5-minute quadrangles.

Mammoth Cave National Park

Mammoth Cave National Park is located in the southeastern part of the Beaver Dam quadrangle. Its 52,830 acres lie primarily within the Nolin Lake, Cub Run, Brownsville, Rhoda, and Mammoth Cave 7.5-minute quadrangles. The park contains many karst features, including the longest mapped cave system in the world, at over 365 mi of mapped passages to date. Much of the park is underlain by limestone that ranges from 330 to 460 ft thick and dips at a 3º angle northwestward toward the Green River. The limestone around Mammoth Cave is relatively pure, which enhances the rate of chemical weathering (Currens, 1992). Major passageways were at or just below regional base level at the time of formation (White and others, 1970). Most passageways in the Mammoth Cave system follow the same bedding planes and rarely cut across beds (Palmer, 1981). Multiple passageways have formed as a result of changing regional base levels through time (Currens, 1992). The Mammoth Cave system is developed in the Girkin, Ste. Genevieve, and St. Louis Limestones (Sable and Dever, 1990).

ECONOMIC GEOLOGY

Coal, oil, gas, limestone, rock asphalt, and gravel are the principal mineral resources in the Beaver Dam quadrangle. Numerous coal mines are operating in the quadrangle and many oil and gas fields have been discovered. Rock asphalt or tar sands have been mined in the past and will be an important economic resource in the future.

COAL

Major coal mining has occurred in significant areas of the northeastern part of the Beaver Dam quadrangle. The primary productive bed was the Springfield coal (No. 9), but the Baker (No. 13) and Herrin (No. 11) have also been recovered from surface mines (G.R. Weisenfluh, Kentucky Geological Survey, personal communication, 2005). Other coals that have been mined are, from youngest to oldest, the Davis (No. 6), Mining City split (No. 4a), Mining City (No. 4), Dunbar, Elm Lick, Aberdeen, Amos and Foster, Main Nolin, and Mud River. In addition, many small, unnamed coal beds have been mined in other quadrangles, and occasionally mined just for local use. In the past, coals were both strip mined and deep mined. Beds that have been mined most recently are the Baker, Herrin, Springfield, Mining City, and Main Nolin. The Kentucky Department of Mines and Minerals reported two active coal operations in the Beaver Dam quadrangle during 2000. Near Aberdeen in Butler County is a surface operation mining a 19-in. seam of No. 4 coal, which produced 16,665 short tons in 2000. Near McHenry in Ohio County is an auger-surface operation mining a 60-in. seam of the Springfield coal, which produced 120,113 short tons in 2000.

In the northwestern part of the quadrangle, the Elm Lick is the thickest coal bed. The western part of the quadrangle has had mining in the younger coals (No. 13, No. 11, and No. 9) and the west-central part has had mining in the Mining City, No. 4a, and No. 4 coals. In the central part of the quadrangle, the Aberdeen, Foster, and Amos coals have been mined. In the east-central part of the Beaver Dam quadrangle, the Main Nolin has been the primary source of coal.

PETROLEUM AND NATURAL GAS

The two deepest oil or gas wells in the Beaver Dam quadrangle were drilled in the Spring Lick 7.5-minute quadrangle in Grayson County. Both reached the Cambrian Eau Claire Formation. The deepest is the Texas Gas Transmission No. 1 Herman Shain well, drilled in 1974. The total depth was 13,551 ft and it had shows of oil and gas. The second deepest is the Conoco No. 1 Isaac Shain well, drilled in 1994. Its total depth was 12,622 ft; shows of oil and gas were also reported. Neither had any recoverable hydrocarbons.

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Jeffersonville Limestone, Clear Creek Formation, Decatur Limestone, Leipers Limestone

Drillers often refer to a major production zone in the south-central, northeastern, and southeastern regions of the quadrangle as the "Corniferous." The producing horizons in the Corniferous include the Dutch Creek Sandstone Member of the Jeffersonville Limestone, Clear Creek Formation, Decatur Limestone, Brownsport Group, Dixon and Lego Members of the Louisville Limestone, Laurel Dolomite and Brassfield Dolomite (Schwalb and others, 1972). The New Albany Shale also produces gas in the quadrangle and the Lower Mississippian limestones such as the Ste. Genevieve, Salem, and Warsaw produce both oil and gas. The Upper Mississippian limestones and sandstones, Benoist Sandstone, Tar Springs Sandstone, and Hardinsburg Limestone also produce oil and gas. Many wells that are still operating throughout the quadrangle have low production levels, after initial high production rates. Many minor oil fields also occur in the Beaver Dam quadrangle.

The two largest gas fields are the Shrewsbury Field, located in the Leitchfield, Ready, Bee Spring, and Caneyville 7.5-minute quadrangles, and the Bowling Green Field in the Hadley and Bowling Green North quadrangles. More than 200 gas wells are in the Shrewsbury Field, which produces from the Ste. Genevieve Limestone, Salem Limestone, Warsaw Formation, and New Albany Shale. The major zones of production in the Bowling Green Field are the St. Louis Limestone, Warsaw Formation, and Corniferous beds, including the Clear Creek Formation. Significant numbers of gas-producing wells have either been abandoned or shut-in and are used only locally. Many minor gas fields also occur in the Beaver Dam quadrangle.

LIMESTONE

Limestone for construction aggregate, road metal, riprap, building stone, and agricultural products has been mined from the Tradewater Formation, Leitchfield Formation, Glen Dean Limestone, Golconda Formation, Girkin Formation, Ste. Genevieve Limestone, and St. Louis Limestone. Active mining occurs in the Glen Dean Limestone, Girkin Formation, and Ste. Genevieve Limestone. One active quarry is in Butler County, two are in Grayson County, and two are in Warren County (Stone and others, 2001).

ROCK ASPHALT

Rock asphalt deposits, also known as tar sands, occur in the south-central, east-central, and northeastern parts of the Beaver Dam quadrangle. Five units contain lenticular deposits of rock asphalt, which have some heavy oil. They are, from youngest to oldest, the Bee Springs and Kyrock Sandstone Members of the Caseyville Formation, Tar Springs Sandstone Member of the Leitchfield Formation, Hardinsburg Sandstone, and Big Clifty Sandstone of the Golconda Formation. The Bee Springs and Kyrock Sandstone Members are sometimes undifferentiated and sometimes separated by the Main Nolin coal bed. The heavy oil resources were estimated in 1984 by the Interstate Oil Compact Commission (Noger, 1999) (Table 1). In the past, this rock asphalt has been used for paving roads; in the future it could be a source for oil (Noger, 1999).

Table 1. Tar sand resource estimates (million barrels) of the Beaver Dam quadrangle. From Noger (1999).

Formation	Speculated	Measured	Total
Caseyville Formation	250	300	550
Tar Springs Sandstone	125	0	125
Hardinsburg Sandstone	155	250	405
Big Clifty Sandstone	810 (approx.)	800 (approx.)	1,610 (approx.)
TOTAL	**1,340 (approx.)**	**1,350 (approx.)**	**2,690 (approx.)**

[illegible]

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Bertagne, A.J., and Leising, T.C., 1990, Interpretation of seismic data from the Rough Creek Graben of western Kentucky and southern [illegible]

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