U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division

Cumbeland Gap National Historical Park

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Cumbeland Gap National Historical Park

cuga_geology.pdf

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Geologic Resources Inventory Map Document for Cumbeland Gap National Historical Park

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Geologic Resources Inventory Map Document

Cumbeland Gap National Historical Park, Kentucky, Tennessee and Virginia

Document to Accompany Digital Geologic-GIS Data

cuga_geology.pdf

Version: 8/23/2023

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Cumbeland Gap National Historical Park, Kentucky, Tennessee and Virginia (CUGA).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.

2) **GRI Digital Maps and Source Map Citations** – A listing of all GRI digital geologic-GIS maps produced for this project along with sources used in their completion. In addition, a brief explanation of how each source map was used is provided.

3) **Map Unit List** – A listing of all geologic map units present on maps for this project, generally listed from youngest to oldest.

4) **Map Unit Descriptions** – Descriptions for all geologic map units. If a unit is present on multiple source maps the unit is listed with its source geologic unit symbol, unit name and unit age followed by the unit's description for each source map.

5) **Geologic Cross Sections** – Geologic cross section graphics with source geologic cross section abbreviations.

6) **Ancillary Source Map Information** – Additional source map information presented by source map.

For each source map this may include a stratigraphic column, map legend and/or map notes.

7) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

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About the NPS Geologic Resources Inventory Program

Background

The Geologic Resources Inventory (GRI) provides geologic map data and pertinent geologic information to support resource management and science-informed decision making in more than 270 natural resource parks throughout the National Park System. Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The GRI is one of 12 inventories funded by the National Park Service (NPS) Inventory and Monitoring Program. The Geologic Resources Division of the NPS Natural Resource Stewardship and Science Directorate administers the GRI. The NPS Geologic Resources Division partners with the Colorado State University Department of Geosciences to produce GRI products. Many additional partners participate in the GRI process by contributing source maps or reviewing products.

The GRI team undertakes three tasks for each park in the Inventory and Monitoring program: (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a geographic information system (GIS) format, and (3) provide a GRI report. These products are designed and written for nongeoscientists.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: https://www.nps.gov/articles/gri-geodatabase-model.htm

Geologic Reports: GRI reports synthesize discussions from the original scoping meeting, follow up conference call(s), and subsequent research. Chapters of each report discuss the geologic setting of the park, distinctive geologic features and processes within the park, highlight geologic issues facing resource managers, and describe the geologic history leading to the present-day landscape. Each report also includes a poster illustrating these GRI digital geologic-GIS data.

For a complete listing of GRI products visit the GRI publications webpage: https://go.nps.gov/gripubs. GRI digital geologic-GIS data is also available online at the NPS Data Store: https://irma.nps.gov/DataStore/Search/Quick. To find GRI data for a specific park or parks select the appropriate park(s), enter “GRI” as a Search Text term, and then select the Search button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: https://www.nps.gov/subjects/geology/gri.htm. At the bottom of that webpage is a "Contact Us" link if you need additional information. You may also directly contact the program coordinator:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division. Learn more about I&M and the 12 baseline inventories at the I&M webpage: https://www.nps.gov/im/inventories.htm.

GRI Digital Maps and Source Map Citations

The GRI digital geologic-GIS maps for Cumbeland Gap National Historical Park, Kentucky, Tennessee and Virginia (CUGA):

Digital Geologic-GIS Map of Cumberland Gap National Historical Park and Vicinity, Kentucky, Tennessee and Virginia (*GRI MapCode CUGA*)

The above GRI digital geologic-GIS park an vicinity map was compiled using the oil and gas map source map listed below, as well as individual 7.5' quadrangle component maps also listed below.

> Kentucky Geological Survey, 2023, Kentucky Oil and Gas Well Location Shapefile: Kentucky Geological Survey Oil and Gas Well Search, accessed 02/2023, scale 1:100,000 (Kentucky Oil and Gas Well Locations). (*GRI Source Map ID 80004*).

Only partial extent of this source map was used, however, all geologic features within that extent were captured. See the Index Map for additional information.

Individual 7.5' quadrangle component maps that comprise the park and vicinity map are listed below. With each map is the source map or maps used in its completion, as well as a brief description of how the source map was used.

Digital Geologic-GIS Map of the Tennessee part of the Back Valley Quadrangle, Tennessee (*GRI MapCode BKVA*)

> Brent, W.B., 1988, Geologic Map and Mineral Resources Summary of the Back Valley Quadrangle, Tennessee: Tennessee Division of Geology, Geologic Quadrangle Map 161 SE, scale 1:24,000 (Back Valley Quadrangle). (*GRI Source Map ID 68208*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Digital Geologic-GIS Map of the Coleman Gap Quadrangle, Tennessee and Virginia (*GRI MapCode COGA*)

> Harris, L.D., Stephens, J.G., and Miller, R.L., 1962, Geology of the Coleman Gap Quadrangle, Tennessee and Virginia: U.S. Geological Survey, Geologic Quadrangle Map GQ-188, scale 1:24,000 (Coleman Gap Quadrangle). (*GRI Source Map ID 2481*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Digital Geologic-GIS Map of the Ewing Quadrangle, Kentucky and Virginia (*GRI MapCode EWIN*)

> Englund, K.J., Smith, H.L., Harris, L.D., and Stephens, J.G., 1963, Geology of the Ewing Quadrangle, Kentucky and Virginia: U.S. Geological Survey, Bulletin 1142-B, scale 1:24,000 (Ewing Quadrangle). (*GRI Source Map ID 2480*).

All geologic features on the above source map were captured for portions not in Kentucky. In Kentucky only fault and fold symbols, cross section lines and mine points were captured if present.

Mullins, J. E., 2003, Spatial Database of the Ewing Quadrangle, Kentucky, Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_172, scale 1:24,000 (Ewing Quadrangle (digital)). (*GRI Source Map ID 69706*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Digital Geologic-GIS Map of the Tennessee part of the Fork Ridge Quadrangle, Tennessee (*GRI MapCode FORD*)

Kohl, M.S., Sykes, C.R., 1991, Geologic Map and Mineral Resources Summary of the Fork Ridge Quadrangle, Tennessee: Tennessee Division of Geology, Geologic Quadrangle Map 144 SE, scale 1:24,000 (Fork Ridge Quadrangle). (*GRI Source Map ID 68311*).

The full extent of the above source map was used, and most geologic features within this extent were captured. Per guidance from the Tennessee Geological Survey, some mine related areas were not captured because of changes to the landscape from mine reclamation.

Digital Geologic-GIS Map of the Kayjay Quadrangle and Kentucky part of the Fork Ridge Quadrangle, Kentucky (*GRI MapCode KAYJ*)

Rice, C.L., and Maughan, E.K, 1978, Geologic Map of the Kayjay Quadrangle and part of the Fork Ridge Quadrangle, Bell and Knox Counties, Kentucky: U.S. Geological Survey, Geologic Quadrangle Map GQ-1505, scale 1:24,000 (Kayjay Quadrangle and part of the Fork Ridge Quadrangle). (*GRI Source Map ID 2483*).

All geologic features on the above source map were captured for portions not in Kentucky. In Kentucky only fault and fold symbols, cross section lines and mine points were captured if present.

Conley, T.J., 2003, Spatial Database of the Kayjay Quadrangle and part of the Fork Ridge Quadrangle, Bell and Knox Counties, Kentucky: Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_1505, scale 1:24,000 (Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital)). (*GRI Source Map ID 69704*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Digital Geologic-GIS Map of the Middlesboro North Quadrangle, Kentucky (*GRI MapCode MBNO*)

Rice, C.L., and Ping, R.G., 1989, Geology of the Middlesboro North Quadrangle, Kentucky: U.S. Geological Survey, Geologic Quadrangle Map GQ-1663, scale 1:24,000 (Middlesboro North Quadrangle). (*GRI Source Map ID 2484*).

All geologic features on the above source map were captured for portions not in Kentucky. In Kentucky only fault and fold symbols, cross section lines and mine points were captured if present.

Sparks, T.N., Lambert, J.R., 2003, Spatial Database of the Middlesboro North Quadrangle, Kentucky: Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_1663, scale 1:24,000 (Middlesboro North Quadrangle (digital)). (*GRI Source Map ID 69705*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Digital Geologic-GIS Map of the Middlesboro South Quadrangle, Tennessee, Kentucky and Virginia (*GRI MapCode MBSO*)

Englund, K.J., 1964, Geology of the Middlesboro South Quadrangle, Tennessee, Kentucky and Virginia: U.S. Geological Survey, Geologic Quadrangle Map GQ-301, scale 1:24,000 (Middlesboro South Quadrangle). (*GRI Source Map ID 2477*).

All geologic features on the above source map were captured for portions not in Kentucky. In Kentucky only fault and fold symbols, cross section lines and mine points were captured if present.

Thompson, M.F., 2003, Spatial Database of the Middlesboro South Quadrangle, Kentucky: Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_301, scale 1:24,000 (Middlesboro South Quadrangle (digital)). (*GRI Source Map ID 69708*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Digital Geologic-GIS Map of the Kentucky part of the Rose Hill Quadrangle, Kentucky (*GRI MapCode ROHI*)

Maughan, E.K., and Tazelaar, J.F, 1973, Geologic Map of part of the Rose Hill Quadrangle, Harlan County, Kentucky: U.S. Geological Survey, Geologic Quadrangle Map GQ-1121, scale 1:24,000 (part of the Rose Hill Quadrangle). (*GRI Source Map ID 2482*).

The full extent of the above source map was used, however only fault and fold symbols, cross section lines and mine points were captured.

Crawford, M.M., 2003, Spatial Database of the Rose Hill Quadrangle, Harlan County, Kentucky: Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_1121, scale 1:24,000 (Rose Hill Quadrangle (digital)). (*GRI Source Map ID 69198*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Digital Geologic-GIS Map of the Varilla Quadrangle, Kentucky and Virginia (*GRI MapCode VARI*)

Englund, K.J., Landis, E.R., and Smith, H.L., 1963, Geology of the Varilla Quadrangle, Kentucky and Virginia: U.S. Geological Survey, Geologic Quadrangle Map GQ-190, scale 1:24,000 (Varilla Quadrangle). (*GRI Source Map ID 2478*).

All geologic features on the above source map were captured for portions not in Kentucky. In Kentucky only fault and fold symbols, cross section lines and mine points were captured if present.

Johnson, T.L., 2003, Spatial Database of the Varilla Quadrangle, Kentucky, Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_190, scale 1:24,000 (Varilla Quadrangle (digital)). (*GRI Source Map ID 69707*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Digital Geologic-GIS Map of the Wheeler Quadrangle, Tennessee and Virginia (*GRI MapCode WHEE*)

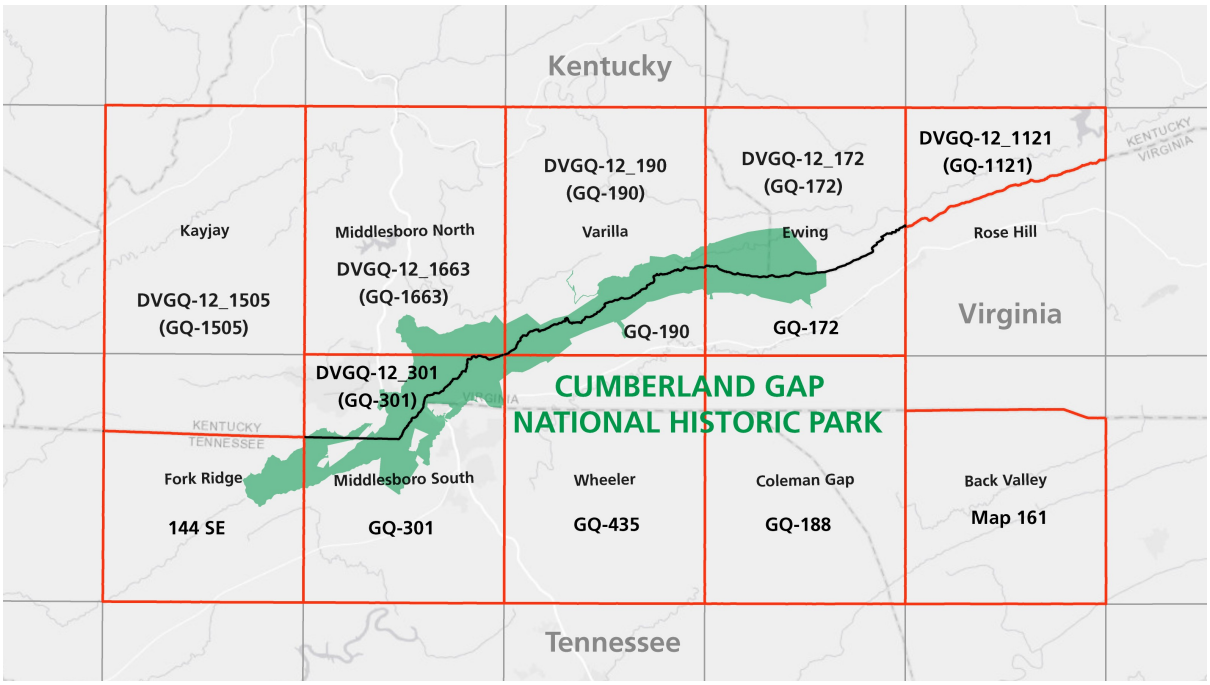
Harris, L.D., 1965, Geologic Map of the Wheeler Quadrangle, Claiborne County, Tennessee and Lee County, Virginia: U.S. Geological Survey, Geologic Quadrangle Map GQ-435, scale 1:24,000 (Wheeler Quadrangle). (*GRI Source Map ID 8179*).

The full extent of the above source map was used, and all geologic features within this extent were captured.

Additional information pertaining to each source map is also presented in the GRI Source Map Information (CUGAMAP) table included with the GRI digital geologic-GIS data.

Index Map

The following index map displays the extents of the GRI digital geologic-GIS maps produced for Cumbeland Gap National Historical Park (CUGA). The boundary for Cumbeland Gap National Historical Park (as of July 1, 2023) shown in green. Th GRI digital geologic-GIS maps for Cumbeland Gap National Historical Park (CUGA) are displayed in red outlines.The state line delineating use of different sources for a quadrangle are shown in black. Map sources are displayed in parentheses were used to supplement the other source listed with fault/fold symbols, cross sections lines, and mine points.



Basemap credits: Esri, HERE, Garmin, OpenStreetMap

Index map by Jim Chappell (Colorado State University).

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Cumbeland Gap National Historical Park, Kentucky, Tennessee and Virginia (CUGA) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qaf - Artificial fill). Units are listed from youngest to oldest. Information about each geologic unit is also presented in the GRI Geologic Unit Information (CUGAUNIT) table included with the GRI digital geologic-GIS data. Some source unit symbols, names and/or ages may have been changed in this document and in the GRI digital geologic-GIS data. This was done if a unit was considered to be the same unit as one or more units on other source maps used for this project, and these unit symbols, names and/or ages differed. Additionally, stratigraphic classification has changed since some source maps used for this project were published. Every effort was made to correlate older stratigraphic names and grouping with newer source map also used for this project. Unit symbols, names and/or ages in unit descriptions, correlation figures or other source map figures were not edited. If a unit symbol, name or age was changed by the GRI the unit's source map symbol, name and/or age appears with the unit's source map description.

Cenozoic Era

Quaternary Period
Qaf - Artificial fill
Qal - Alluvium
Qf - Alluvial fan deposits
Qls - Landslide deposits
Qc - Colluvium
Qt - Terrace deposits
Qtl - Terrace deposits, low-level
Qth - Terrace deposits, high-level

Paleozoic Era

Pennsylvanian Period
PNbd - Breathitt Group, intensely deformed
PNbdc2 - Unnamed coal bed in Breathitt Group, intensely deformed
PNfc - Four Corners Formation
PNfcre - Four Corners Formation, Reynolds Sandstone Member
PNfchz - Hazard coal bed
PNfcc1 - Unnamed coal bed between Hazard and Haddix coal beds
PNlfchd - Haddix coal bed
PNfcmag - Four Corners Formation, Magoffin Member
PNb - Breathitt Group, upper part, undifferentiated
PNbdss - Breathitt Group, unnamed sandstone member
PNbdc1 - Breathitt Group, unnamed coal bed at base of unnamed sandstone member
PNh - Hyden Formation
PNhj - Hyden Formation, Jesse Sandstone Member
PNbuc4 - Unnamed coal between Magoffin Member and Fire Clay rider coal bed
PNhc1 - Unnamed coal bed between Haddix and Fire Clay coal beds
PNhfr - Fire Clay rider coal bed
PNhfc - Fire Clay coal bed
PNhp - Hyden Formation, Puckett Sandstone Member
PNhw - Whitesburg coal bed
PNham - Amburgy coal bed

PNhams - Amburgy coal bed (Sterling coal bed part)
PNbuc3 - Unnamed coal seams between Poplar Lick and Darby coal beds
PNm - Mingo Formation
PNpk - Pikeville Formation
PNbm - Breathitt Group, middle part, undifferentiated
PNpkd - Darby (Upper Elkhorn No. 3.5) coal bed
PNbuc2 - Unnamed coal seam between Darby and Upper Elkhorn No. 2 (Jellico) coal beds in upper Breathitt Group
PNpkc3 - Unnamed coal bed between Darby and Upper Elkhorn No. 2 (Jellico) coal beds in Pikeville Formation
PNpke3 - Upper Elkhorn No. 3 coal
PNpke2 - Upper Elkhorn No. 2 (Jellico) coal bed
PNha - Hance Formation
PNpkc2 - Unnamed coal bed between Upper Elkhorn No. 2 (Jellico) and Lower Elkhorn (Blue Gem) coal beds
PNpke1 - Lower Elkhorn (Blue Gem) coal bed
PNpkc1 - Unnamed coal bed between Lower Elkhorn (Blue Gem) and Manchester coal beds
PNpklbg - Little Blue Gem coal bed
PNmn - Manchester coal bed
Png - Grundy Formation
PNgmr - Mason rider coal bed
PNgma - Mason coal bed
PNbuc1 - Unnamed coal beds in part of upper Breathitt Group
PNgc1 - Unnamed coal bed in Grundy Formation
PNbl - Breathitt Group, lower part
PNggh - Gray Hawk coal bed
PNgcf - Clear Fork coal bed
PNgy - Grundy Formation, Yellow Creek Sandstone Member
PNbr - Bee Rock Sandstone
PNbru - Upper part of Bee Rock Sandstone, Naese Sandstone Member
PNbrn - Naese coal bed
PNbrc1 - Unnamed coal bed in Naese Sandstone Member below Naese coal bed
PNbrl - Bee Rock Sandstone, lower part
PNah - Alvy Creek Formation, Hensley Member
PNahus - Alvy Creek Formation, Hensley Member and upper part of Sewanee Sandstone
PNtu - Stearns No. 2 coal bed
PNss - Sewanee Sandstone
PNsw - Sewanee and Warren Point Sandstones
PNlss - Sewanee Sandstone, lower part
PNbcd - Bottom Creek Formation, Dark Ridge Shale Member
PNbdcw - Bottom Creek Formation, Dark Ridge Shale Member and Warren Point Sandstone
PNbcdcg - Cumberland Gap coal bed
PNwp - Warren Point Sandstone
PNwpw - Warren Point Sandstone, White Rocks sandstone bed

Pennsylvanian and Mississippian Periods
PNMbp - Breathitt Group, lower part and Pennington Group

Mississippian Period
Mp - Pennington Group
Mpu - Pennington Group, upper part
Mpo - Pinnacle Overlook Sandstone
Mpl - Pennington Group, lower part

Mn - Newman Limestone
Mnu - Newman Limestone, upper member
Mnl - Newman Limestone, lower member
Mnf - Newman Limestone, lower part and Fort Payne Chert
Mg - Grainger Formation

Mississippian and Devonian Periods
MDc - Chattanooga Shale

Silurian Period
Sh - Hancock Dolomite
Sct - Clinton Shale
Sr - Rockwood Formation
Sru - Rockwood Formation, upper shale member
Srs - Rockwood Formation, sandstone member
Srl - Rockwood Formation, lower shale member
Sc - Clinch Sandstone
Scp - Clinch Sandstone, Poor Valley Ridge Member
Sch - Clinch Sandstone, Hagan Shale Member

Ordovician Period
Os - Sequatchie Formation
Or - Reedsville Shale
Ot - Trenton Limestone
Oe - Eggleston Limestone
Ohc - Hardy Creek Limestone
Obh - Ben Hur Limestone
Ow - Woodway Limestone
Ohb - Hurricane Bridge Limestone
Omp - Martin Creek Limestone and Poteet Limestone
Omrp - Martin Creek, Rob Camp Limestone and Poteet Limestone, undivided
Omc - Martin Creek Limestone
Orc - Rob Camp Limestone
Op - Poteet Limestone
Opd - Poteet Limestone and Dot Formation, undivided
Od - Dot Formation
On - Newala Dolomite
Oln - Newala Dolomite and Longview Dolomite, undivided
Ol - Longview Dolomite
Oma - Mascot Dolomite
Ok - Kingsport Formation
Oc - Chepultepec Dolomite
Ocu - Chepultepec Dolomite, upper member
Ocl - Chepultepec Dolomite, lower member

Cambrian Period
Ccr - Copper Ridge Dolomite
Ccrm - Copper Ridge Dolomite and Maynardville Formation, undivided
Cmn - Maynardville Limestone
Cmncr - Maynardville Limestone, Conasauga Shale and Rome Formation, undivided
Cc - Conasauga Shale
Cn - Nolichucky Shale
Cm - Maryville Limestone

Crg - Rogersville Shale
Crt - Rutledge Limestone
Cpv - Pumpkin Valley Shale
Cr - Rome Formation

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. In some cases, coal beds and sandstone members have been grouped with the formation they appear in and are out of the sorting order shown on the previous map unit list.

Qaf - Artificial fill (Quaternary)

af - Artificial Fill (Pleistocene and Holocene)
Stable fill on gentle slopes, and stabilized engineered structures. Description from source map: Fork Ridge Quadrangle.

af - Artificial fill (Quaternary)
No addition description provided on the source map. Unit appears on source maps: Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital).

Qal - Alluvium (Quaternary)

Qal - Alluvial Deposits (Pleistocene and Holocene)
Clay, silt, sand, gravel, and boulders, unconsolidated to loosely consolidated; mostly in beds and floodplains of present or past water courses, but merging with slopewash in some areas. Description from source map: Back Valley Quadrangle.

Qal - Alluvium (Quaternary)
Clay, silt, sand, boulders, unconsolidated material locally derived. Description from source map: Coleman Gap Quadrangle.

Qal - Alluvium (Quaternary)
Unconsolidated stream deposits, sand, silt, and gravel (alluvium and terrace deposits). Description from source map: Ewing Quadrangle.

Qal - Alluvium (Quaternary)
North and west of Pine Mountain
Sand, silt, clay, and gravel. Sand, fine to medium, quartzose, well sorted. Silt and clay, laminated to thin-bedded, rich in organic matter. Gravel, well-rounded pebbles, cobbles, and boulders of quartz, chert, sandstone, siltstone, limestone, and coal from rocks of Mississippian and Pennsylvanian age. Occurs in unconsolidated deposits in narrow valley bottoms, in flood plain and terrace deposits of Cumberland River, and grades into colluvium along valley sides.

South of Pine Mountain
Similar as previously described north and west of Pine Mountain. Poorly stratified, unconsolidated deposits in valley bottoms; locally includes beds of silt and clay deposited when streams were ponded by landslides; unit merges with colluvium along valley sides. Mapped only in larger stream valleys and in tributaries of the Cumberland River or in the central basin of the Middlesboro impact structure. Trellis pattern noted on front and back edges of the Pine Mountain thrust sheet where dipping bedrock is present.

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

Qal - Alluvium (Pleistocene and Holocene)
Clay, silt, sand, and gravel unconsolidated stream deposits. Description from source map: Fork Ridge Quadrangle.

Qal - Alluvium (Quaternary)
Clay, silt, sand, and gravel in unconsolidated stream deposits. Boulders, gravel, and sand; sub-rounded, poorly sorted, unconsolidated. Description from source map: Middlesboro South Quadrangle.

Qal - Alluvium (Quaternary)
Boulders, gravel, sand, silt, and clay. Description from source map: Varilla Quadrangle.

Qal - Alluvium (Quaternary)
Clay, silt, sand, boulders, unconsolidated. Description from source map: Wheeler Quadrangle.

Qf - Alluvial fan deposits (Quaternary)

Qaf - Alluvial fan deposits (Quaternary)
Boulders, gravel, sand, and silt. Poorly sorted deposits spilling out from the mouths of one or more ravines along Clover Fork of the Cumberland River, and at the foot of Cumberland Mountain along Martins Fork; may include some colluvial material. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source map: Rose Hill Quadrangle (digital).

Qls - Landslide deposits (Quaternary)

North and west of Pine Mountain
Landslide deposits commonly contain large slumped sandstone blocks and are often flanked by scarps. Colluvium is poorly sorted to unsorted, angular to rounded pebbles, cobbles, and boulders in a clay, silt, and sand matrix. Present on most slopes, mapped only where thicker than 1.5 m (5 ft); mapped by interpretation of hummocky topography and fan-shaped lobes. Colluvium also mapped with debris fans and landslides at mouths of hollows and on concave slopes, and as talus below escarpments at meanders of Cumberland River; forms veneer along north slope of White Mountain and along north slope and foot of Pine Mountain. Landslide deposits combined with colluvium in the eastern part of quadrangle in steep, narrow gullies, on north slope of Pine Mountain, and along Straight Creek where deposits are as much as 9 m (30 ft) thick. Colluvium mapped separately in the western half of the quadrangle area.

South of Pine Mountain
Similar as previously described. Landslide deposits include large slumped blocks of bedrock and colluvial debris; in deposits as much as 24 m (80 ft) thick, often flanked by scarps; mapped separately on Kayjay 7.5-minute quadrangle along Clear Creek. Colluvium consists of sandstone and siltstone blocks and boulders in unsorted, unbedded matrix of sand, silt, and clay; forms continuous veneer of unconsolidated slope deposits on northern foothills of Brush Mountain in the Varilla 7.5-minute quadrangle. Colluvium mapped, in part, with talus, fan, or landslide deposits as combined unit.

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

Qc - Colluvium (Quaternary)

Qlf - Colluvium (Quaternary)
Clay, silt, sand, boulders, unconsolidated material, locally derived. Description from source map: Coleman Gap Quadrangle.

Qca - Colluvium (Quaternary)
Slope deposits of boulders in clay to sand matrix. Description from source map: Ewing Quadrangle.

Qc - Colluvium (Quaternary)
North and west of Pine Mountain
Landslide deposits commonly contain large slumped sandstone blocks and are often flanked by scarps. Colluvium is poorly sorted to unsorted, angular to rounded pebbles, cobbles, and boulders in a clay, silt, and sand matrix. Present on most slopes, mapped only where thicker than 1.5 m (5 ft); mapped by interpretation of hummocky topography and fan-shaped lobes. Colluvium also mapped with debris fans and landslides at mouths of hollows and on concave slopes, and as talus below escarpments at meanders of Cumberland River; forms veneer along north slope of White Mountain and along north slope and foot of Pine Mountain. Landslide deposits combined with colluvium in the eastern part of quadrangle in steep, narrow gullies, on north slope of Pine Mountain, and along Straight Creek where deposits are as much as 9 m (30 ft) thick. Colluvium mapped separately in the western half of the quadrangle area.

South of Pine Mountain
Similar as previously described. Landslide deposits include large slumped blocks of bedrock and colluvial debris; in deposits as much as 24 m (80 ft) thick, often flanked by scarps; mapped separately on Kayjay 7.5-minute quadrangle along Clear Creek. Colluvium consists of sandstone and siltstone blocks and boulders in unsorted, unbedded matrix of sand, silt, and clay; forms continuous veneer of unconsolidated slope deposits on northern foothills of Brush Mountain in the Varilla 7.5-minute quadrangle. Colluvium mapped, in part, with talus, fan, or landslide deposits as combined unit.

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Varilla Quadrangle (digital).

Qc - Colluvium (Pleistocene and Holocene)
Clay, silt, sand, and gravel unconsolidated stream deposits. Description from source map: Fork Ridge Quadrangle.

Qc - Colluvium (Quaternary)
Boulders, angular to sub-rounded, clay and sand matrix, in unconsolidated slope deposits. Description from source map: Middlesboro South Quadrangle.

Qc - Colluvium (Quaternary)
Boulders, gravel, sand, silt, and clay. Description from source map: Varilla Quadrangle.

Qc - Colluvium (Quaternary)
Clay, silt, sand, boulders, unconsolidated. Description from source map: Wheeler Quadrangle.

Qt - Terrace deposits (Quaternary and Tertiary)

Qt - Terrace deposits (Quaternary)
Unconsolidated stream deposits, sand, silt, and gravel. Description from source map: Ewing Quadrangle
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Qt - Terrace deposits (Tertiary)
Boulders, gravel, sand, silt, and clay. In stream deposits above normal flood level, range 1.5–6 m (5–20 ft) above river level.

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Varilla Quadrangle (digital).

Qt - Terrace deposits (Quaternary)
Boulders, angular to sub-rounded, clay and sand matrix, in unconsolidated slope deposits. Description from source map: Middlesboro South Quadrangle.

Qt - Terrace deposits (Quaternary)
Boulders, gravel, sand, silt, and clay. Description from source map: Varilla Quadrangle.

Qtl - Terrace deposits, low-level (Quaternary)

Qt - Terrace deposits, low-level (Quaternary)
Clay, silt, sand, boulders, unconsolidated material, locally derived. Description from source map: Coleman Gap Quadrangle.

Qt - Terrace deposits, low-level (Quaternary)
Clay, silt, sand, boulders, unconsolidated. Description from source map: Wheeler Quadrangle.

Qth - Terrace deposits, high-level (Quaternary)

Qth - Terrace deposits, high-level (Quaternary)
Clay, silt, sand, boulders, unconsolidated material, locally derived. Description from source map: Coleman Gap Quadrangle.

Qth - Terrace deposits, high-level (Quaternary)
Clay, silt, sand, boulders, unconsolidated. Description from source map: Wheeler Quadrangle.

PNbd - Breathitt Group, intensely deformed (Middle Pennsylvanian)

Pbd - Breathitt Group, intensely deformed (Middle Pennsylvanian)
Shale, siltstone, sandstone, and coal. Mapped as Mingo and Hance

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital)

The following coal beds and/or members are present within the Breathitt Group, intensely deformed:

PNbdc2 - Unnamed coal bed in Breathitt Group, intensely deformed (Middle Pennsylvanian)

c1 - Unnamed coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital)

PNbdss - Breathitt Group, unnamed sandstone member (Middle Pennsylvanian)

ss - Unnamed sandstone member, Breathitt Group (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Varilla Quadrangle (digital).

PNhas - Hance Formation, sandstone members (Pennsylvanian)
Sandstone Member, very light gray to white, thick-bedded to massive, cross- bedded, conspicuously quartzose; averages about 25 feet in thickness. Yellow Creek Sandstone, light-gray, very fine to fine-grained, micaceous, cliff-forming. Descriptions from source map: Middlesboro South Quadrangle.

PNbdc1 - Breathitt Group, unnamed coal bed at base of unnamed sandstone member (Middle Pennsylvanian)

c2 - Unnamed coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital).

PNfc - Four Corners Formation (Middle Pennsylvanian)

Pfc - Four Corners Formation (Middle Pennsylvanian)
North and west of Pine Mountain
Mapped as part of the Breathitt Formation on earlier maps. Named by Chesnut (1992) for strata between the base of the Magoffin Member and the top of the Hindman coal bed. Basal portion is the Magoffin Member, a 1.5–24 m (5–80 ft) dark-gray, silty, calcareous, fossiliferous shale and dark-gray to black, micaceous, silty, nodular limestone with abundant marine fossils; grades upward into interbedded siltstone and shale; base of Magoffin forms distinct topographic bench. Coals include, in descending order, the Hindman (Hazard No. 9), Hazard No. 8 (Francis), Hazard No. 7, Hazard zone (Leatherwood), and Haddix zone.

South of Pine Mountain
Sandstone, siltstone, shale, coal, and limestone. Similar as previously described north and west of Pine Mountain. Mapped as Bryson and Hignite Formations, or Harlan Formation on earlier quadrangles. Top of section not present. Base of section as defined by Chesnut (1992) is base of Magoffin Member; when absent, then base of unit is mapped at top of Limestone(?) coal (Copland/Taylor equivalent). Reynolds Sandstone Member, mapped locally, fine to coarse-grained, medium to thick-bedded, usually crossbedded; forms prominent cliffs on highest ridges in map area; occurs near base of the unit. Coals include, in descending order, Hazard No. 7 (High Splint), Hazard zone (Red Springs and Morris), and Haddix zone (Low Splint of Hignite Formation). Unit outcrops on highest mountains of Harlan County (Black Mountain and Little Black Mountain) and along elongate ridges of Log Mountains of southwestern

Bell County.

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

The following coal beds and/or members are present within the Four Corners Formation:

PNfchz - Hazard coal bed (Middle Pennsylvanian)

rs - Hazard coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

PNfcc1 - Unnamed coal bed between Hazard and Haddix coal beds (Middle Pennsylvanian)

c1 - Unnamed coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

PNlfchd - Haddix coal bed (Middle Pennsylvanian)

lo - Haddix coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

PNfcmag - Four Corners Formation, Magoffin Member (Middle and Lower Pennsylvanian)

mag - Magoffin zone (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Fork Ridge Quadrangle.

PNfcre - Four Corners Formation, Reynolds Sandstone Member (Middle Pennsylvanian)

Pfre - Reynolds Sandstone Member, Four Corners Formation (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Ewing Quadrangle (digital).

PNb - Breathitt Group, upper part, undifferentiated (Middle and Lower Pennsylvanian)

Pb - Breathitt Formation (Lower and Middle Pennsylvanian)
Shale, silty, gray, (weathers brown), occasionally laminated, often micaceous with abundant macerated plant remains. Siltstone, dark-gray to light-gray, (weathers yellowish-brown), massive to bedded. Fossil leaf, stem imprints, and siderite nodules common. Clay shale, medium-gray to black, (weathers yellowish- brown), often contains fossil plant imprints and siderite nodules. Sandstone, very light-gray to gray, fine- to coarse-grained, thin- bedded to massive, usually in multiple cross laminated beds up to 40 feet thick. Sandstones in higher parts of the formation are often impure, gray, speckled with lithic fragments and mica, and occur in beds up to 100 feet thick. All sandstones are discontinuous laterally and may pinch or feather out abruptly. Underclay, light- to medium-gray, commonly silty, contains abundant Stigmaria, ranges up to three feet in thickness, commonly underlying coal beds. Magofflin zone is a thin shale bed containing abundant productid brachiopods, gastropods, cephalopods, and ostracods at the base of a coarsening upwards sequence of shale and siltstone. Description from source map: Fork Ridge Quadrangle.

PNl - Lee Formation, undifferentiated (Pennsylvanian)
In cross section only. Unit appears on source map: Middlesboro South Quadrangle.

The following coal beds and/or members are present within the Breathitt Group, upper part, undifferentiated:

PNbuc4 - Unnamed coal between Magoffin Member and Fire Clay rider coal bed (Middle Pennsylvanian)

uc - Unnamed coal bed (Lower and Middle Pennsylvanian)
No addition description provided on the source map.
Unit appears on source map: Fork Ridge Quadrangle

PNbuc3 - Unnamed coal seams between Poplar Lick and Darby coal beds (Middle Pennsylvanian)

us1 - Unnamed coal bed (Lower and Middle Pennsylvanian)
No addition description provided on the source map.
Unit appears on source map: Fork Ridge Quadrangle

PNbuc2 - Unnamed coal seam between Darby and Upper Elkhorn No. 2 (Jellico) coal beds in upper Breathitt Group (Middle Pennsylvanian)

us2 - Unnamed coal bed (Lower and Middle Pennsylvanian)
No addition description provided on the source map.
Unit appears on source map: Fork Ridge Quadrangle

PNbuc1 - Unnamed coal beds in part of upper Breathitt Group (Lower Pennsylvanian)

ub - Unnamed coal bed (Lower Pennsylvanian)
No addition description provided on the source map.
Unit appears on source map: Fork Ridge Quadrangle

PNh - Hyden Formation (Middle Pennsylvanian)

Ph - Hyden Formation (Middle Pennsylvanian)
North and West of Pine Mountain
Mapped as middle part of the Breathitt Formation on earlier maps. Named by Chesnut (1992) for strata between the base of the Kendrick Shale Member and the base of the Magoffin Member. The Kendrick is an olive-gray to dark-gray shale, slightly calcareous, with sparse to moderately abundant marine fossils (small brachiopods, pelecypods, and shell fragments); contains silty lenses, grades into siltstone, and ranges 0 to 18 m (0 to 60 ft). The Kendrick is mapped locally and where the shale is absent the base of the Hyden Formation is approximately located from the top of the Amburgy coal zone or its stratigraphic equivalent. Coals include, in descending order, the Copland, Hamlin zone, Fire Clay rider, Fire Clay, and Whitesburg zone. The Fire Clay coal contains, near its base, a distinctive 1- to 4-cm (2- to 10-in) thick, light to dark brownish-gray flint-clay parting with conchoidal fracture that was deposited as a volcanic ash. The flint clay has been radiometrically dated at 312 ±1 Ma by Lyons and others (1992) and 311 ±1 Ma by Rice and others (1994).

South of Pine Mountain
Sandstone, siltstone, shale, coal, and minor limestone. As previously described. Mapped as Catron and upper part of the Mingo Formations, upper part of the Wise Formation, or Breathitt Formation on earlier quadrangles. Base of section is the base of the Kendrick Shale Member, which is locally mapped on the Pennington Gap 7.5-minute quadrangle. Elsewhere, the base of the unit is mapped from the top of the Poplar Lick (Amburgy) coal zone or its stratigraphic equivalent. Three named sandstones are locally mapped in the unit. The Jesse, Rockhouse Valley, and Puckett Sandstone Members are fine- to coarse-grained sandstones, commonly massive, crossbedded, and cliff-forming. The Jesse is also conglomeratic at base, with white quartz pebbles, clay pellets, and lithic fragments. Coals include, in descending order, Copland/Taylor (Limestone), Hamlin zone (Pardee, Wax), Fire Clay rider (Smith, Hignite, Gin Creek), Fire Clay (Wallins Creek, Lower Hignite), and Whitesburg zone (Stray).

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

PNct - Catron Formation (Pennsylvanian)
Sandstone, shale, coal, and underclay: Sandstone, very light gray, brown-weathering, fine- to medium-grained, micaceous, mostly thick-bedded to massive in beds ranging from a few feet to about 30 feet in thickness. Interbedded with medium- to dark- gray shale, light-gray underclay, and coal. Underlies small area at top of Mingo Mountains on the west edge of the quadrangle. Description from source map: Middlesboro South Quadrangle.

The following coal beds are present within the Hyden Formation:

PNhc1 - Unnamed coal bed between Haddix and Fire Clay coal beds (Middle Pennsylvanian)

c2 - Unnamed coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

PNhfr - Fire Clay rider coal bed (Middle Pennsylvanian)

h - Hignite (Fire Clay rider) coal (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Fork Ridge Quadrangle.

h and sm - Fire Clay rider coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Rose Hill Quadrangle (digital).

PNhfc - Fire Clay coal bed (Middle Pennsylvanian)

wc and fc - Fire Clay coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

PNhw - Whitesburg coal bed (Middle Pennsylvanian)

st - Stray (Whitesburg) coal zone (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Fork Ridge Quadrangle.

st - Whitesburg coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

PNham - Amburgy coal bed (Middle Pennsylvanian)

am - Amburgy coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Ewing Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

pl - Poplar Lick (Amburgy) coal (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Fork Ridge Quadrangle, Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital).

pl - Poplar Lick (Amburgy) coal bed (Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Middlesboro South Quadrangle.

PNhams - Amburgy coal bed (Sterling coal bed part) (Middle Pennsylvanian)

s - Amburgy coal bed (Sterling coal bed part) (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Fork Ridge Quadrangle.

s - Amburgy coal bed (Sterling coal bed part) (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

PNhj - Hyden Formation, Jesse Sandstone Member (Middle Pennsylvanian)

Phj - Jesse Sandstone Member, Hyden Formation (Middle Pennsylvanian)
Sandstone, fine- to coarse-grained, light-gray, massive, micaceous. Conglomeratic with well-rounded quartz pebbles from 1/4 to 1/2 in. in diameter. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source map: Ewing Quadrangle (digital).

PNhp - Hyden Formation, Puckett Sandstone Member (Middle Pennsylvanian)

Php - Puckett Sandstone Member, Hyden Formation, Breathitt Group (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Ewing Quadrangle (digital).

PNm - Mingo Formation (Middle Pennsylvanian)

PNm - Mingo Formation (Pennsylvanian)
Shale, silty shale, siltstone, sandstone, coal, and underclay: Shale, medium-gray to black; contains fossil leaf and stem imprints; commonly interbedded with or grades into silty shale, siltstone, and very fine grained sandstone. Sandstone is mostly light gray, buff to brown weathering, micaceous, thin to thick bedded. Massive medium- grained crossbedded sandstone as much as 30 feet thick in upper part. Several thin beds of light- to medium-gray underclay with abundant Stigmaria. Description from source map: Middlesboro South Quadrangle.

PNpk - Pikeville Formation (Middle Pennsylvanian)

Ppk - Pikeville Formation (Middle Pennsylvanian)
North and west of Pine Mountain
Mapped as middle part of the Breathitt Formation on earlier maps. Named by Chesnut (1992) for strata between the base of the Betsie Shale Member and the base of the Kendrick Shale Member. The Betsie Shale was defined by Rice and others in 1987 and was not mapped on the earlier 7.5-minute quadrangle maps; although it occurs just above the Lily (Manchester) coal. For this quadrangle, the Pikeville Formation was approximated between the top of the Lily coal and the top of the Amburgy coal zone or its equivalent. Coals include, in descending order, the Amburgy zone, Upper Elkhorn No. 3 zone, Jellico zone (Upper Elkhorn No. 2, Rim), Blue Gem zone (Lower Elkhorn, Straight Creek), and Little Blue Gem coal. The unit predominantly occurs in the northwestern corner of the quadrangle.

South of Pine Mountain
Siltstone, shale, sandstone, and coal. As previously described. Mapped as lower part of the Mingo and upper part of the Hance Formations, lower part of the Wise Formation, or Breathitt Formation on earlier quadrangles. Base of section, base of the Betsy Shale Member, was not mapped; therefore the top of the Manchester coal equivalent (Hance, Bennetts Fork, or Puckett Creek coal) was used to map the base of the section. Two named sandstones are mapped locally in the unit. The Marcum Hollow and Clover Fork Sandstone Members are fine- to medium-grained, massive, usually crossbedded, and cliff-forming. In addition, the Clover Fork commonly contains ironstone pebbles. Coals include, in descending order, Amburgy zone (Creech, Poplar Lick, Sterling, Low Splint of Wise Formation), Darby coal (Taggart, Buckeye Spring), Upper Elkhorn No. 3 zone (Kellioka, Taggart Marker), Jellico zone (Harlan, Mingo), Blue Gem zone (Path Fork, Rich Mountain, Imboden), and Little Blue Gem coal (Phoebe).

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

The following coal beds are present within the Pikeville Formation:

PNpkd - Darby (Upper Elkhorn No. 3.5) coal bed (Middle Pennsylvanian)

bs - Buckeye Springs (Darby) coal (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Fork Ridge Quadrangle.

bs - Darby (Upper Elkhorn No. 3.5) coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Rose Hill Quadrangle (digital).

PNpkc3 - Unnamed coal bed between Darby and Upper Elkhorn No. 2 (Jellico) coal beds in Pikeville Formation (Middle Pennsylvanian)

c3 - Unnamed coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro North Quadrangle (digital)

PNpke3 - Upper Elkhorn No. 3 coal (Middle Pennsylvanian)

kl - Upper Elkhorn No. 3 coal (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Ewing Quadrangle (digital), Varilla Quadrangle (digital).

PNpke2 - Upper Elkhorn No. 2 (Jellico) coal bed (Middle Pennsylvanian)

hl, mg - Upper Elkhorn No. 2 (Jellico) coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

mg - Mingo (Upper Elkhorn No. 2) coal zone (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears source map: Fork Ridge Quadrangle.

hl - Harlan (Upper Elkhorn No. 2) coal bed (Pennsylvanian)
No addition description provided on the source map. Unit appears source map: Middlesboro South Quadrangle.

PNpkc2 - Unnamed coal bed between Upper Elkhorn No. 2 (Jellico) and Lower Elkhorn (Blue Gem) coal beds (Middle Pennsylvanian)

c4 - Unnamed coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro North Quadrangle (digital).

PNpke1 - Lower Elkhorn (Blue Gem) coal bed (Middle Pennsylvanian)

pf, rm - Lower Elkhorn (Blue Gem) coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

rm - Rich Mountain (Lower Elkhorn (Blue Gem)) coal (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Fork Ridge Quadrangle.

pf - Path Fork (Lower Elkhorn (Blue Gem)) coal bed (Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro South Quadrangle.

PNpkc1 - Unnamed coal bed between Lower Elkhorn (Blue Gem) and Manchester coal beds (Middle Pennsylvanian)

c3 - Unnamed coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Rose Hill Quadrangle (digital).

PNpklbg - Little Blue Gem coal bed (Middle Pennsylvanian)

p - Little Blue Gem coal bed (Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital).

PNbm - Breathitt Group, middle part, undifferentiated (Middle Pennsylvanian)

Pbm - Middle part of Breathitt Group, undifferentiated (Middle Pennsylvanian)
North and west of Pine Mountain
Mapped as Breathitt Formation, undifferentiated; or Breathitt Formation, intensely deformed and undifferentiated. Occurs in two locations: a narrow belt of undifferentiated, deformed rocks adjacent to the north side of the Pine Mountain overthrust fault; and a north-south trending, narrow, fault-bounded belt of undifferentiated rocks along the White Mountain fault zone. Shale, siltstone, sandstone, and coal. Shale and siltstone, light- to dark-gray, interbedded with thin-bedded sandstone, micaceous, locally carbonaceous, in part calcareous with sparse marine fossils, locally intensely sheared. Sandstone, fine to medium-grained, poorly to well sorted; thin to thick-bedded, micaceous, in part quartzose and carbonaceous, crossbedded; some vertically dipping beds as much as 15 m (50 ft) thick. Coal, sheared and slickensided, several unnamed beds 0.5 m (1.5 ft) thick occur near top, a vertically dipping coal bed reported to be as much as 0.8 m (2.5 ft) thick was mined for local use along south bank of Straight Creek. Unit poorly exposed, generally covered by alluvium and colluvium. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital).

PNha - Hance Formation (Middle Pennsylvanian)

PNha - Hance Formation (Pennsylvanian)
Upper sandstone member-
Shale, silty shale, siltstone, sandstone, underclay, and coal: Medium- to dark-gray shale and silty shale, locally interbedded with siltstone or very fine grained sandstone, fossil plant imprints and siderite nodules common. Sandstone is very light to light gray, very fine to medium grained, thin to thick bedded, micaceous, buff to brown weathering, mostly in crosslaminated beds ranging from a few feet to 40 feet in thickness. Underclay is light to medium gray, commonly silty, contains abundant Stigmaria, ranges from 1 to 3 feet in thickness, and underlies the coal beds.

Sandstone member-
Sandstone, very light gray to white, thick-bedded to massive, cross- bedded, conspicuously quartzose; averages about 25 feet in thickness.

Middle sandstone member
Shale, medium-gray to black; siderite nodules common; contains few interbeds of light-gray very fine to fine-grained micaceous sandstone, siltstone, coal, and underclay. Distinctly ripple-bedded middle sandstone member of adjacent quadrangles grades largely to siltstone.

Yellow Creek Sandstone Member-
Sandstone, light-gray, very fine to fine-grained, micaceous, cliff-forming.

Below Yellow Creek Sandstone Member-
Shale, medium- to dark-gray; siderite nodules common.

Description from source map: Middlesboro South Quadrangle.

PNg - Grundy Formation (Lower Pennsylvanian)

Pg - Grundy Formation (Lower Pennsylvanian)
North and west of Pine Mountain
Mapped as lower part of the Breathitt Formation on earlier maps. Named by Chestnut (1992) for strata from the top of the Bee Rock Sandstone to the base of the Betsie Shale. Approximately 61 m (200 ft) of the upper Grundy Formation is exposed along the crest of the Flat Lick Anticline in the Artemus 7.5-minute quadrangle. Coals include the Lily (Manchester).

South of Pine Mountain
Siltstone, shale, sandstone, and coal. As previously described. Mapped as lower part of Hance Formation, or lower part of Breathitt Formation on earlier quadrangles. The base of the section is the top of the underlying Bee Rock Formation (Chesnut, 1992). Upper boundary is at the base of the Betsie Shale Member; where not mapped, the top of the Manchester coal (or its equivalent). Two sandstones, were mapped locally in the unit, particularly on Varilla and the east side of Middlesboro North 7.5-minute quadrangles; an upper unnamed sandstone and the Yellow Creek Sandstone Member. Sandstones are very fine- to medium-grained, micaceous, cliff forming; upper sandstone commonly contains argillaceous laminae, Yellow Creek Sandstone is moderately well sorted and quartzose. Mapped unit is exposed in uplifted, flat lying strata in eastern Bell County, and in dipping beds along two narrow belts (southern foothills of Pine Mountain and northern side of Cumberland Mountain). Coals include, in descending order, Manchester (Hance, Bennetts Fork, Puckett Creek), Mason rider, Mason (Chenoa), Gray Hawk (Split Seam), Clear Fork, and Naese.

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

The following coal beds are present within the Grundy Formation:

PNmn - Manchester coal bed (Lower Pennsylvanian)

p, b, ha, hn- Manchester coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

k - Kent (Manchester) coal (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Fork Ridge Quadrangle.

hn - Hance (Manchester) coal bed (Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro South Quadrangle.

PNgmr - Mason rider coal bed (Lower Pennsylvanian)

mr - Mason rider coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro North Quadrangle (digital).

PNgma - Mason coal bed (Lower Pennsylvanian)

ch, ma - Mason coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Varilla Quadrangle (digital).

ma - Mason coal bed (Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro South Quadrangle.

PNgc1 - Unnamed coal bed in Grundy Formation (Lower Pennsylvanian)

c4 - Unnamed coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital).

PNggh - Gray Hawk coal bed (Lower Pennsylvanian)

sp - Gray Hawk coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Middlesboro North Quadrangle (digital), Varilla Quadrangle (digital).

PNgcf - Clear Fork coal bed (Lower Pennsylvanian)

cf - Clear Fork coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Varilla Quadrangle (digital).

cf - Clear Fork coal bed (Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro South Quadrangle.

PNbl - Breathitt Group, lower part (Lower Pennsylvanian)

Pbl - Lower part of Breathitt Group (Lower Pennsylvanian)
North and west of Pine Mountain
Mapped as Lee Formation, undivided, on earlier maps. Since the Lee sandstone members were elevated to formations by Chesnut (1992), the name “Lee Formation” was formally dropped in Kentucky.

Sandstone, siltstone, and shale. Sandstone, white to darkgray, fine to coarse-grained, poorly to moderately well sorted, thin to thick-bedded, locally friable and quartzose, in part quartzitic, micaceous, crossbedded, and conglomeratic; sheared, fractured and slickensided; vertically dipping beds form prominent ridges and cliffs. Siltstone and shale, interbedded with fine-grained sandstone, micaceous, in part carbonaceous, slickensided and fractured; darkgray shale contains ironstone concretions. Lower part of unit is conglomeratic, with sheared, well-rounded quartz pebbles up to 2.5 cm (1 in) in diameter. Unit exposed along northern foothills of Pine Mountain, and on north face of White Mountain. Base of unit, forming sole of Pine Mountain overthrust fault, is 6 m (20 ft) sheared, quartzitic, bleached and altered fine grained sandstone; possibly includes sandstone from the Pennington Formation.

South of Pine Mountain
Sandstone, siltstone, and shale. As previously described. Mapped as Lee Formation, undivided, on earlier maps; later redefined as lower part of the Breathitt Group (Chesnut, 1992) when “Lee Formation” was formally dropped from Kentucky nomenclature. Unit exposed in fault slices adjacent to Pine Mountain, and in the central uplift core of the Middlesboro Basin (England and Roen, 1962; Milam and Kuehn, 2002).

Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital)

PNgy - Grundy Formation, Yellow Creek Sandstone Member (Lower Pennsylvanian)

Pgy - Yellow Creek Sandstone Member, Grundy Formation, Breathitt Group (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Varilla Quadrangle (digital).

PNhay - Hance Formation, Yellow Creek Sandstone Member (Pennsylvanian)
Sandstone, light-gray, very fine to fine-grained, micaceous, cliff-forming. Description from source map: Middlesboro South Quadrangle.

PNbr - Bee Rock Sandstone (Lower Pennsylvanian)

Pbr - Bee Rock Sandstone (Lower Pennsylvanian)
South of Pine Mountain
Sandstone, conglomeratic sandstone, siltstone, shale, and minor coal. Mapped as member of Lee Formation on earlier quadrangles. Chesnut (1992) elevated Bee Rock Sandstone to formation status and included the immediately overlying Naese Sandstone Member of Hance Formation, where mapped. Sandstone, white to light-gray, fine- to coarse-grained, well sorted, quartzose, locally micaceous and silty in upper part, thin bedded to massive, conspicuously crossbedded, locally conglomeratic at base with well-rounded white quartz pebbles 0.6 to 5 cm (1/4 to 2 in) in diameter; forms prominent cliffs and hogbacks along south slope of Pine Mountain. Siltstone and shale, medium- to dark-gray, micaceous, carbonaceous, silty and sandy, with occasional thin unmapped coal bed. Thin shale occurs near middle of unit and forms persistent slope break, or swales, between cliff-forming sandstones. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Middlesboro North Quadrangle (digital), Varilla Quadrangle (digital).

The following coal bed is present within the Bee Rock Sandstone:

PNbrn - Naese coal bed (Lower Pennsylvanian)

n - Naese coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Middlesboro North Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

PNbru - Bee Rock Sandstone, upper part and Naese Sandstone Member (Lower Pennsylvanian)

Pbru - Naese Sandstone Member, Upper part of Bee Rock Sandstone (Lower Pennsylvanian)
South of Pine Mountain
Upper part of unit, where previously mapped as Naese Sandstone Member, now mapped as upper part of Bee Rock Sandstone. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

PNln - Lee Formation, Naese Sandstone Member (Pennsylvanian)
Sandstone, light-gray, fine- to medium-grained, thick-bedded to massive, micaceous, crossbedded. Description from source map: Middlesboro South Quadrangle.

The following coal bed is present within the Bee Rock Sandstone, upper part and Naese Sandstone Member:

PNbrc1 - Unnamed coal bed in Naese Sandstone Member below Naese coal bed (Lower Pennsylvanian)

c5 - Unnamed coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Middlesboro North Quadrangle (digital).

PNbrl - Bee Rock Sandstone, lower part (Lower Pennsylvanian)

Pbrl - Lower part of Bee Rock Sandstone (Lower Pennsylvanian)
South of Pine Mountain
Lower part of Bee Rock Sandstone, where mapped separately, now mapped as lower part of Bee Rock Sandstone. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

PNlbr - Lee Formation, Bee Rock Sandstone Member (Pennsylvanian)
Sandstone, white to very light gray, very fine to coarse-grained, cross- bedded; quartzose in lower part; intraformational breccia in upper part; includes lentil of dark-gray shale in middle part. Description from source map: Middlesboro South Quadrangle.

PNah - Alvy Creek Formation, Hensley Member (Lower Pennsylvanian)

PNld - Lee Formation, sandstone and shale member D (Pennsylvanian)
Shale, medium-gray to black, and sandstone, wavy- to platy-bedded, very fine to fine-grained, light-gray, in upper part. Middle part is thick-bedded to massive very fine to fine-grained light-gray sandstone. Medium-gray shale with very fine to fine-grained wavy- to platy-bedded sandstone in lower part. Description from source map: Ewing Quadrangle.

PNld - Lee Formation, sandstone and shale member D (Pennsylvanian)
Shale, sandstone, coal, and underclay: Lower part is medium-gray shale and silty shale with few thin beds of very fine to fine-grained thin- bedded sandstone, coal, and underclay. Middle part contains light-gray very fine to fine-grained thick-bedded to massive micaceous sandstone. Upper part consists of medium-gray to grayish-black shale and silty shale, light-gray very fine to fine-grained thin- to thick-bedded micaceous sandstone, and 2 coal beds with underclay. Description from source map: Middlesboro South Quadrangle.

PNld - Lee Formation, sandstone and shale member D (Pennsylvanian)
Shale, sandstone, coal, and underclay: Lower part is medium- gray shale and very fine to fine-grained, platybedded sand- stone. Middle part is light-gray, very fine to fine-grained, thick-bedded to massive sandstone. Upper part consists of medium-gray to grayish-black shale; light-gray, very fine to fine-grained, platy to thick-bedded sandstone; and one thin coal bed with underclay. Description from source map: Varilla Quadrangle.

Pah - Hensley Member, Alvy Creek Formation (Lower Pennsylvanian)
South of Pine Mountain
Shale, siltstone, sandstone, and minor coal. Shale and siltstone, medium to darkgray, sandy, micaceous, carbonaceous, thin-bedded; form swales at top and base of unit. Sandstone, very fine- to medium-grained, well to poorly sorted, thin- to thick-bedded micaceous and carbonaceous; locally forms cliffs. Tunnel coal bed, occurs in upper shaly zone of unit, locally exposed. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

The following coal bed is present within the Alvy Creek Formation, Hensley Member:

PNtu - Stearns No. 2 coal bed (Lower Pennsylvanian)

tu - Stearns No. 2 coal bed (Lower Pennsylvanian)
No addition description provided on the source map. Unit appears on source maps: Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital).

PNahus - Alvy Creek Formation, Hensley Member and upper part of Sewanee Sandstone (Lower Pennsylvanian)

PNlu - Upper Member of Lee Formation (Lower Pennsylvanian)
Sandstone, mostly light-gray (weathers brown). fine- to medium- grained, micaceous; some units are light-gray to white, (weather yellowish-brown to white), crossbedded, fine- to coarse-grained, quartzose, commonly nonconglomeratic, and forming prominent outcrops. Siltstone, argillaceous to sandy, gray,

(weathers grayish-brown to brown), laminated, poorly exposed. Shale, silty, in places very dark-gray and carbonaceous. Coal not exposed in this quadrangle. Description from source map: Fork Ridge Quadrangle.

PNss - Sewanee Sandstone (Lower Pennsylvanian)

PNlc - Lee Formation, sandstone member C (Pennsylvanian)
Sandstone, fine- to coarse-grained, very light gray, massive, quartzose, crossbedded. Conglomeratic with lenses, as much as 5 ft thick, of well- rounded quartz pebbles commonly 1/2 to 1 in. in diameter and as much as 2 in. long. Four conglomeratic sandstone beds can be differentiated locally where they are separated by thin lenses of platy sandstone, shale, coal, and underclay. Description from source map: Ewing Quadrangle.

PNlsc - Lee Formation, sandstone member C (Pennsylvanian)
Sandstone, white to very light gray, fine- to coarse-grained, quartzose, massive, crossbedded, conglomeratic with well-rounded quartz pebbles commonly 1/2 to 1 inch in diameter. Locally member is divided into 4 conglomeratic sandstone ledges by fine-grained thin- bedded sandstone and shale, forms prominent cliffs and hogbacks on northwest slope of Cumberland Mountain. Description from source map: Middlesboro South Quadrangle.

PNlsc - Lee Formation, sandstone member C (Pennsylvanian)
Sandstone, white to very light gray, fine- to coarse-grained, quartzose, massive, crossbedded; conglomeratic with well-rounded quartz pebbles commonly one-half to one inch in diameter. Locally the member is divided into four conglomeratic sandstone beds by intervening beds of very fine to fine-grained platybedded sandstone, shale, coal, and underclay. Description from source map: Varilla Quadrangle.

Pss - Sewanee Sandstone (Lower Pennsylvanian)
South of Pine Mountain
Conglomerate, sandstone, siltstone, and shale. As described above. Unit identified only where intervening Dark Ridge Member is mapped between the Sewanee and Warren Point Sandstones. Locally divided into four conglomeratic sandstone ledges; forms prominent cliffs and hogbacks on top of Rocky Face and on northwest slope of Cumberland Mountain. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

PNsw - Sewanee and Warren Point Sandstones (Lower Pennsylvanian)

Psw - Sewanee and Warren Point Sandstones (Lower Pennsylvanian)
South of Pine Mountain
Conglomeratic sandstone, sandstone, siltstone, and shale. Sandstone, white to light-gray, fine- to coarse-grained, quartzose, massive, strikingly crossbedded, in part conglomeratic with well-rounded quartz pebbles up to 7.6 cm (3 in) in diameter; forms several resistant ledges. Siltstone and shale, olive- to dark-gray, micaceous, partly carbonaceous, interbedded with and grades into very fine-grained sandstone; forms narrow valleys separating sandstone ridges. Previously mapped as Middlesboro Member of the Lee Formation, but later divided into Sewanee and Warren Point Sandstones by Chesnut (1992). On this map, combined unit, Sewanee and Warren Point Sandstones, is well exposed in an elongate belt of three or four prominent hogback ridges on the south flank of Pine Mountain. Base sharp and undulating; probably unconformable with underlying units. Unit description provided by Kentucky

Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital).

PNlss - Sewanee Sandstone, lower part (Lower Pennsylvanian)

PNMlm - Middle Member of Lee Formation (Upper Mississippian and Lower Pennsylvanian)
Sandstone, white to very light-gray, fine- to coarse-grained, quartzose, massive, crossbedded, conglomeratic with well-rounded quartz pebbles commonly 1/2 to 1 inch in diameter. Locally, member is divided into 4 conglomeratic sandstone ledges by less resistant sandstone and shale; forms prominent cliffs and hogbacks on northwest slope of Cumberland Mountain. Description from source map: Fork Ridge Quadrangle.

PNbcd - Bottom Creek Formation, Dark Ridge Shale Member (Lower Pennsylvanian)

PNlb - Lee Formation, sandstone and shale member B (Pennsylvanian)
Shale, medium-gray, in lower part, and very fine to fine-grained, wavy-bedded light-gray and light-olive-gray sandstone in upper part. Description from source map: Ewing Quadrangle.

Pbcd - Dark Ridge Shale Member, Bottom Creek Formation (Lower Pennsylvanian)
South of Pine Mountain
Shale, siltstone, sandstone, and coal. Shale and siltstone, medium- to darkgray, slightly calcareous, locally grayish-green clay shale; interbedded with ripple-laminated siltstone and fine-grained sandstone. Sandstone, light gray, fine- to medium-grained, lithic fragments common. Cumberland Gap coal bed locally exposed near top of unit. Previously mapped as a member of the Lee Formation, now formally a member of the Bottom Creek Formation (Chesnut, 1992). Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

PNlsb - Lee Formation, sandstone and shale member B (Pennsylvanian)
Shale, medium-dark-gray; at top includes coal bed with medium-gray underclay. Description from source map: Middlesboro South Quadrangle.

PNlsb - Lee Formation, sandstone and shale member B (Pennsylvanian)
Sandstone, white to very light gray, fine- to coarse-grained, quartzose, massive, crossbedded; conglomeratic with well- rounded quartz pebbles ranging mostly from one-half to one inch in diameter; wedges out northwestward. Description from source map: Varilla Quadrangle.

The following coal bed is present within the Bottom Creek Formation, Dark Ridge Shale Member:

PNbcdcg - Cumberland Gap coal bed (Lower Pennsylvanian)

cg - Cumberland Gap coal (Lower and Middle Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Fork Ridge Quadrangle.

cg - Cumberland Gap coal bed (Lower Pennsylvanian)

No addition description provided on the source map. Unit appears on source maps: Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

cg - Lee Formation, Cumberland Gap coal bed (Pennsylvanian)
No addition description provided on the source map. Unit appears on source map: Varilla Quadrangle.

PNbdcw - Bottom Creek Formation, Dark Ridge Shale Member and Warren Point Sandstone (Lower Pennsylvanian)

PNMll - Lower Member of Lee Formation (Upper Mississippian and Lower Pennsylvanian)
Shale, medium dark-gray to light olive-gray, includes several coal beds and underclays in upper part. Sandstone, very light-gray to white, (weathers gray to buff), fine- to coarse-grained, quartzose, not conglomeratic in this quadrangle, crossbedded, forms prominent bluff. Description from source map: Fork Ridge Quadrangle.

PNwp - Warren Point Sandstone (Lower Pennsylvanian)

PNla - Lee Formation, sandstone member A (Pennsylvanian)
Sandstone, fine- to medium-grained, very light gray, quartzose, massive. Lens of conglomeratic sandstone at base locally. Lower part grades laterally and intertongues with Pennington formation. Upper part is too thin to be shown on the map east of White Rocks. Description from source map: Ewing Quadrangle.

Pwp - Warren Point Sandstone (Lower Pennsylvanian)
South of Pine Mountain
Conglomerate, sandstone, and siltstone. As described above. Originally mapped as White Rocks Sandstone Member or Chadwell Member of the Lee Formation, renamed Warren Point Sandstone by Chesnut (1992). Mapped on west side of Rocky Face and forms two or more sandstone ledges near the top of Cumberland Mountain. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Ewing Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

PNla - Lee Formation, sandstone member A (Pennsylvanian)
Sandstone, white to very light gray, fine- to coarse-grained, quartzose, massive, crossbedded, partly conglomeratic with well-rounded quartz pebbles about 1/2 inch in diameter. Description from source map: Middlesboro South Quadrangle.

PNla - Lee Formation, sandstone member A (Pennsylvanian)
Sandstone, very light gray, fine- to medium-grained, massive; conglomeratic sandstone lens at base ranges from 0 to 38 feet in thickness. Description from source map: Varilla Quadrangle.

PNwpw - Warren Point Sandstone, White Rocks sandstone bed (Lower Pennsylvanian)

PNlw - Lee Formation, White Rocks sandstone member (Pennsylvanian)
Sandstone, fine- to coarse-grained, very light gray, quartzose, massive, crossbedded. Very conglomeratic with well-rounded quartz pebbles ranging mostly from 2 to 1 in. in diameter. Includes at

center lentil of very fine grained wavy-bedded light olive-gray sandstone. Named from exposure at White Rocks on Cumberland Mountain. Description from source map: Ewing Quadrangle.

PNlw - Lee Formation, White Rocks Sandstone Member (Pennsylvanian)
Sandstone, white to very light gray, fine- to coarse-grained, quartzose, massive, crossbedded; conglomeratic with well- rounded quartz pebbles ranging mostly from one-half to one inch in diameter; wedges out northwestward. Description from source map: Varilla Quadrangle.

PNMbp - Breathitt Group, lower part and Pennington Group (Lower Pennsylvanian and Mississippian)

PNMlp - Lee and Pennington Formations (Mississippian and Pennsylvanian)
Sandstone, shale, and siltstone: Alternating zones of light- olive-gray to light-gray sandstone and light-olive-gray to greenish-gray shale and siltstone. Sandstone in lower part is thin-bedded and very fine-grained; in upper part it is massive-bedded, fine- to medium-grained, conglomeratic. Description from source map: Wheeler Quadrangle.

Mp - Pennington Group (Mississippian)

Mp - Pennington Formation (Upper Mississippian)
Sandstone, shale, siltstone, and limestone, lower 300-350 feet consists of shale, siltstone, limestone, and thin sandstone. Above is 200 feet of sandstone overlain by 200 feet of fine- grained sandstone, siltstone, shale, and limestone lenses, succeeded by 60 feet of thick-bedded sandstone with quartz-pebble conglomerate. At top is more than 200 feet of interbedded shale and sandstone with quartz-pebble and polymictic conglomerates and some thin, impure coal lenses; top of formation removed by faulting and erosion. Description from source map: Back Valley Quadrangle.

Mp - Pennington Formation (Mississippian)
In lower half, fine- to medium-grained in beds 1-4 feet thick; upper half, fine-grained in wavy beds 1 inch to 1 foot thick; minor amounts of intercalated greenish-gray shale. Description from source map: Coleman Gap Quadrangle.

Mp - Pennington Formation (Upper Mississippian)
Sandstone, very light-gray to light olive-gray. (weathers gray or brown), fine-grained, ripple-bedded with abundant argillaceous laminae. Sandstone light-gray, (weathers brown to buff), medium-grained, massive-bedded, crossbedded, and forms prominent bluffs. Also present are a few beds of calcareous bioclastic sandstone, siltstone, and light olive-gray shale. Description from source map: Fork Ridge Quadrangle.

Mp - Pennington Group (Mississippian)
South of Pine Mountain
Siltstone, shale, sandstone, and minor limestone. Mapped as two units on earlier quadrangles, combined as one unit for this map. Siltstone and shale, interbedded, green, gray, reddish-brown, thin-bedded to laminated, in part carbonaceous, locally calcareous with marine fossil fragments, poorly exposed; forms swales between ridges. Sandstone composed of two types: (1) light- to medium-gray, fine- to medium-grained, quartzose, well sorted, occasional scattered quartz pebbles with coal and rock fragments, medium- to thick-bedded, crossbedded; and (2) greenish-gray, fine-grained, thin-bedded; grades laterally into silty, ripplebedded sandstone; forms subdued linear ridges between shale valleys. Limestone, olive-gray, argillaceous, very fossiliferous; forms discontinuous bed or found as float near base of unit. Unit forms prominent cliffs along crest and north side of Pine Mountain and near crest of

Cumberland Mountain; also poorly exposed in fault slices along main thrust plane of Pine Mountain overthrust fault zone. May contain parts of Stony Gap Sandstone Member or Pinnacle Overlook Sandstone. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital), Varilla Quadrangle (digital).

Mpu - Pennington Group, upper part (Upper Mississippian)

Mpu - Pennington formation, upper member (Mississippian)
Shale, light-olive-gray to grayish-green with interbedded very fine to fine- grained, platy- and wavy-bedded sandstone. Locally sandstone is fine to medium grained and conglomeratic. Description from source map: Ewing Quadrangle.

Mpu - Pennington Formation, upper member (Upper Mississippian)
Shale, medium-gray to light-olive-gray; thin coal bed and underclay in lower part locally. Description from source map: Middlesboro South Quadrangle.

Mpu - Pennington Formation, upper member (Mississippian)
Shale and siltstone, light-olive-gray to greenish-gray. Shale, light-olive gray; locally contains thin bed of argillaceous limestone. Description from source map: Varilla Quadrangle.

Mpo - Pinnacle Overlook Sandstone (Mississippian)

Mpo - Pinnacle Overlook Member of Lee Formation (Upper Mississippian and Lower Pennsylvanian)
Pinnacle Overlook Member of Lee Formation Sandstone, white to very light-gray, fine- to coarse-grained, quartzose, crossbedded, thick-bedded to massive partly conglomeratic with well-rounded quartz pebbles about 1/2 inch in diameter. Description from source map: Fork Ridge Quadrangle.

Mpo - Pinnacle Overlook Sandstone, Pennington Group (Mississippian)
South of Pine Mountain
Sandstone, white to light-gray, fine- to coarse-grained, quartzose, in part conglomeratic with well-rounded quartz pebbles, and small cobbles up to 10 cm (4 in), crossbedded, massive, cliff forming; grades laterally into calcareous siltstone and shale. Mapped as lower tongue or sandstone tongue of Lee Formation, believed to be equivalent to the Princeton Sandstone; currently recognized as a sandstone formation of the upper part of the Pennington Group (Chesnut, 1992). Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital), Rose Hill Quadrangle (digital).

PNll - Lee Formation, lower tongue (Pennsylvanian)
Sandstone, white to very light gray, fine- to coarse-grained, quartzose, crossbedded, thick-bedded to massive, partly conglomeratic with well-rounded quartz pebbles about 1/2 inch in diameter. Description from source map: Middlesboro South Quadrangle.

PNll - Lee Formation, lower tongue (Pennsylvanian)
Sandstone, white to very light gray, fine- to medium-grained, quartzose, crossbedded; mostly conglomeratic with well-rounded quartz pebbles. Description from source map: Varilla Quadrangle.

Mpl - Pennington Group, lower part (Upper Mississippian)

Mpl - Pennington formation, lower member (Mississippian)
Sandstone, very fine to fine-grained, platy- and wavy-bedded, with few thin beds of light olive-gray shale and siltstone. Description from source map: Ewing Quadrangle.

Mpl - Pennington Formation, lower member (Upper Mississippian)
Sandstone, very light gray to light-olive-gray, very fine to fine-grained, partly ripple-bedded with abundant argillaceous laminae; few thin beds of light-olive-gray shale and siltstone. Description from source map: Middlesboro South Quadrangle.

Mpl - Pennington Formation, lower member (Mississippian)
Sandstone, very light gray to light-olive-gray, very fine to fine-grained, platy and wavy-bedded; few thin beds of light-olive-gray shale and siltstone. Description from source map: Varilla Quadrangle.

Mn - Newman Limestone (Upper Mississippian)

Mn- Newman Limestone, (Upper Mississippian)
Limestone and shale, upper part 25 to 40 feet of olive-gray shale with limestone lenses at base; overlain by gray, fine- to medium-grained impure limestone; lower part limestone, medium- to thick-bedded, medium-gray, fine-grained to fossil-fragmental, with oolitic zones and some dolomite, especially near base. Highly fossiliferous throughout; unconformity at base. Description from source map: Back Valley Quadrangle.

Mnu - Newman Limestone, upper member (Mississippian)

Mnu - Newman Limestone, upper member (Mississippian)
Shale, siltstone, and limestone: Greenish-gray to dark-greenish-gray shale and minor amounts of siltstone; olive-gray limestone of three types; calcilutite, argillaceous calcilutite, and medium-grained oolite, all in beds 1 inch to 4 feet thick. Description from source map: Coleman Gap Quadrangle.

Mnu - Newman Limestone, upper member (Mississippian)
Shale and limestone, olive-gray, calcareous shale predominates; some thick beds of lutite-textured or oolitic olive-gray limestone. Description from source map: Ewing Quadrangle.

Mnu - Newman Limestone, upper member (Upper Mississippian)
Shale, medium-gray to medium dark-gray, partly calcareous; interbedded with limestone, medium-gray to olive-gray, very fine- to medium-grained, partly argillaceous; minor calcareous sandstone. Poorly exposed. Description from source map: Fork Ridge Quadrangle.

Mnu - Upper part of Newman Limestone (Mississippian)
South of Pine Mountain
Shale and limestone. Shale, light- to dark-gray, calcareous, partly laminated to thin-bedded, fossiliferous, grading to blocky claystone; interbedded with limestone. Limestone, medium- to dark-gray, thin- to medium-bedded, fossiliferous; in part argillaceous, oolitic, and bioclastic. Poorly exposed, often covered by colluvium along north slope of Pine Mountain. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital), Middlesboro South Quadrangle (digital).

Mnu - Newman Limestone, upper member (Upper Mississippian)
Shale and limestone: Medium-gray to medium-dark-gray shale, partly calcareous; interbedded with medium-gray to olive-gray lutite-to arenite-textured partly argillaceous limestone. Description from source map: Middlesboro South Quadrangle.

Mnu - Newman Limestone, upper member (Mississippian)
Shale and limestone: Medium-dark-gray and olive-gray shale, partly calcareous, interbedded with medium-gray to olive- gray, lutite- to arenite-textured, partly argillaceous limestone. Description from source map: Varilla Quadrangle.

Mnu - Newman Limestone, upper member (Mississippian)
Shale and limestone: Predominantly medium-gray calcareous shale; interbedded units calcilutite, argillaceous calcilutite, and fine to medium oolitic limestone. Description from source map: Wheeler Quadrangle.

Mnl - Newman Limestone, lower member (Upper Mississippian)

Mnl - Newman Limestone, lower member (Mississippian)
Limestone: Interbedded light-olive-gray calcilutite and medium oolite in beds 1 inch to 4 feet thick; olive-black chert present at base, middle, and top. Description from source map: Coleman Gap Quadrangle.

Mnl - Newman Limestone, lower member (Mississippian)
Limestone, basal few feet olive-gray, lutite-textured argillaceous lime- stone with abundant dark-gray chert; remainder is mainly oolitic, light-olive-gray limestone with some interbeds of lutite-textured light-olive-gray limestone. Description from source map: Ewing Quadrangle.

Mnl - Newman Limestone, lower member (Upper Mississippian)
Limestone, light olive-gray, (weathers light-gray), very fine- to medium-grained, partly pelletal; basal beds contain dolomite locally and chert nodules in most places. Often forms conspicuous bluffs. Description from source map: Fork Ridge Quadrangle.

Mnl - Newman Limestone, lower member (Upper Mississippian)
Limestone, light-olive-gray, lutite- to arenite-textured, partly oolitic; basal beds contain dolomite locally and chert nodules in most places. Description from source map: Middlesboro South Quadrangle.

Mnl - Newman Limestone, lower member (Mississippian)
Limestone, light-olive-gray, lutite- to arenite-textured, oolitic; basal few feet argillaceous; few beds contain dark-gray chert nodules. Description from source map: Varilla Quadrangle.

Mnl - Newman Limestone, lower member (Mississippian)
Limestone, fine to medium olive-gray oolitic with a few interbeds of calcilutite: lower few feet argillaceous, containing abundant olive-black chert nodules. Description from source map: Wheeler Quadrangle.

Mnf - Newman Limestone, lower part and Fort Payne Chert (Mississippian)

Mnf - Lower part of Newman Limestone and Fort Payne Chert (Mississippian)
South of Pine Mountain
Limestone, chert, and dolomite. Mapped as a combined unit. Lower part of Newman Limestone as described above. Fort Payne, chert and dolomite. Chert, light gray, pink, or white, thin-bedded to

nodular, interbedded with silty shale of underlying unit. Dolomite, silty, in thin beds, interbedded with shale. Fort Payne thins eastward, only present on west side of quadrangle; intertongues with underlying Grainger Formation. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps:Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital).

Mg - Grainger Formation (Mississippian)

Mg - Grainger Formation (Lower Mississippian and Upper Devonian)
Siltstone, greenish-gray and gray, with interbedded shale, gray to greenish-gray. Shale predominant near middle of formation. Grayish-red shale and siltstone common in upper and lower parts of formation at some localities; zone of grayish-red shale near top of formation may represent lateral tongue of Maccrady Formation. Brachiopods, bryozoans, and pelmatozoans present; unconformity at top of formation. Description from source map: Back Valley Quadrangle.

Mg - Grainger Formation (Mississippian)
Greenish-gray shale and interbedded siltstone in 1-inch beds; grayish-red shale present near middle of formation; and about 20 feet of greenish-gray chert in beds 2 to 4 inches at top. Description from source map: Coleman Gap Quadrangle.

Mg - Grainger formation (Mississippian)
Shale, greenish-gray or pale-olive; locally grayish-red beds occur in lower half and at top; some interbedded pale-olive siltstone. Description from source map: Ewing Quadrangle.

Mg - Grainger Formation (Lower Mississippian)
Shale. greenish-gray and grayish-red; a few beds of siltstone, dark greenish-gray and grayish-red: abundant siderite nodules in basal 30 feet: includes as much as 30 feet of Fort Payne Formation at top. Description from source map: Fork Ridge Quadrangle.

Mg - Grainger Formation (Mississippian)
South of Pine Mountain
Siltstone and shale, interbedded, red, green, and gray, laminated to medium-bedded; upper part more thick-bedded siltstone, lower part dominantly shale. Occurs on north face of Pine Mountain; forms steep, rubble-covered slopes, covered by colluvium and reddish-green soil. Basal contact concealed. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital).

Mg - Grainger Formation (Lower Mississippian)
Shale, greenish-gray and grayish-red; few beds of dark-greenish-gray and grayish-red siltstone; abundant siderite nodules in basal 30 feet; includes as much as 20 feet of Fort Payne Chert (not mapped separately) at top. Description from source map: Middlesboro South Quadrangle.

Mg - Grainger Formation (Mississippian)
Shale, greenish-gray and grayish-red; few beds of siltstone and very fine grained sandstone; abundant ironstone nodules in basal 35 feet; locally includes a few feet of Fort Payne Chert (not mapped separately) at top. Description from source map: Varilla Quadrangle.

Mg - Grainger Formation (Mississippian)
Shale, greenish-gray with minor amounts of grayish-red; some interbedded pale-olive siltstone. Description from source map: Wheeler Quadrangle.

MDc - Chattanooga Shale (Lower Mississippian and Middle Devonian)

MDc - Chattanooga Shale (Lower Mississippian and Upper Devonian)
Shale, black, carbonaceous, fissile, with silty zones, especially near base. Description from source map: Back Valley Quadrangle.

MDc - Chattanooga Shale (Upper Devonian and Mississippian)
Grayish-black carbonaceous shale with minor intercalated greenish-gray shale units about 3 inches thick. Description from source map: Coleman Gap Quadrangle.

Dc - Chattanooga shale (Devonian)
Shale, carbonaceous, grayish-black with some thin zones of greenish-gray shale. Description from source map: Ewing Quadrangle.

MDc - Chattanooga Shale (Lower Mississippian and Upper Devonian)
Shale. Grayish-black. (weathers gray). Carbonaceous, pyritic. Description from source map: Fork Ridge Quadrangle.

MDc - Chattanooga Shale (Middle Devonian and Lower Mississippian)
South of Pine Mountain
Shale, dark-gray to black, weathers rust red to greenish-yellow, fissile to platy, brittle, carbonaceous, locally pyritic and silty, rare conodonts and linguloid brachiopods present, reddish-brown plant spores locally abundant. Poorly exposed, forms gentle colluvium-covered slopes along sole of Pine Mountain overthrust fault, locally thickened and deformed by drag folding; base not found. Unit description provided by Kentucky Geological Survey from the Middlesboro 30'x60' (GMS-12_007) for source maps: Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital), Middlesboro North Quadrangle (digital).

Dc - Chattanooga Shale (Upper Devonian)
Shale, grayish-black, carbonaceous, pyritic; locally includes as much as 50 feet of greenish-gray shale in lower part. Description from source map: Middlesboro South Quadrangle.

Dc - Chattanooga Shale (Devonian)
Shale, grayish-black, carbonaceous, pyritic; few thin beds of greenish-gray shale. Description from source map: Varilla Quadrangle.

MDc - Chattanooga Shale (Upper Devonian and Mississippian)
Shale, grayish-black, carbonaceous; minor amounts of inter- bedded greenish-gray shale. Description from source map: Wheeler Quadrangle.

Sh - Hancock Dolomite (upper Silurian)

Sh - Hancock Dolomite (Upper Silurian)
Dolomite, gray, fine-grained to very fine-grained, with some limestone and coral reef zones. Sandstone lenses occur locally, especially in lower part. Unconformity at top. Description from source map: Back Valley Quadrangle.

Sh - Hancock Dolomite (Upper Silurian)
Dolomite: Basal 10 feet fine- to medium-grained, slightly conglomeratic calcareous sandstone in 1-foot beds; balance of unit is very light gray to medium-gray, very finely crystalline dolomite in beds 2 inches

to 1 foot thick. Description from source map: Coleman Gap Quadrangle.

Sh - Hancock dolomite (Upper Silurian)
Dolomite, dark-gray, very finely crystalline; base marked by 5 ft of conglomeratic sandstone. Description from source map: Ewing Quadrangle.

Sh - Hancock Dolomite (Upper Silurian)
Dolomite, olive-gray, very finely crystalline; abundant well-rounded and frosted quartz grains and pebbles at base. Description from source map: Middlesboro South Quadrangle.

Sh - Hancock Dolomite (Upper Silurian)
Dolomite, medium-gray, very finely crystalline; conglomeratic sandstone at base. Description from source map: Varilla Quadrangle.

Sh - Hancock Dolomite (Upper Silurian)
Dolomite, light-gray to medium-gray, very finely crystalline; basal few feet fine- to medium-grained conglomeratic calcareous sandstone. Description from source map: Wheeler Quadrangle.

Sct - Clinton Shale (middle Silurian)

Sct - Clinton Shale (Middle Silurian)
Shale, siltstone, and sandstone. Predominately pale-olive shale; numerous greenish-gray, 1-inch beds of siltstone, and a few beds of slightly conglomeratic fine- to medium-grained sandstone. One inch to 3 1/2 feet beds of oolitic hematite in lower part of formation. Description from source map: Coleman Gap Quadrangle.

Sct - Clinton shale (Middle Silurian)
Shale, light-olive-gray; some thin beds of light-olive-gray, very fine grained sandstone; oolitic hematite near base. Description from source map: Ewing Quadrangle.

Sct - Clinton Shale (Middle Silurian)
Shale, light-olive-gray; thin beds of very fine to fine-grained sandstone; contains few beds of oolitic hematite. Description from source map: Varilla Quadrangle.

Sr - Rockwood Formation (middle and lower Silurian)

Sr - Rockwood formation (Lower and Middle Silurian)
Upper part is pale-olive shale interbedded with siltstone and thin to thick sandstone beds, with hematitic and calcareous zones at various horizons. Lower part is mostly grayish- red shale interbedded with thin-bedded, evenly bedded sandstone; fossiliferous.
Description from source map: Back Valley Quadrangle

Sr - Rockwood Formation (Lower and Middle Silurian)
Shale. mostly light olive-gray with some grayish-red and greenish-gray beds a few thin beds of siltstone, very fine to fine-grained sandstone, and oolitic hematite. Sandstone, medium-gray to brownish-gray, very fine- to medium-grained, thin- to thick-bedded in lower part.
Description from source map: Fork Ridge Quadrangle

Sr - Rockwood Formation, undivided (Lower and Middle Silurian)
In cross section only.

Upper shale member-
Shale, mostly light-olive-gray with some grayish-red and greenish-gray beds; few thin beds of siltstone, very fine to fine-grained sandstone, and oolitic hematite.

Sandstone member-
Sandstone, medium-gray to brownish-gray, very fine to fine-grained, thin- to thick-bedded; with thin interbeds of greenish-gray shale; well-rounded quartz pebbles as much as 1/4 inch in diameter in some beds; includes coarsely crystalline limestone bed as thick as 4 feet with marine fossils.

Lower shale member-
Shale, olive-gray to dark-greenish-gray; contains few very fine grained sandstone beds as much as 1 1\2 inches thick.
Description from source map: Middlesboro South Quadrangle

Sr - Rockwood Formation (Lower and Middle Silurian)
Shale and sandstone: Shale light-olive-gray; interbedded with fine-grained sandstone; a thin oolitic hematite bed near middle. This sequence of rocks in adjacent quadrangles to the east has been mapped as two formations, the Clinch Sandstone overlain by the Clinton Formation, but in this quadrangle sandstone of the Clinch wedges out, and the entire unit is referred to as the Rockwood Formation.
Description from source map: Wheeler Quadrangle

Sru - Rockwood Formation, upper shale member (middle and lower Silurian)

Sru - Rockwood Formation, upper shale member (Lower and Middle Silurian)
Shale, mostly light-olive-gray with some grayish-red and greenish-gray beds; few thin beds of siltstone, very fine to fine-grained sandstone, and oolitic hematite. Description from source map: Middlesboro South Quadrangle.

Srs - Rockwood Formation, sandstone member (middle and lower Silurian)

Srs - Rockwood Formation, sandstone member (Lower and Middle Silurian)
Sandstone, medium-gray to brownish-gray, very fine to fine-grained, thin- to thick-bedded; with thin interbeds of greenish-gray shale; well-rounded quartz pebbles as much as 1/4 inch in diameter in some beds; includes coarsely crystalline limestone bed as thick as 4 feet with marine fossils. Description from source map: Middlesboro South Quadrangle.

Srl - Rockwood Formation, lower shale member (middle and lower Silurian)

Srl - Rockwood Formation, lower shale member (Lower and Middle Silurian)
Shale, olive-gray to dark-greenish-gray; contains few very fine grained sandstone beds as much as 1 1\2 inches thick. Description from source map: Middlesboro South Quadrangle.

Sc - Clinch Sandstone (middle and lower Silurian)

Sc - Clinch Sandstone (Lower and Middle Silurian)
Poor Valley Ridge Member-
Gray, medium-grained sandstone with silty and shaly zones in upper part; lenses of quartz-pebble conglomerate common near base and top of member; contains brachiopods on Wallen Ridge.

Hagan Shale Member-
Olive-gray to brown shale, silty shale, and minor sandstone; lenticular hematite zones and marine fossils common.

Description from source map: Back Valley Quadrangle.

Sc - Clinch sandstone (Lower Silurian)
Sandstone and shale; pale-olive shale concentrated in lower third and as zones in upper two-thirds; sandstone is slightly conglomeratic, fine to medium grained, crossbedded. Description from source map: Ewing Quadrangle.

Sc - Clinch Sandstone (Lower Silurian)
Sandstone and shale: Upper part is olive-gray and brownish- gray, very fine to fine-grained, slightly conglomeratic sand- stone interbedded with greenish-gray shale; sandstone wedges out northwestward. Lower part consists of grayish- green shale interbedded with few thin beds of very fine to fine-grained sandstone. Description from source map: Varilla Quadrangle.

Scp - Clinch Sandstone, Poor Valley Ridge Member (middle and lower Silurian)

Scp - Clinch Sandstone, Poor Valley Ridge Member (Lower and Middle Silurian)
Gray, medium-grained sandstone with silty and shaly zones in upper part; lenses of quartz-pebble conglomerate common near base and top of member; contains brachiopods on Wallen Ridge. Description from source map: Back Valley Quadrangle.

Scp - Clinch Sandstone, Poor Valley Ridge Member (Lower Silurian)
Sandstone: Lower half fine- to medium-grained, locally conglomeratic sandstone in 1- to 2-foot-thick beds with a few intercalated pale-olive shale beds; upper half composed of alternating beds of siltstone and sandstone in beds as much as 6 inches thick. Description from source map: Coleman Gap Quadrangle.

Sch - Clinch Sandstone, Hagan Shale Member (middle and lower Silurian)

Sch - Clinch Sandstone, Hagan Shale Member (Lower and Middle Silurian)
Olive-gray to brown shale, silty shale, and minor sandstone; lenticular hematite zones and marine fossils common. Description from source map: Back Valley Quadrangle.

Sch - Clinch Sandstone, Hagan Shale Member (Lower Silurian)
Shale, pale-olive; locally contains beds of very fine grained sandstone. Description from source map: Coleman Gap Quadrangle.

Os - Sequatchie Formation (Upper Ordovician)

Os - Sequatchie Formation (Upper Ordovician)
Siltstone, mostly thin- to medium-bedded, with shale and sub- ordinate limestone; minor sandstone in upper part, all grayish-red, dark greenish-gray, brownish-gray, and medium-gray. Description from source map: Back Valley Quadrangle.

Os - Sequatchie Formation (Upper Ordovician)
Siltstone and limestone: Lower half is about half argillaceous greenish- gray limestone, and half grayish-red calcareous siltstone; upper half is mainly grayish-red siltstone with some argillaceous limestone. All beds are planar, 1 inch to 3 feet thick. Description from source map: Coleman Gap Quadrangle.

Os - Sequatchie formation (Upper Ordovician)
Shale and siltstone, grayish-red, calcareous. Description from source map: Ewing Quadrangle.

Os - Sequatchie Formation (Upper Ordovician)
Calcareous shale and siltstone, grayish-red and greenish-gray. Description from source map: Fork Ridge Quadrangle.

Os - Sequatchie Formation (Upper Ordovician)
Shale, silty, grayish-red and greenish-gray, calcareous. Description from source map: Middlesboro South Quadrangle.

Os - Sequatchie Formation (Upper Ordovician)
Shale and siltstone, grayish-red and greenish-gray, calcareous. Description from source map: Varilla Quadrangle.

Os - Sequatchie Formation (Upper Ordovician)
Shale, siltstone, and limestone: Grayish-red shale and calcareous siltstone with interbedded argillaceous greenish-gray or grayish-red limestone. Description from source map: Wheeler Quadrangle.

Or - Reedsville Shale (Upper Ordovician)

Or - Reedsville Shale (Upper Ordovician)
Shale, mostly gray to grayish-olive, with some green; minor gray and green siltstone that grades laterally into lime- stone; bryozoan reefs; gray, very fine-grained limestone lenses and gray sandstone lenses occur locally. Description from source map: Back Valley Quadrangle.

Or - Reedsville Shale (Upper Ordovician)
Grayish-olive shale with small amounts of greenish-gray silt- stone, silty medium-dark-gray calcilutite, and coquinoid limestone; minor amounts of siltstone and silty limestone in 1- to 2-inch-thick planar beds, coquinoid limestone in irregular beds 6 inches to 1 foot thick. Description from source map: Coleman Gap Quadrangle.

Or - Reedsville shale (Upper Ordovician)
Shale, pale-olive-gray; some interbedded coquinoid limestone and siltstone. Description from source map: Ewing Quadrangle.

Or - Reedsville Shale (Upper Ordovician)
Shale. medium-gray. calcareous: interbedded medium-gray coquinoid limestone and a few beds of calcareous siltstone. Description from source map: Fork Ridge Quadrangle.

Or - Reedsville Shale (Upper Ordovician)
Shale, limestone, and siltstone: Shale, medium-gray, calcareous; with interbedded medium-gray coquinoid limestone and few beds of calcareous siltstone; medium-gray arenite-textured limestone in upper 30 feet. Description from source map: Middlesboro South Quadrangle.

Or - Reedsville Shale (Upper Ordovician)
Shale, limestone, and siltstone: medium-gray calcareous shale with interbedded coquinoid limestone and siltstone; upper 30 feet is medium-gray, arenite-textured limestone. Description from source map: Varilla Quadrangle.

Or - Reedsville Shale (Upper Ordovician)

Shale, pale olive-gray, with thin platy beds of calcareous silt- stone and medium-gray coquinoid limestone in beds averaging 6 inches thick. Description from source map: Wheeler Quadrangle.

Ot - Trenton Limestone (Middle Ordovician)

Ot - Trenton Limestone (Middle Ordovician)
Limestone, mostly medium-gray, medium-crystalline, in beds less than 8 inches thick; interbedded with limestone, fossil- fragmental to nodular above; limestone, fossil-fragmental, with some fine-grained to finely crystalline limestone. Description from source map: Back Valley Quadrangle.

Ot - Trenton Limestone (Middle Ordovician)
Limestone: Base marked by 2-foot unit of calcareous, very fine to fine- grained sandstone. Lower 220 feet is medium-gray limestone, coquinoid in wavy beds 2 to 6 inches thick; upper part is medium- dark calcilutite to calcarenite in regular beds 2-6 inches thick; minor amounts of porous olive-black chert in upper 100 feet. Description from source map: Coleman Gap Quadrangle.

Ot - Trenton limestone (Middle Ordovician)
Limestone, medium-light-gray; coquinoid in lower half; upper half medium dark gray, interbedded coquinoid and lutite textured. Description from source map: Ewing Quadrangle.

Ot - Trenton Limestone (Middle Ordovician)
Limestone, medium-gray and brownish-gray, coarse- to medium- grained, medium-bedded, largely coquinoid. Description from source map: Fork Ridge Quadrangle.

Ot - Trenton Limestone (Middle Ordovician)
Limestone, medium-gray and brownish-gray, lutite- to arenite-textured, platy bedded, partly coquinoid. Description from source map: Middlesboro South Quadrangle.

Ot - Trenton Limestone (Middle Ordovician)
Limestone, medium-gray and brownish-gray, lutite- to arenite- textured, platybedded, partly coquinoid. Description from source map: Varilla Quadrangle.

Ot - Trenton Limestone (Middle Ordovician)
Limestone: Lower half medium light-gray, locally partly silicified, coquinoid limestone 2-inch wavy beds; upper half interbedded medium dark-gray calcilutite in thin platy beds and medium-gray coquinoid limestone in thin wavy beds. Description from source map: Wheeler Quadrangle.

Oe - Eggleston Limestone (Middle Ordovician)

Oe - Eggleston Limestone (Middle Ordovician)
Limestone, gray, very fine-grained; calcareous shale; clay- stone above, with two bentonite beds, each underlain by zones of silicified limestone; middle part consists of gray, very fine-grained limestone, fossil-fragmental limestone, and shale; lower part mostly calcareous claystone. Description from source map: Back Valley Quadrangle.

Oe - Eggleston Limestone (Middle Ordovician)
Calcareous mudstone and limestone: Lower and upper third, yellowish- gray weathering calcareous mudstone; middle part is olive-gray calcilutite in beds 2-4 inches thick. Two prominent greenish-gray bentonites in upper part. Description from source map: Coleman Gap Quadrangle.

Oe - Eggleston limestone (Middle Ordovician)
Limestone, yellowish-gray, lutite-textured. Contains two prominent bentonite beds in upper part. Description from source map: Ewing Quadrangle.

Oe - Eggleston Limestone (Middle Ordovician)
Limestone. light olive-gray and yellowish-gray, very fine-grained, argillaceous in lower and upper parts, olive-black chert nodules at center, upper part contains two persistent bentonite beds. Description from source map: Fork Ridge Quadrangle.

Oe - Eggleston Limestone (Middle Ordovician)
Limestone, light-olive-gray and yellowish-gray, lutite-textured; argillaceous in lower and upper parts; olive-black chert nodules at center; upper part contains two persistent bentonite beds. Description from source map: Middlesboro South Quadrangle.

Oe - Eggleston Limestone (Middle Ordovician)
Limestone, light-olive-gray to yellowish-gray, lutite-textured, partly argillaceous; olive-black chert nodules in middle part; upper part includes two prominent bentonite beds. Description from source map: Varilla Quadrangle.

Oe - Eggleston Limestone (Middle Ordovician)
Argillaceous limestone and limestone: Lower and upper parts, yellowish-gray argillaceous limestone; middle part olive- gray calcilutite, locally with olive-black chert nodules. Two thick greenish-gray bentonite beds in upper part-one at base and the other about 15 feet from the top. Description from source map: Wheeler Quadrangle.

Ohc - Hardy Creek Limestone (Middle Ordovician)

Ohc - Hardy Creek Limestone (Middle Ordovician)
Limestone, gray, fine- to very fine-grained, in thin to thick beds; some argillaceous limestone; distinctive irregular lenticular black chert nodules present. Description from source map: Back Valley Quadrangle.

Ohc - Hardy Creek Limestone (Middle Ordovician)
Limestone: Olive-gray calcilutite in planar beds from 1 inch to 1 foot thick; beds of argillaceous calcilutite near middle; minor amounts of olive-black, more or less perfectly oval shaped chert nodules. Description from source map: Coleman Gap Quadrangle.

Ohc - Hardy Creek limestone (Middle Ordovician)
Limestone, light-olive-gray, lutite-textured; zone of argillaceous yellowish- gray limestone near middle. Olive-black chert nodules. Description from source map: Ewing Quadrangle.

Ohc - Hardy Creek Limestone (Middle Ordovician)
Limestone, light olive-gray, thin-bedded, very fine-grained, grayish-brown chert nodules in middle part, upper part argillaceous. Description from source map: Fork Ridge Quadrangle.

Ohc - Hardy Creek Limestone (Middle Ordovician)
Limestone, light-olive-gray, lutite-textured; olive-black chert nodules abundant in middle part. Description from source maps: Middlesboro South Quadrangle, Varilla Quadrangle.

Ohc - Hardy Creek Limestone (Middle Ordovician)
Limestone, olive-gray calcilutite in even beds, somewhat laminated from 1 inch to 1 foot thick, unit of argillaceous yellowish-gray calcilutite near middle; few olive-black chert nodules throughout, locally

abundant in upper part. Description from source map: Wheeler Quadrangle.

Obh - Ben Hur Limestone (Middle Ordovician)

Obh - Ben Hur Limestone (Middle Ordovician)
Limestone, gray, argillaceous, fine-grained, and platy; weathers to shaly residuum with limestone lenses. Description from source map: Back Valley Quadrangle.

Obh - Ben Hur Limestone (Middle Ordovician)
Limestone: Yellowish-gray, hackly weathering argillaceous limestone with some interbedded olive-gray calcilutite, all in beds 2-6 inches thick. Description from source map: Coleman Gap Quadrangle.

Obh - Ben Hur limestone (Middle Ordovician)
Limestone, yellowish-gray, lutite-textured, argillaceous. Few beds com- posed of fossil detritus near middle. Description from source map: Ewing Quadrangle.

Obh - Ben Hur Limestone (Middle Ordovician)
Limestone, light olive-gray to yellowish-gray, very fine-grained, argillaceous to very silty. Description from source map: Fork Ridge Quadrangle.

Obh - Ben Hur Limestone (Middle Ordovician)
Limestone, light-olive-gray to yellowish-gray, lutite-textured, argillaceous. Description from source maps: Middlesboro South Quadrangle, Varilla Quadrangle.

Obh - Ben Hur Limestone (Middle Ordovician)
Limestone, yellowish-gray, argillaceous with some interbedded olive-gray calcilutite, especially prominent in middle part. Description from source map: Wheeler Quadrangle.

Ow - Woodway Limestone (Middle Ordovician)

Ow - Woodway Limestone (Middle Ordovician)
Limestone, mostly gray, very fine-grained to medium-crystal- line in thin to thick beds, with some gray, nodular to fossil- fragmental limestone; chert common near base and top of formation. Stromatocerium rugosum and large gastropods near base, Camarocladia in upper half. Description from source map: Back Valley Quadrangle.

Ow - Woodway Limestone (Middle Ordovician)
Limestone: Lower 100 feet is interbedded light-olive-gray calcilutite and olive-gray calcarenite in 3-inch wavy beds; upper part is mainly olive-gray calcilutite with some olive-gray calcarenite in beds 2-3 inches thick. Nodules of olive-black chert in lower part and near top. Description from source map: Coleman Gap Quadrangle.

Ow - Woodway limestone (Middle Ordovician)
Limestone, olive-gray to brownish-gray, lutite- to arenite-textured; few olive-black chert nodules in lower part. Description from source map: Ewing Quadrangle.

Ow - Woodway Limestone (Middle Ordovician)
Limestone, light brownish-gray to brownish-gray, very fine-grained, often wavy-bedded, abundant Stromatocerium rugosum in beds at base. Description from source map: Fork Ridge Quadrangle.

Ow - Woodway Limestone (Middle Ordovician)
Limestone, light-brownish-gray to brownish-gray, lutite-textured; abundant Stromatocerium rugosum in thin bed at base. Description from source maps: Middlesboro South Quadrangle, Varilla Quadrangle.

Ow - Woodway Limestone (Middle Ordovician)
Limestone: Lower one-third interbedded light-olive-gray calcilutite in thin even beds and olive-gray to olive-black calcarenite in thin wavy beds; upper part olive-gray calcilutite with some interbedded olive-gray calcarenite, all in thin even to slightly wavy beds. Few nodules of olive-black chert in lower and upper parts. Description from source map: Wheeler Quadrangle.

Ohb - Hurricane Bridge Limestone (Middle Ordovician)

Ohb - Hurricane Bridge Limestone (Middle Ordovician)
Limestone, mostly medium-gray, fine- to very fine-grained, in medium to thick beds; some nodular to fossil-fragmental; zones of grayish-red, shaly, mudcracked limestone common near base and top of formation; red, coarse fossil- fragmental limestone ("marble") containing limestone and shale fragments occurs at some localities. Description from source map: Back Valley Quadrangle.

Ohb - Hurricane Bridge Limestone (Middle Ordovician)
Limestone: Alternating units of light-olive gray thin-bedded calcilutite, grayish-red argillaceous calcilutite and light-olive gray thick-bedded calcilutite. Bedding in the thin-bedded units is planar, beds are 1-6 inches thick; beds in the thick-bedded units are 1-4 feet thick. Description from source map: Coleman Gap Quadrangle.

Ohb - Hurricane Bridge limestone (Middle Ordovician)
Limestone, light-olive-gray, lutite-textured; contains two grayish-red argillaceous limestone zones. Description from source map: Ewing Quadrangle.

Ohb - Hurricane Bridge Limestone (Middle Ordovician)
Limestone, light olive-gray to olive-gray, very fine-grained, with calcite "birdseyes", partly argillaceous, upper part fossiliferous, contains a few grayish-red argillaceous limestone beds. Description from source map: Fork Ridge Quadrangle.

Ohb - Hurricane Bridge Limestone (Middle Ordovician)
Limestone, light-olive-gray to olive-gray, lutite-textured, partly argillaceous; few grayish-red argillaceous limestone beds. Description from source map: Middlesboro South Quadrangle.

Ohb - Hurricane Bridge Limestone (Middle Ordovician)
Limestone, light-olive-gray to olive-gray, lutite-textured, partly argillaceous; few grayish-red argillaceous beds. Description from source map: Varilla Quadrangle.

Ohb - Hurricane Bridge Limestone (Middle Ordovician)
Limestone: Alternating units of light-olive-gray thin-bedded calcilutite, grayish-red argillaceous calcilutite and light-olive- gray thick-bedded calcilutite. Beds in thin-bedded units are planar 1-6 inches thick, beds in thick-bedded units are planar 1-4 feet thick. Description from source map: Wheeler Quadrangle.

Omp - Martin Creek Limestone and Poteet Limestone (Middle Ordovician)

Opm - Martin Creek Limestone and Poteet Limestone (Middle Ordovician)
Limestone. light olive-gray to brownish-gray. very fine- to medium- grained: argillaceous limestone. and

abundant medium-gray to black chert nodules in some beds. Description from source map: Fork Ridge Quadrangle.

Omrp - Martin Creek, Rob Camp Limestone and Poteet Limestone, undivided (Middle Ordovician)

Omrp - Martin Creek, Rob Camp, and Poteet Limestone, Undivided (Middle Ordovician)
Individually mapped in the area northwest of the Wallen Valley Fault. In central part of quadrangle, on the hanging wall of Wallen Valley Fault, individual units not recognizable with any certainty; mapped together in that area. Description from source map: Back Valley Quadrangle.

Omc - Martin Creek Limestone (Middle Ordovician)

Omc - Martin Creek Limestone (Middle Ordovician)
Medium- to medium dark-gray, fine- to very fine-grained, and medium- to thick-bedded, with abundant nodules and lenses of black chert. Description from source map: Back Valley Quadrangle.

Omc - Martin Creek Limestone (Middle Ordovician)
Limestone: Locally at base there may be as much as 30 feet of calcarenite composed of rounded, fine sand to granule-size particles of light-olive-gray calcilutite derived from erosion of the Rob Camp. Remaining part, alternating beds of olive-gray fine calcarenite and light-olive-gray calcilutite in beds 2 inches to 1 foot thick. Abundant olive-black chert nodules. Description from source map: Coleman Gap Quadrangle.

Omc - Martin Creek limestone (Middle Ordovician)
Limestone, olive-gray; arenite textured in lower part; light-olive-gray lutite-textured abundant olive-black chert nodules in upper part. Description from source map: Ewing Quadrangle.

Omc - Martin Creek Limestone (Middle Ordovician)
Limestone, light-olive-gray to brownish-gray, lutite- to arenite-textured; abundant medium-gray to black chert nodules. Description from source map: Middlesboro South Quadrangle, Varilla Quadrangle.

Omc - Martin Creek Limestone (Middle Ordovician)
Limestone, olive-gray calcarenite and light-olive-gray calcarenite interbedded; locally at base as much as 35 feet of fine- to coarse-calcarenite derived from erosion of Rob Camp Limestone. Olive-black chert nodules throughout, but are more abundant in upper part. Description from source map: Wheeler Quadrangle.

Orc - Rob Camp Limestone (Middle Ordovician)

Orc - Rob Camp Limestone (Middle Ordovician)
Medium-gray, fine- to very fine- grained, medium- to thick-bedded. Description from source map: Back Valley Quadrangle.

Orc - Rob Camp Limestone (Middle Ordovician)
Limestone: Light-olive-gray calcilutite in beds 1 to 4 feet thick. Description from source map: Coleman Gap Quadrangle.

Orc - Rob Camp limestone (Middle Ordovician)
Limestone, light-olive-gray; lutite-textured in massive beds. Description from source map: Ewing Quadrangle.

Orc - Rob Camp Limestone (Middle Ordovician)
Limestone, light-olive-gray, lutite-textured, massive; contains patches of white calcite. Description from source map: Middlesboro South Quadrangle.

Orc - Rob Camp Limestone (Middle Ordovician)
Limestone, light-olive-gray, lutite-textured, massive; patches of white calcite. Description from source map: Varilla Quadrangle.

Orc - Rob Camp Limestone (Middle Ordovician)
Limestone, light-olive-gray, massive bedded calcilutite. Range of thickness caused by differential erosion prior to deposition of the Martin Creek Limestone. Description from source map: Wheeler Quadrangle.

Op - Poteet Limestone (Middle Ordovician)

Op - Poteet Limestone (Middle Ordovician)
Light-gray to medium dark-gray, fine- to very fine-grained, with some nodular limestone and lenses, nodules, and masses of black chert. Description from source map: Back Valley Quadrangle.

Op - Poteet Limestone (Middle Ordovician)
Limestone: Interbedded argillaceous yellowish-gray-weathering calcilutite and olive-gray calcilutite, all in beds 1-6 inches thick; olive- black chert nodules abundant in lower half of formation, sparse in upper part. Description from source map: Coleman Gap Quadrangle.

Op - Poteet limestone (Middle Ordovician)
Limestone, light-olive-gray or medium-gray, lutite- to arenite-textured; abundant olive-black chert nodules. Description from source map: Ewing Quadrangle.

Op - Poteet Limestone (Middle Ordovician)
Limestone, light-olive-gray to brownish-gray, lutite- to arenite- textured, partly argillaceous; few beds contain olive-black chert nodules. Description from source map: Varilla Quadrangle.

Op - Poteet Limestone (Middle Ordovician)
Limestone: Olive-gray calcilutite and yellowish-gray argillaceous calcilutite interbedded; olive-black chert nodules abundant. Description from source map: Wheeler Quadrangle.

Opd - Poteet Limestone and Dot Formation, undivided (Middle Ordovician)

Opd - Poteet Limestone and Dot Formation, undivided (Middle Ordovician)
Poteet Limestone-
Limestone: Interbedded argillaceous yellowish-gray-weathering calcilutite and olive-gray calcilutite, all in beds 1-6 inches thick; olive-black chert nodules abundant in lower half of formation, sparse in upper part.

Dot Formation-
Limestone and dolomite: Basal beds are argillaceous conglomeratic dolomite; color may be either grayish-red or yellowish-gray. Conglomerate is either angular chert and (or) dolomite fragments. Middle part is interbedded calcareous, very light gray shale, argillaceous light-olive-gray calcilutite and light-olive-gray calcilutite; upper part is light-olive-gray calcilutite.

Description from source map: Coleman Gap Quadrangle.

Opd - Poteet Limestone and Dot Formation (Middle Ordovician)
Limestone and dolomite: Limestone, light-olive-gray to brownish-gray, lutite- to arenite-textured, argillaceous; few beds of olive-black chert nodules in upper part; lower part is interbedded light-olive-gray lutite-textured limestone and light-gray to yellowish-gray very finely to finely crystalline argillaceous dolomite; chert- and dolomite-pebble conglomerate at base. Description from source map: Middlesboro South Quadrangle.

Od - Dot Formation (Middle Ordovician)

Od - Dot Limestone (Lower Ordovician)
Limestone and dolomite, light- to medium-gray, fine- to very fine-grained, with dolomitic limestone beds at various horizons; where formation is thickest, lower part has gray, impure limestone and dolomitic limestone with zones that are reddish- and greenish-gray; chert fragments common. Description from source map: Back Valley Quadrangle.

Od - Dot Formation (Middle Ordovician)
Limestone: Interbedded argillaceous yellowish-gray-weathering calcilutite and olive-gray calcilutite, all in beds 1-6 inches thick; olive- black chert nodules abundant in lower half of formation, sparse in upper part. Description from source map: Coleman Gap Quadrangle.

Od - Dot formation (Middle Ordovician)
Dolomite and limestone; base marked by chert and dolomite pebble conglomerate; dolomite is greenish gray, very fine grained, and argillaceous, and is overlain by argillaceous limestone and light-olive-gray lutite-textured limestone. Description from source map: Ewing Quadrangle.

Od - Dot Formation (Middle Ordovician)
Limestone, light olive-gray, very fine-grained, interbedded with dolomite, light-gray to yellowish-gray, very finely- to finely-crystalline, argillaceous, chert and dolomite pebble conglomerate at base where it rests upon the post-Knox unconformity.
Description from source map: Fork Ridge Quadrangle.

Od - Dot Formation (Middle Ordovician)
Limestone and dolomite: Upper part is mostly light-olive-gray, lutite-textured limestone; few thin shale beds. Lower part is light-gray to yellowish-gray, very finely to finely crystalline argillaceous dolomite; basal chert and dolomite pebble conglomerate. Unconformity at base. Description from source map: Varilla Quadrangle.

Od - Dot Formation (Middle Ordovician)
Limestone and dolomite: Argillaceous conglomeratic grayish- red or yellowish-gray dolomite at base, grades upward from interbedded very light-gray shale and light-olive-gay calcilutite to light-olive-gray calcilutite. Conglomeratic mate- rial composed of chert and dolomite fragments derived from erosion of Newala Dolomite. Description from source map: Wheeler Quadrangle.

On - Newala Dolomite (Lower Ordovician)

On - Newala Dolomite (Lower Ordovician)
Dolomite: Light-olive-gray, very finely to finely crystalline dolomite in beds 6 inches to 1 foot thick. Locally grayish-red dolomite common in upper part. Few 1- to 2-inch-thick beds of fine-grained chert-matrix sandstone in upper part; chert nodules and irregular masses throughout. Description from source map: Coleman Gap Quadrangle.

On - Newala dolomite (Lower Ordovician)
Dolomite, very light gray, very finely to finely crystalline. Description from source map: Ewing Quadrangle .

On - Newala Dolomite (Lower Ordovician)
Dolomite, very light to light-gray, very finely to finely crystalline; few chert beds and nodules. Description from source map: Middlesboro South Quadrangle, Varilla Quadrangle.

On - Newala Dolomite (Lower Ordovician)
Dolomite, light-olive-gray, very-finely to finely crystalline in even beds 3 inches to 1 foot thick; chert nodules masses throughout, locally abundant. Description from source map: Wheeler Quadrangle.

Oln - Newala Dolomite and Longview Dolomite, undivided (Lower Ordovician)

Oln - Newala Dolomite and Longview Dolomite (Lower Ordovician)
Newala Dolomite-
Dolomite: light-olive-gray, very finely to finely crystalline dolomite in beds 6 inches to 1 foot thick. Locally grayish-red dolomite common in upper part. Few 1- to 2-inch-thick beds of fine-grained chert- matrix sandstone in upper part; chert nodules and irregular masses throughout.

Longview Dolomite-
Dolomite: light-gray, coarsely crystalline dolomite in beds 1-4 feet thick. Isolated quartz sand grains are common in lower half, very light gray chert beds and masses abundant throughout.

Description from source map: Coleman Gap Quadrangle.

Ol - Longview Dolomite (Lower Ordovician)

Ol - Longview Dolomite (Lower Ordovician)
Dolomite: Light-gray, coarsely crystalline dolomite in beds 1-4 feet thick. Isolated quartz sand grains are common in lower half, very light gray chert beds and masses abundant throughout. Description from source map: Coleman Gap Quadrangle.

Ol - Longview dolomite (Lower Ordovician)
Dolomite, light-gray, finely to coarsely crystalline; contains abundant white- weathering chert beds and nodules. Description from source map: Ewing Quadrangle.

Olo - Longview Dolomite (Lower Ordovician)
Dolomite, white to very light gray, finely to coarsely crystalline; abundant white chert nodules and beds. Description from source map: Middlesboro South Quadrangle.

Ol - Longview Dolomite (Lower Ordovician)
Dolomite, light-gray, coarsely crystalline dolomite in massive beds up to 4 feet thick; abundant irregular masses and nodules of white-weathering chert. Description from source map: Wheeler Quadrangle.

Oma - Mascot Dolomite (Lower Ordovician)

Oma - Mascot Dolomite (Lower Ordovician)
Dolomite, gray to light-gray, fine- to very fine-grained, with nodules and masses of chert; thin sandstone lenses and mottled, light- and medium dark-gray stromatolitic zones occur locally; unconformity at top marked by nodules to large masses of chert. Description from source map: Back Valley Quadrangle.

Oma - Mascot Dolomite (Lower Ordovician)
Dolomite, olive gray to white, mostly fine-grained: limestone. light olive-gray. fine grained. occasionally sandy: and chert in beds and nodules. Description from source map: Fork Ridge Quadrangle.

Ok - Kingsport Formation (Lower Ordovician)

Ok - Kingsport Formation (Lower Ordovician)
Dolomite, light- to medium-gray, medium crystalline and thick-bedded with masses of chert; thin sandstones and zones of grayish-green, silty shale near top, may be locally unconformable. Lower part consists of dolomite, medium- to thin-bedded, light-gray, fine-grained; basal contact gradational. Description from source map: Back Valley Quadrangle.

Ok - Kingsport Formation (Lower Ordovician)
,Limestone, light olive-gray, fine-grained: dolomite, mostly coarse-grained, and chert. often in beds and large masses. Description from source map: Fork Ridge Quadrangle.

Oc - Chepultepec Dolomite (Lower Ordovician)

Oc - Chepultepec Dolomite (Lower Ordovician)
Dolomite, light- to medium-gray, fine- to medium-grained, thin- to thick-bedded, cherty; some beds weather to sand- stone or shale by solution of carbonate cement. Description from source map: Back Valley Quadrangle.

Oc - Chepultepec Dolomite (Lower Ordovician)
Upper member-
Dolomite: Medium-light-gray to light-gray very finely to finely crystalline dolomite in beds 6 inches to 3 feet thick; one dolomitic fine-grained sandstone bed, 2 feet thick, near middle. Chert in nodules and masses abundant in lower and middle parts.

Lower member-
Dolomite and dolomitic sandstone: Principally light-gray to medium- light-gray, very finely crystalline to finely crystalline dolomite in planar beds 6 inches to 2 feet thick; some 2-foot beds of fine dolomitic quartz sandstone; chert nodules and masses abundant in lower and upper parts.

Description from source map: Coleman Gap Quadrangle.

Oc - Chepultepec Dolomite (Lower Ordovician)
In cross section only.
Dolomite, light-gray to light olive-gray, mostly finely-crystalline, white, oolitic chert nodules in a few beds, medium-grained sandstone in beds as much as 10 feet thick in lower part, abundant chert. Description from source map: Fork Ridge Quadrangle.

Och - Chepultepec Dolomite (Lower Ordovician)

Dolomite, light-gray to light-olive-gray, mostly finely crystalline; white oolitic chert nodules in a few beds; very fine to fine-grained sand- stone in beds as much as 10 feet thick common in lower part. Description from source map: Middlesboro South Quadrangle.

Ocu - Chepultepec Dolomite, upper member (Lower Ordovician)

Ocu - Chepultepec Dolomite, upper member (Lower Ordovician)
Dolomite: Medium-light-gray to light-gray very finely to finely crystalline dolomite in beds 6 inches to 3 feet thick; one dolomitic fine-grained sandstone bed, 2 feet thick, near middle. Chert in nodules and masses abundant in lower and middle parts. Description from source map: Coleman Gap Quadrangle.

Ocu - Chepultepec dolomite, upper member (Lower Ordovician)
Dolomite, light-olive-gray, finely crystalline, argillaceous; few banded chert nodules. Description from source map: Ewing Quadrangle.

Ocu - Chepultepec Dolomite, upper member (Lower Ordovician)
Dolomite, light-olive-gray, very-finely to finely crystalline, contains abundant white-weathering chert nodules and masses in lower and middle parts. Description from source map: Wheeler Quadrangle.

Ocl - Chepultepec Dolomite, lower member (Lower Ordovician)

Ocl - Chepultepec Dolomite, lower member (Lower Ordovician)
Dolomite and dolomitic sandstone: Principally light-gray to medium- light-gray, very finely crystalline to finely crystalline dolomite in planar beds 6 inches to 2 feet thick; some 2-foot beds of fine dolomitic quartz sandstone; chert nodules and masses abundant in lower and upper parts. Description from source map: Coleman Gap Quadrangle.

Ocl - Chepultepec dolomite, lower member (Lower Ordovician)
Dolomite, light-olive-gray, finely crystalline, in part argillaceous; fine-grained dolomitic sandstone abundant. Description from source map: Ewing Quadrangle.

Ocl - Chepultepec Dolomite, lower member (Lower Ordovician)
Dolomite and dolomitic sandstone: Light-olive-gray or medium- light-gray very finely to medium crystalline dolomite with interbeds of fine dolomitic sandstone; some chert nodules and masses throughout, but most abundant in middle and upper parts. Description from source map: Wheeler Quadrangle.

Ccr - Copper Ridge Dolomite (Upper Cambrian)

Ccr - Copper Ridge Dolomite (Upper Cambrian)
Dolomite: Lower half is olive-brownish-gray, coarsely crystalline dolomite in irregular beds as much as 4 feet thick; upper half is olive-brownish-gray or medium-light-gray, very finely to finely crystalline dolomite in even beds 1 inch to 2 feet thick. Olive-black oolitic chert is common throughout but is most abundant near the top of the formation. Description from source map: Coleman Gap Quadrangle.

Ccr - Copper Ridge dolomite (Upper Cambrian)
Dolomite; olive-brown; lower part medium to coarsely crystalline; upper part very fine to finely crystalline. Olive-black oolitic chert locally abundant. Description from source map: Ewing Quadrangle.

Ccr - Copper Ridge Dolomite (Upper Cambrian)
In cross section only.
Dolomite, lower part is brownish-gray to olive-gray, fine- to medium- crystalline, with petroliferous odor, occasional beds with cryptozoon chert, upper part is very light-gray to light olive-gray, fine- to medium-crystalline, contains oolitic chert nodules. Description from source map: Fork Ridge Quadrangle.

Ccr - Copper Ridge Dolomite (Upper Cambrian)
Dolomite, lower part is olive gray to brownish gray, medium to coarsely crystalline, with petroliferous odor; upper part is very light gray to light olive gray, very finely to finely crystalline, contains oolitic chert nodules. Description from source map: Middlesboro South Quadrangle.

Ccr - Copper Ridge Dolomite (Upper Cambrian)
Dolomite, olive-brownish-gray very-finely to medium crystal- line dolomite; olive-black, fine to medium oolitic chert throughout, but is more abundant near top. Description from source map: Wheeler Quadrangle.

Ccrm - Copper Ridge Dolomite and Maynardville Formation, undivided (Upper Cambrian)

Ccrm - Copper Ridge Dolomite and Maynardville Formations, undivided (Upper Cambrian)
Dolomite, gray to medium-gray, fine- to medium-grained, medium- to thick-bedded, with sandy zones and chert common; prominent zone of siliceous ooliths at and near top of formation. Thrust fault cuts off base of Copper Ridge except locally, where fine-grained, gray dolomite and bluish- gray limestone of the Maynardville Limestone occur along the fault in exposures too small and discontinuous to map separately. Description from source map: Back Valley Quadrangle.

Cmcr - Copper Ridge Dolomite and Maynardville Formations, undivided (Upper Cambrian)
Copper Ridge Dolomite-
Dolomite: Lower half is olive-brownish-gray, coarsely crystalline dolomite in irregular beds as much as 4 feet thick; upper half is olive-brownish-gray or medium-light-gray, very finely to finely crystalline dolomite in even beds 1 inch to 2 feet thick. Olive-black oolitic chert is common throughout but is most abundant near the top of the formation.

Maynardville Formation-
Limestone and dolomite: Lower half is mainly medium-dark-gray calcilutite ribboned with 1-inch bands of olive-gray, argillaceous, very finely crystalline dolomite. Beds near the top are paper laminated and grade laterally into dolomite. Upper half is very finely crystalline dolomite in even beds 6 inches thick. Color of dolomite grades upward from olive gray at base to light olive in upper part; olive-black oolitic chert in upper part locally and a few fine-grained 1-inch dolomitic quartz sandstone bands near middle.

Description from source map: Coleman Gap Quadrangle.

Cmn - Maynardville Limestone (Upper Cambrian)

Cmn - Maynardville Limestone (Upper Cambrian)
Limestone and dolomite: Lower half is mainly medium-dark-gray calcilutite ribboned with 1-inch bands of olive-gray, argillaceous, very finely crystalline dolomite. Beds near the top are paper laminated and grade laterally into dolomite. Upper half is very finely crystal- line dolomite in even beds 6 inches thick. Color of dolomite grades upward from olive gray at base to light olive in upper part; olive-black oolitic chert in upper part locally and a few fine-grained 1-inch dolomitic quartz sandstone bands near middle.

Description from source map: Coleman Gap Quadrangle.

Cmn - Maynardville limestone (Upper Cambrian)
Limestone and dolomite; limestone medium gray and ribbon bedded, with lutite-textured yellow-gray very finely crystalline dolomite. Description from source map: Ewing Quadrangle.

Cmn - Maynardville Limestone (Upper Cambrian)
In cross section only. Limestone, massive to bedded, medium olive-gray, weathering to bluish-gray. Upper part ribboned and bedded with dolomite. Middle part thick-bedded to massive, often showing large scale scalloped bedforms. Lower part bedded, with interbedded olive-gray shale. Description from source map: Fork Ridge Quadrangle.

Cmn - Maynardville Limestone (Cambrian)
In cross section only. Limestone and dolomite: Limestone, medium-gray, lutite-texture; interbedded with yellowish-gray very finely crystalline dolomite. Description from source map: Middlesboro South Quadrangle.

Cmncr - Maynardville Limestone, Conasauga Shale and Rome Formation, undivided (Cambrian)

Cmn and Cr - Maynardville Limestone, Conasauga shale, and Rome Formation (Cambrian)
In cross section only. No addition description provided on the source map. See unit Cmn for description of Maynardville Limestone. Unit appears on source map: Wheeler Quadrangle.

Cc - Conasauga Shale (Upper and Middle Cambrian)

Cc - Conasauga Shale (Middle and Upper Cambrian)
Shale: Dark-greenish-gray shale, with interbedded minor amounts of grayish-red shale, medium-dark-gray calcilutite, and medium-dark- gray oolitic limestone. Intraformational conglomerate common in many limestone beds. Description from source map: Coleman Gap Quadrangle.

Cc - Conasauga Shale (Cambrian)
In cross section only. Shale, greenish-gray and grayish-red; interbedded with lesser amounts of very fine to fine-grained sandstone and light- to medium-gray lutite- to arenite-textured limestone. Description from source map: Middlesboro South Quadrangle.

Cn - Nolichucky Shale (Upper Cambrian)

Cn - Nolichucky Shale (Upper Cambrian)
In cross section only. Shale, yellowish- to greenish-gray calcareous shale with thin interbeds of limestone and very fine sandstone. Description from source map: Fork Ridge Quadrangle.

Cm - Maryville Limestone (Middle Cambrian)

Cm - Maryville Limestone (Middle Cambrian)
Limestone, bluish-gray, fine- to very fine-grained, with silty, dolomitic laminae; shale zones; oolitic, fossil-fragmental, nodular limestone, and flat-pebble limestone conglomerate. Thickness about 450 to

500 feet in subsurface; top cut off by Clinchport Fault at surface; lower 200 feet exposed in southeast corner of quadrangle. Description from source map: Back Valley Quadrangle.

Crg - Rogersville Shale (Middle Cambrian)

Crg - Rogersville Shale (Middle Cambrian)
Shale, olive-gray to medium-gray, with lenses of siltstone and limestone. Description from source map: Back Valley Quadrangle.

Crt - Rutledge Limestone (Middle Cambrian)

Crt - Rutledge Limestone (Middle Cambrian)
Limestone, mostly bluish-gray to medium-gray, fine- to very fine-grained with silty, dolomitic laminae and some fossil-fragmental limestone, nodular limestone, and flat-pebble limestone conglomerate; shale zones common near top and bottom. Description from source map: Back Valley Quadrangle.

Cpv - Pumpkin Valley Shale (Middle Cambrian)

Cpv - Pumpkin Valley Shale (Middle Cambrian)
Upper part mostly red, green, and gray shale, with some silt- stone and limestone lenses; lower part interbedded shale, siltstone, and sandstone. White mica flakes, glauconite, and small brachiopods present. Description from source map: Back Valley Quadrangle.

Cr - Rome Formation (Lower Cambrian)

Cr - Rome Formation (Lower Cambrian)
Glauconitic, shaly sandstone, about 10 feet thick at top; underlain by red, green, and gray shale, silty shale, siltstone, and sandstone. About 50 feet of interbedded dolomite and lime- stone occurs about 400 feet from top of formation; below is sandstone, shale, and siltstone, partly calcareous. Thrust fault cuts off base of formation. Description from source map: Back Valley Quadrangle.

Cr - Rome Formation (Lower Cambrian)
In cross section only. Sandstone and siltstone: Light-gray, very fine to medium-grained glauconitic sandstone, interbedded with siltstone and greenish-gray and grayish-red shale. Limestone not abundant but few beds occur Prominent unit of medium-crystalline, light-olive-gray glauconitic dolomite near base. Base of formation marked by Pine Mountain thrust fault. Description from source map: Coleman Gap Quadrangle.

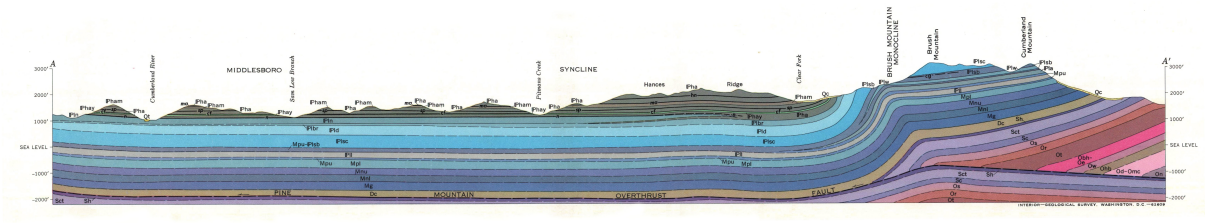
Cr - Rome Formation (Lower Cambrian)
In cross section only. Shale, siltstone, sandstone, and limestone, shales greenish-gray to grayish-red, and gray, interbedded with fine- to coarse-grained, partly glauconitic sandstone and thin beds of gray limestone. Description from source map: Fork Ridge Quadrangle.

Cr - Rome Formation (Cambrian)
In cross section only. Shale, siltstone, sandstone, and limestone: Shale, greenish-gray, grayish-red, and gray; interbedded with fine- to coarse-grained partly glauconitic sandstone and thin beds of gray limestone. Description from source map: Middlesboro South Quadrangle.

Geologic Cross Sections

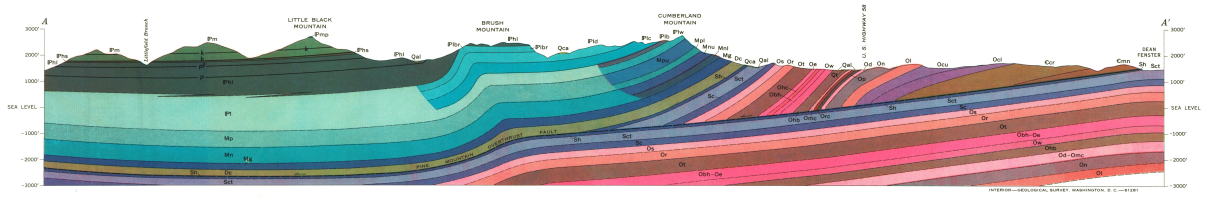
The geologic cross sections present in the GRI digital geologic-GIS data produced for Cumberland Gap National Historical Park, Kentucky, Tennessee and Virginia (CUGA) are presented below. Note that some cross section abbreviations (e.g., A - A') may have been changed from their source map abbreviation in the GRI data so that each cross section abbreviation in the GRI data is unique. Cross section graphics were scanned at a high resolution and can be viewed in more detail by zooming in (if viewing the digital format of this document).

Cross Section A-A'



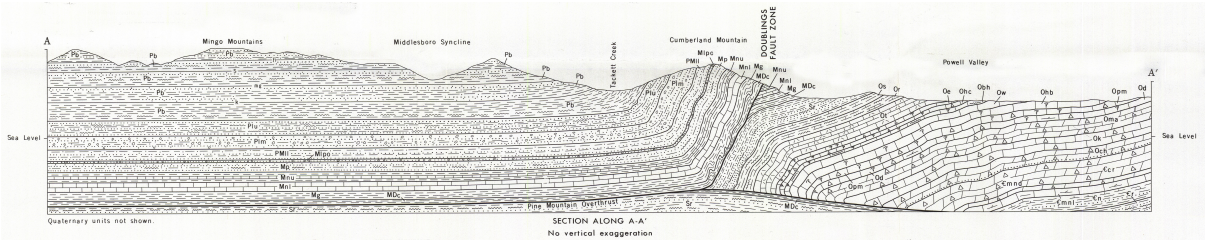
Graphic from source map: Varilla Quadrangle.

Cross Section B-B'



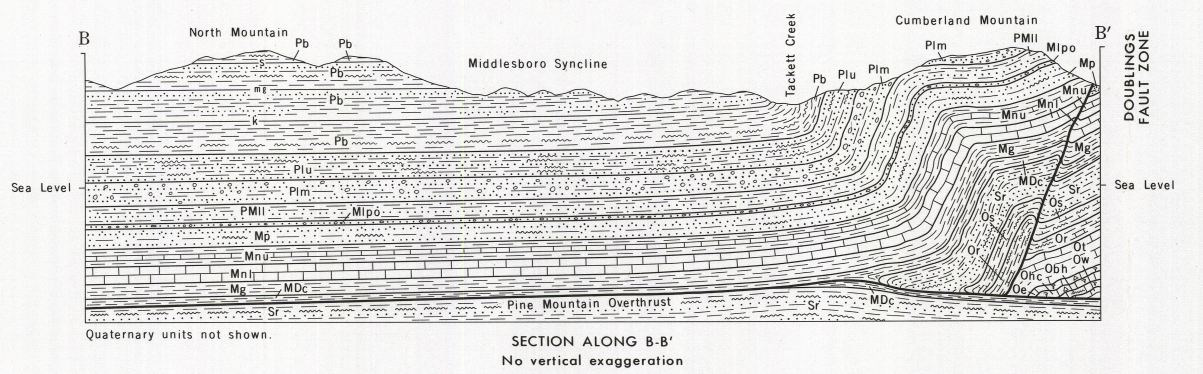
Graphic from source map: Ewing Quadrangle. Cross section A-A' on source map.

Cross Section C-C'



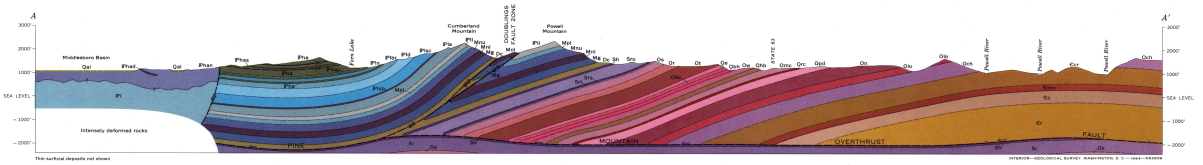
Graphic from source map: Fork Ridge Quadrangle. Cross section A-A' on source map.

Cross Section D-D'



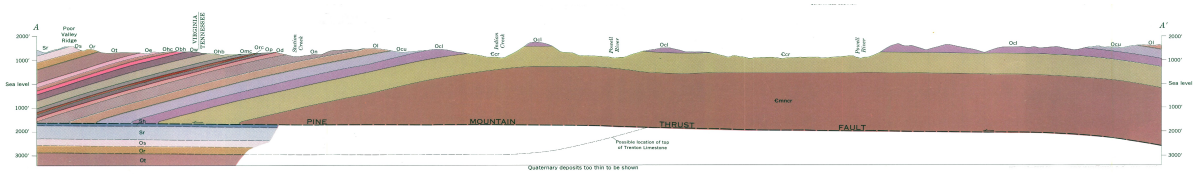
Graphic from source map: Fork Ridge Quadrangle. Cross section B-B' on source map.

Cross Section E-E'



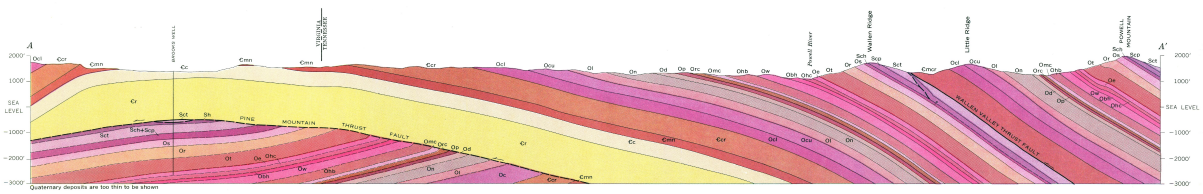
Graphic from source map: Middlesboro South Quadrangle. Cross section A-A' on source map.

Cross Section F-F'



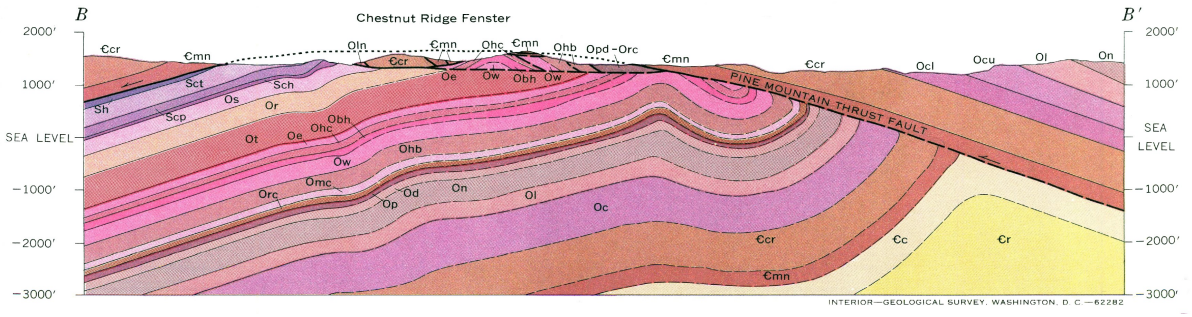
Graphic from source map: Wheeler Quadrangle. Cross section A-A' on source map.

Cross Section G-G'



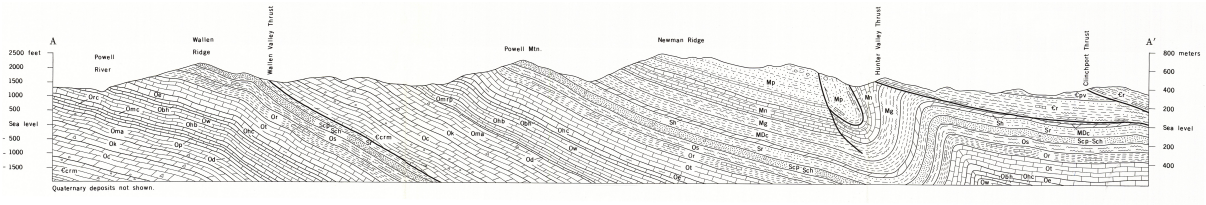
Graphic from source map: Coleman Gap Quadrangle. Cross section A-A' on source map.

Cross Section H-H'



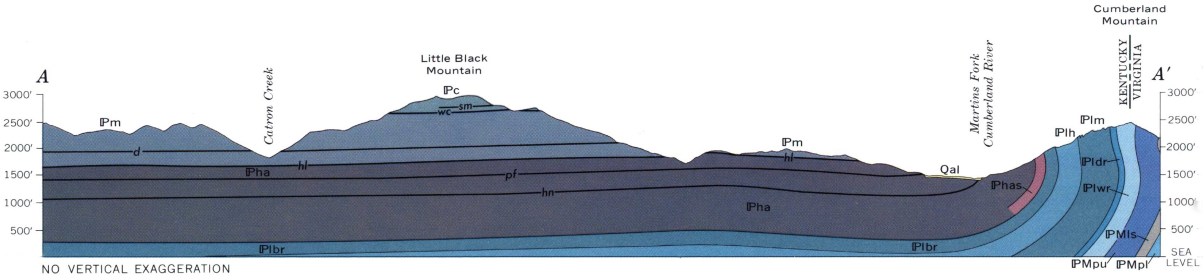
Graphic from source map: Coleman Gap Quadrangle. Cross section B-B' on source map.

Cross Section I-I'



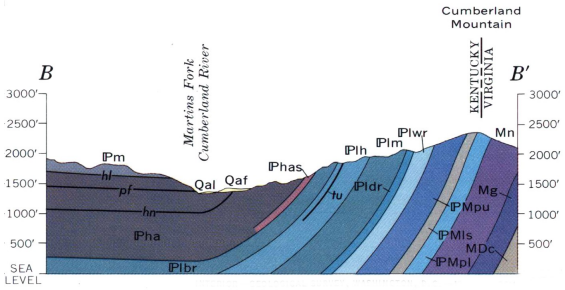
Graphic from source map: Back Valley Quadrangle. Cross section A-A' on source map.

Cross Section J-J'



Graphic from source map: part of the Rose Hill Quadrangle. Cross section A-A' on source map.

Cross Section K-K'



Graphic from source map: part of the Rose Hill Quadrangle. Cross section B-B' on source map.

Ancillary Source Map Information

The following sections present ancillary source map information associated with sources used for this project.

Back Valley Quadrangle

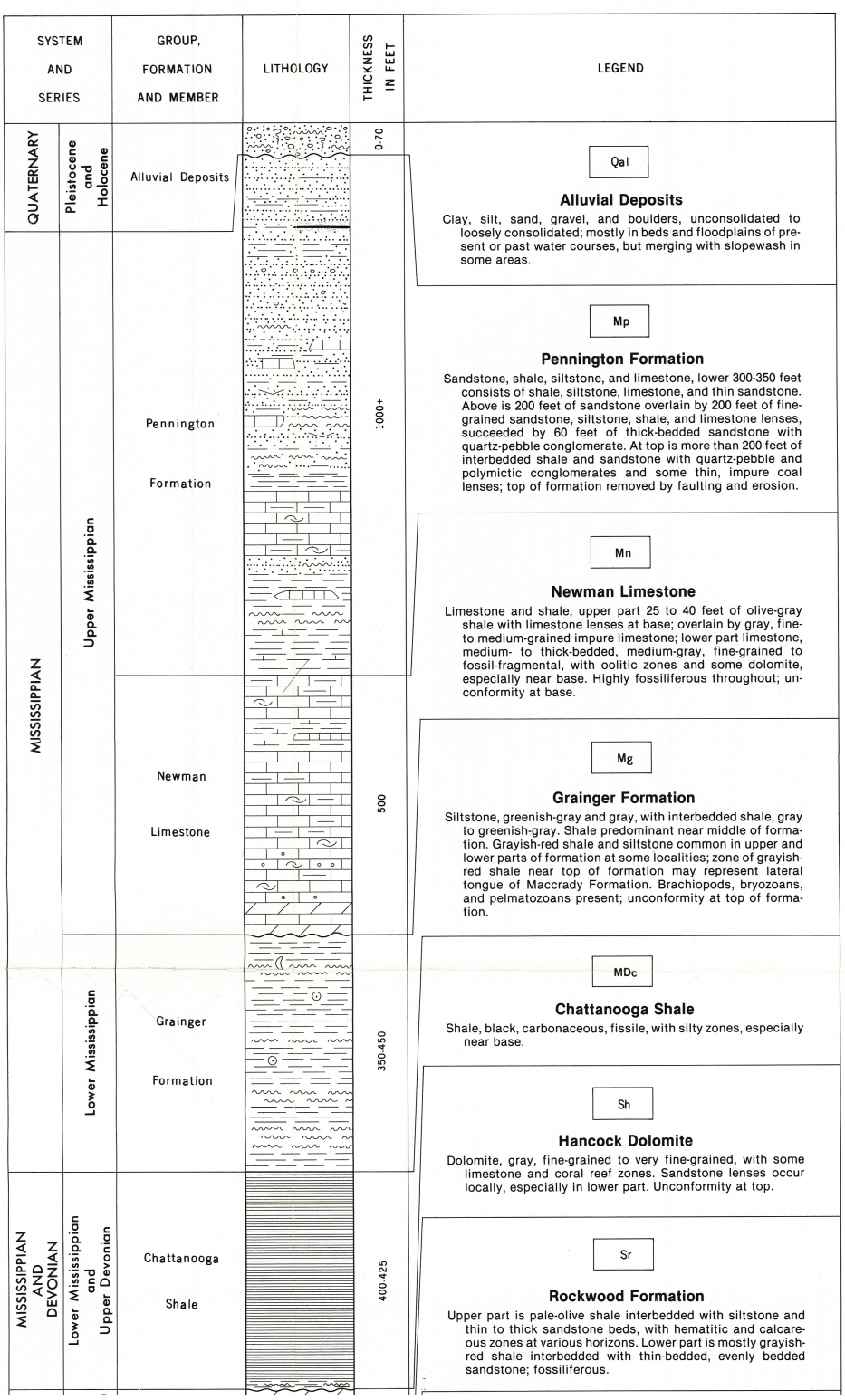
The formal citation for this source.

> Brent, W. B., 1988, Geologic Map and Mineral Resources Summary of the Back Valley Quadrangle, Tennessee: Tennessee Division of Geology, Geologic Quadrangle Map 161 SE, scale 1:24,000 (*GRI Source Map ID 68208*).

The pamphlet associated with this publication contains mineral resource descriptions and additional information about point and line data being depicted on the map. It is available here.

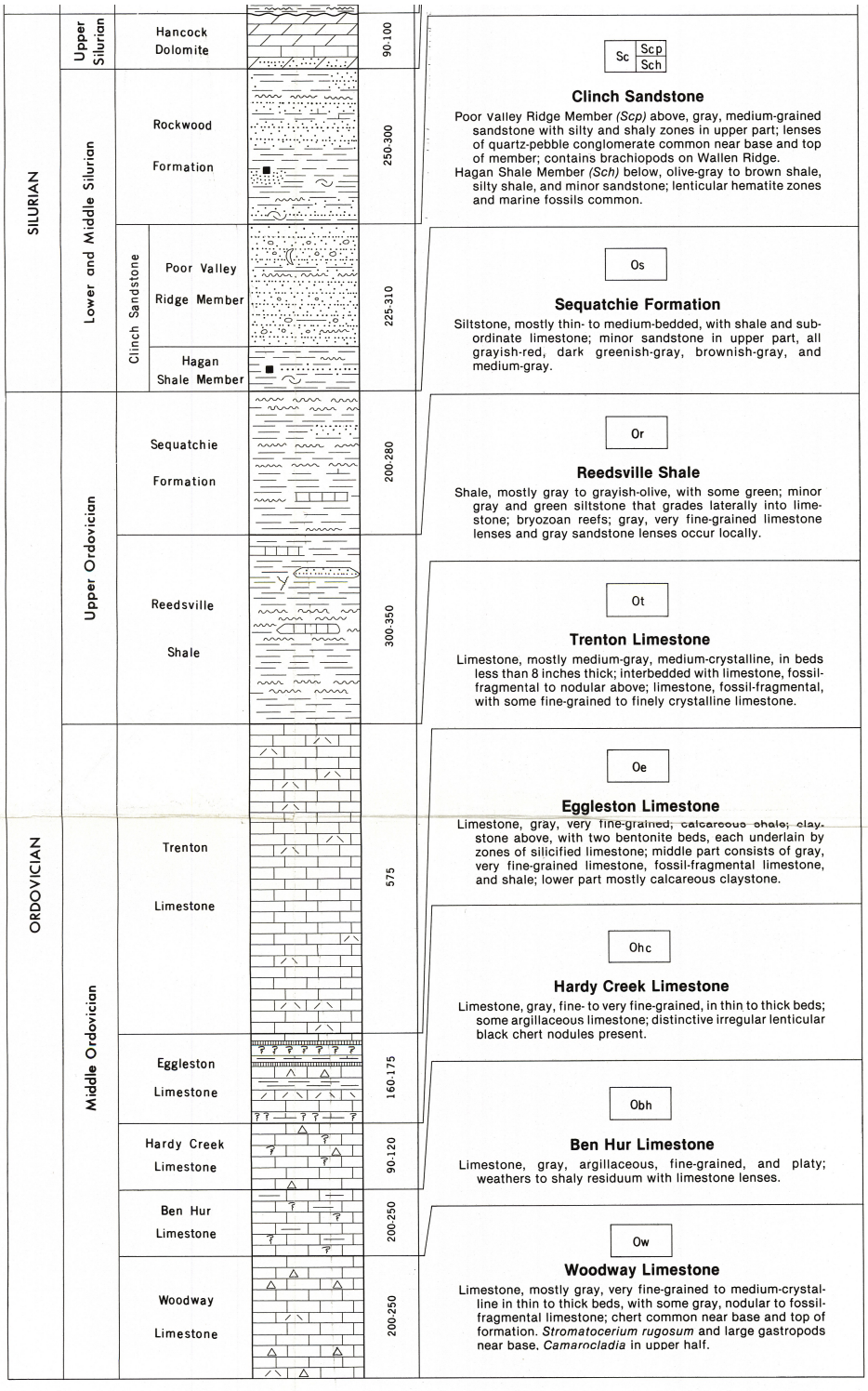
Prominent graphics associated with this source:

Correlation of Map Units and Stratigraphic Section, part 1



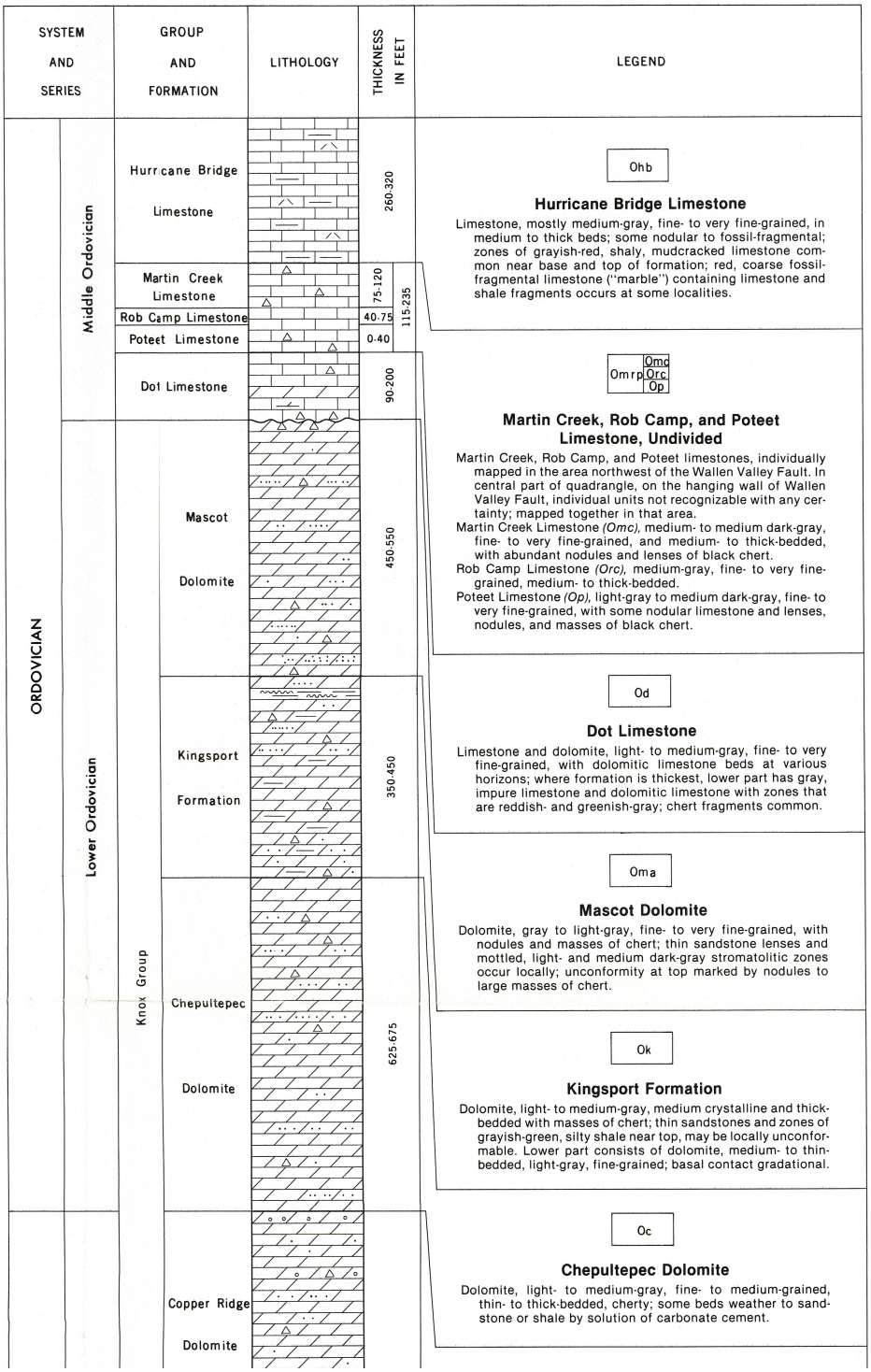
Graphic from source map: Back Valley Quadrangle

Correlation of Map Units and Stratigraphic Section, part 2



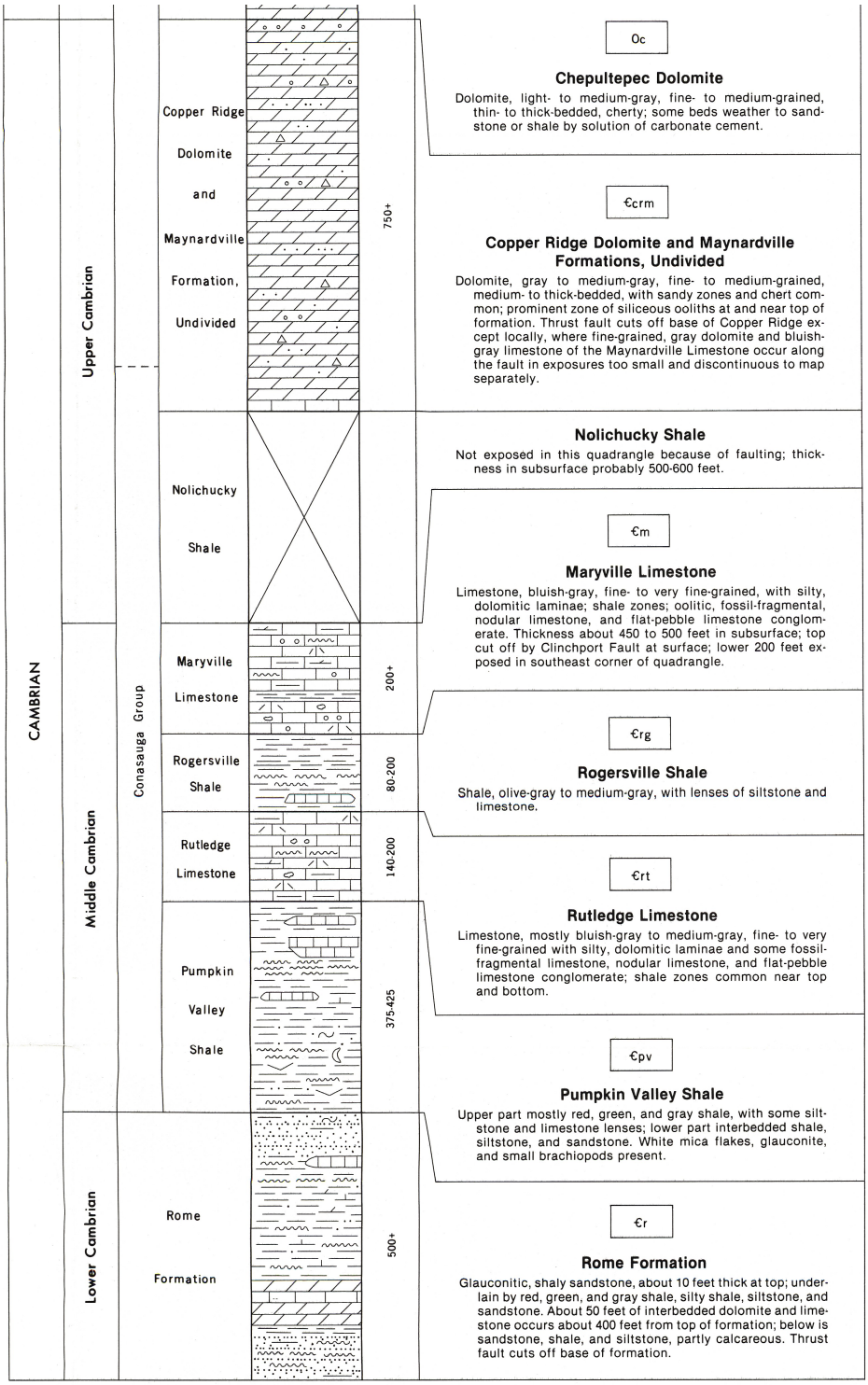
Graphic from source map: Back Valley Quadrangle

Correlation of Map Units and Stratigraphic Section, part 3



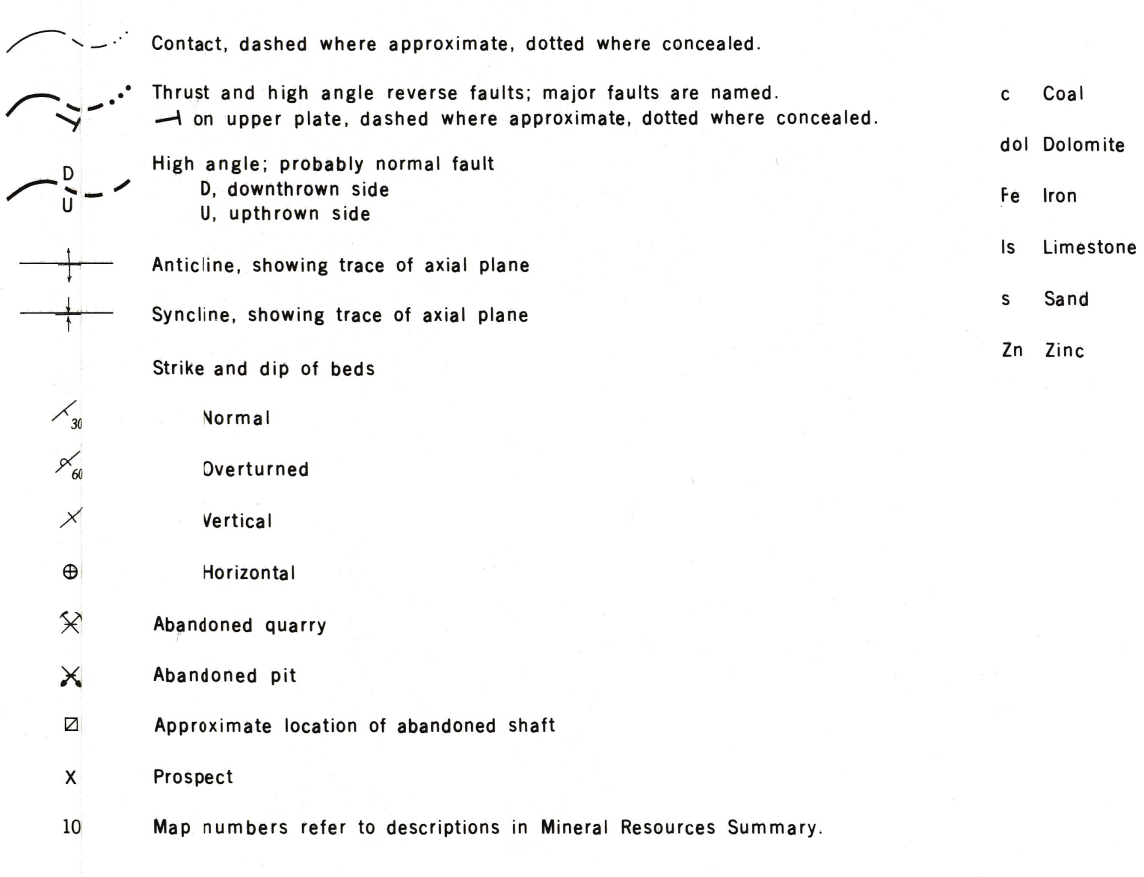
Graphic from source map: Back Valley Quadrangle

Correlation of Map Units and Stratigraphic Section, part 4



Graphic from source map: Back Valley Quadrangle

Map Legend



Graphic from source map: Back Valley Quadrangle

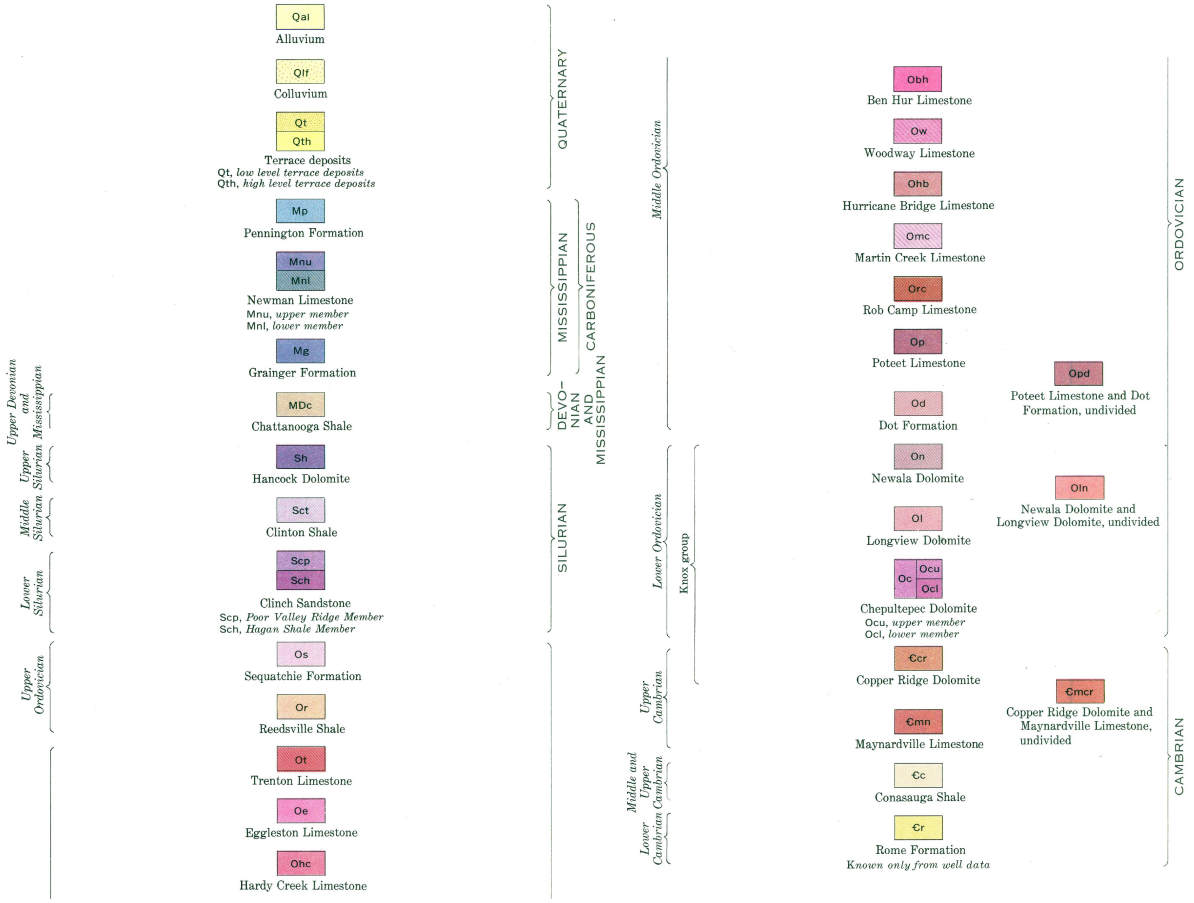
Coleman Gap Quadrangle

The formal citation for this source.

> Harris, L. D., Stephens, J. G., and Miller, R. L., 1962, Geology of the Coleman Gap Quadrangle, Tennessee and Virginia: U.S. Geological Survey, Geologic Quadrangle Map GQ-188, scale 1:24,000 (*GRI Source Map ID 2481*).

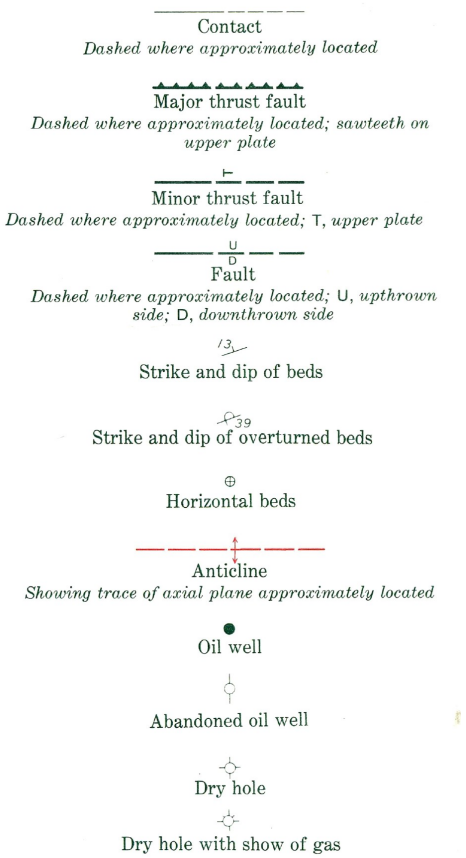
Prominent graphics associated with this source:

Correlation of Map Units



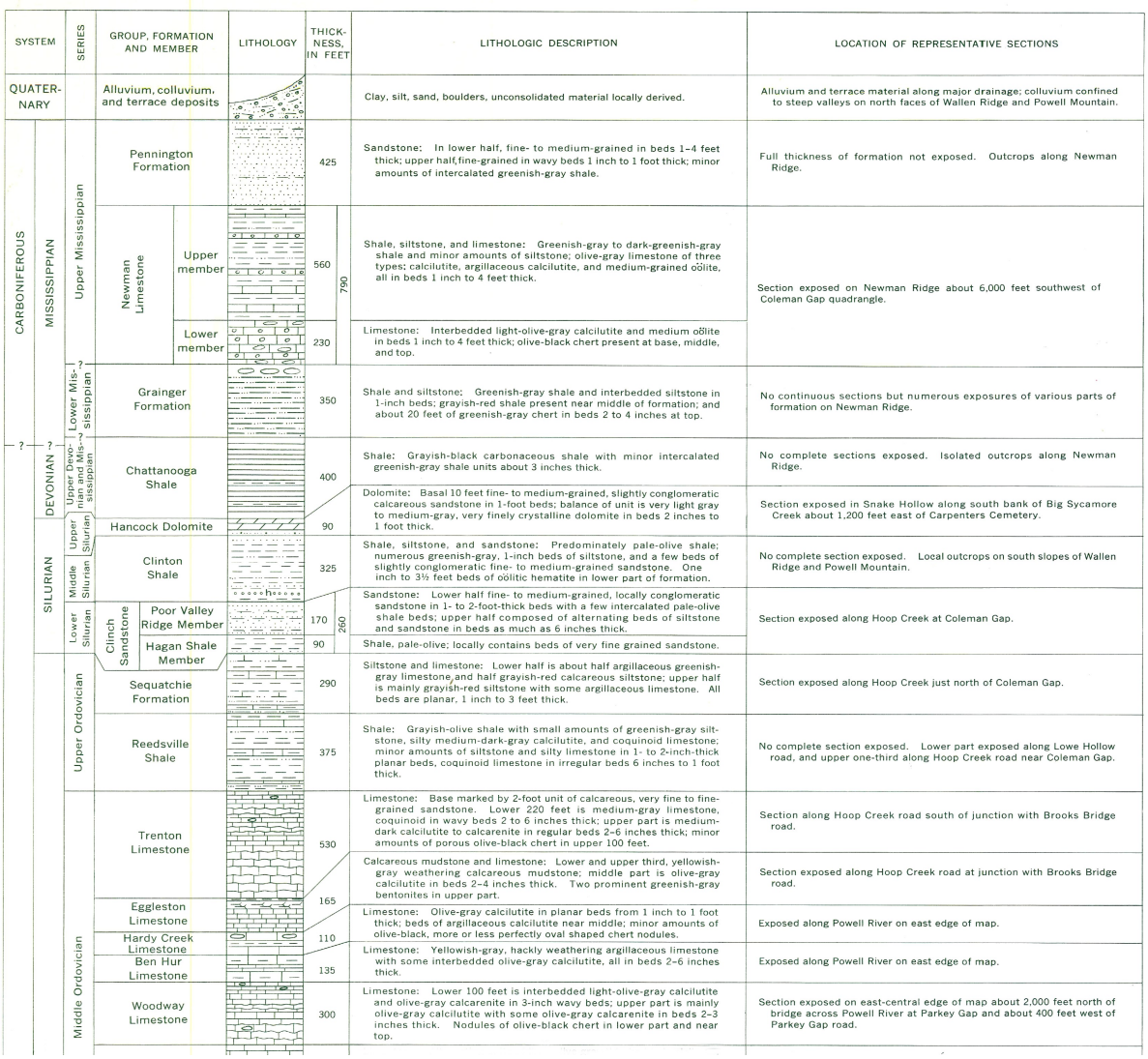
Graphic from source map: Coleman Gap Quadrangle

Map Legend



Graphic from source map: Coleman Gap Quadrangle

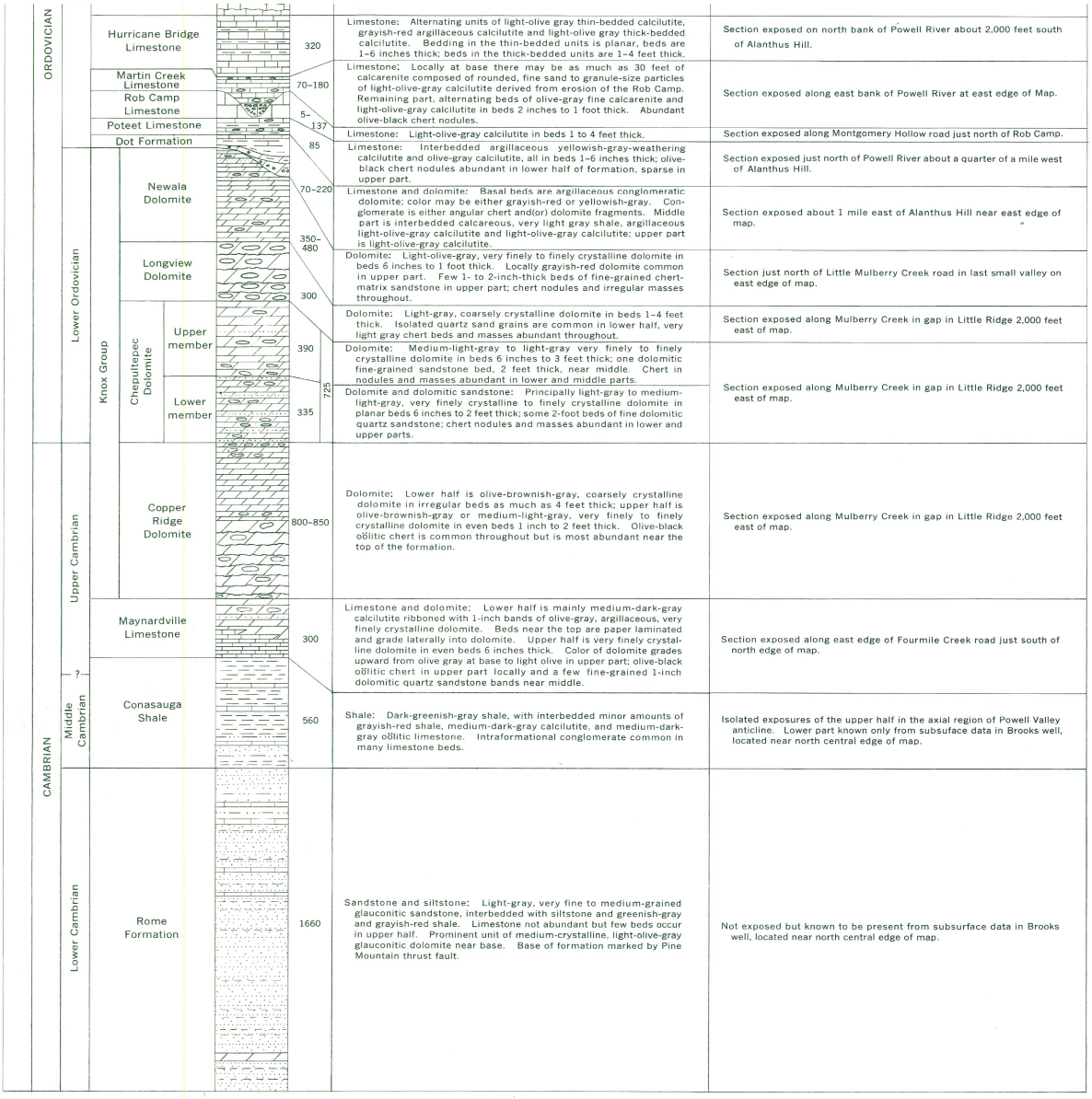
Stratigraphic Section, top portion



SYSTEM	SERIES	GROUP, FORMATION AND MEMBER	THICKNESS, IN FEET	LITHOLOGIC DESCRIPTION	LOCATION OF REPRESENTATIVE SECTIONS
QUATERNARY		Alluvium, colluvium, and terrace deposits		Clay, silt, sand, boulders, unconsolidated material locally derived.	Alluvium and terrace material along major drainage; colluvium confined to steep valleys on north faces of Wallen Ridge and Powell Mountain.
CARBONIFEROUS — MISSISSIPPIAN	Upper Mississippian	Pennington Formation	425	Sandstone: In lower half, fine- to medium-grained in beds 1–4 feet thick; upper half, fine-grained in wavy beds 1 inch to 1 foot thick; minor amounts of intercalated greenish-gray shale.	Full thickness of formation not exposed. Outcrops along Newman Ridge.
		Newman Limestone, Upper member	560 (790)	Shale, siltstone, and limestone: Greenish-gray to dark-greenish-gray shale and minor amounts of siltstone; olive-gray limestone of three types; calcilutite, argillaceous calcilutite, and medium-grained oölite, all in beds 1 inch to 4 feet thick.	Section exposed on Newman Ridge about 6,000 feet southwest of Coleman Gap quadrangle.
		Newman Limestone, Lower member	230	Limestone: Interbedded light-olive-gray calcilutite and medium oölite in beds 1 inch to 4 feet thick; olive-black chert present at base, middle, and top.	
	Lower Mississippian	Grainger Formation	350	Shale and siltstone: Greenish-gray shale and interbedded siltstone in 1-inch beds; grayish-red shale present near middle of formation; and about 20 feet of greenish-gray chert in beds 2 to 4 inches at top.	No continuous sections but numerous exposures of various parts of formation on Newman Ridge.
? — DEVONIAN	Upper Devonian and Mississippian	Chattanooga Shale	400	Shale: Grayish-black carbonaceous shale with minor intercalated greenish-gray shale units about 3 inches thick.	No complete sections exposed. Isolated outcrops along Newman Ridge.
	Upper Silurian	Hancock Dolomite	90	Dolomite: Basal 10 feet fine- to medium-grained, slightly conglomeratic calcareous sandstone in 1-foot beds; balance of unit is very light gray to medium-gray, very finely crystalline dolomite in beds 2 inches to 1 foot thick.	Section exposed in Snake Hollow along south bank of Big Sycamore Creek about 1,200 feet east of Carpenters Cemetery.
SILURIAN	Middle Silurian	Clinton Shale	325	Shale, siltstone, and sandstone: Predominately pale-olive shale; numerous greenish-gray, 1-inch beds of siltstone, and a few beds of slightly conglomeratic fine- to medium-grained sandstone. One inch to 3½ feet beds of oölitic hematite in lower part of formation.	No complete section exposed. Local outcrops on south slopes of Wallen Ridge and Powell Mountain.
	Lower Silurian	Clinch Sandstone, Poor Valley Ridge Member	170 (260)	Sandstone: Lower half fine- to medium-grained, locally conglomeratic sandstone in 1- to 2-foot-thick beds with a few intercalated pale-olive shale beds; upper half composed of alternating beds of siltstone and sandstone in beds as much as 6 inches thick.	Section exposed along Hoop Creek at Coleman Gap.
		Clinch Sandstone, Hagan Shale Member	90	Shale, pale-olive; locally contains beds of very fine grained sandstone.	
	Upper Ordovician	Sequatchie Formation	290	Siltstone and limestone: Lower half is about half argillaceous greenish-gray limestone and half grayish-red calcareous siltstone; upper half is mainly grayish-red siltstone with some argillaceous limestone. All beds are planar, 1 inch to 3 feet thick.	Section exposed along Hoop Creek just north of Coleman Gap.
		Reedsville Shale	375	Shale: Grayish-olive shale with small amounts of greenish-gray siltstone, silty medium-dark-gray calcilutite, and coquinoid limestone; minor amounts of siltstone and silty limestone in 1- to 2-inch-thick planar beds, coquinoid limestone in irregular beds 6 inches to 1 foot thick.	No complete section exposed. Lower part exposed along Lowe Hollow road, and upper one-third along Hoop Creek road near Coleman Gap.
	Middle Ordovician	Trenton Limestone	530	Limestone: Base marked by 2-foot unit of calcareous, very fine to fine-grained sandstone. Lower 220 feet is medium-gray limestone, coquinoid in wavy beds 2 to 6 inches thick; upper part is medium-dark calcilutite to calcarenite in regular beds 2–6 inches thick; minor amounts of porous olive-black chert in upper 100 feet.	Section along Hoop Creek road south of junction with Brooks Bridge road.
		Trenton Limestone	165	Calcareous mudstone and limestone: Lower and upper third, yellowish-gray weathering calcareous mudstone; middle part is olive-gray calcilutite in beds 2–4 inches thick. Two prominent greenish-gray bentonites in upper part.	Section exposed along Hoop Creek road at junction with Brooks Bridge road.
		Eggleston Limestone		Limestone: Olive-gray calcilutite in planar beds from 1 inch to 1 foot thick; beds of argillaceous calcilutite near middle; minor amounts of olive-black, more or less perfectly oval shaped chert nodules.	Exposed along Powell River on east edge of map.
		Hardy Creek Limestone	110		
		Ben Hur Limestone	135	Limestone: Yellowish-gray, hackly weathering argillaceous limestone with some interbedded olive-gray calcilutite, all in beds 2–6 inches thick.	Exposed along Powell River on east edge of map.
		Woodway Limestone	300	Limestone: Lower 100 feet is interbedded light-olive-gray calcilutite and olive-gray calcarenite in 3-inch wavy beds; upper part is mainly olive-gray calcilutite with some olive-gray calcarenite in beds 2–3 inches thick. Nodules of olive-black chert in lower part and near top.	Section exposed on east-central edge of map about 2,000 feet north of bridge across Powell River at Parkey Gap and about 400 feet west of Parkey Gap road.

Graphic from source map: Coleman Gap Quadrangle

Stratigraphic Section, bottom portion



Graphic from source map: Coleman Gap Quadrangle

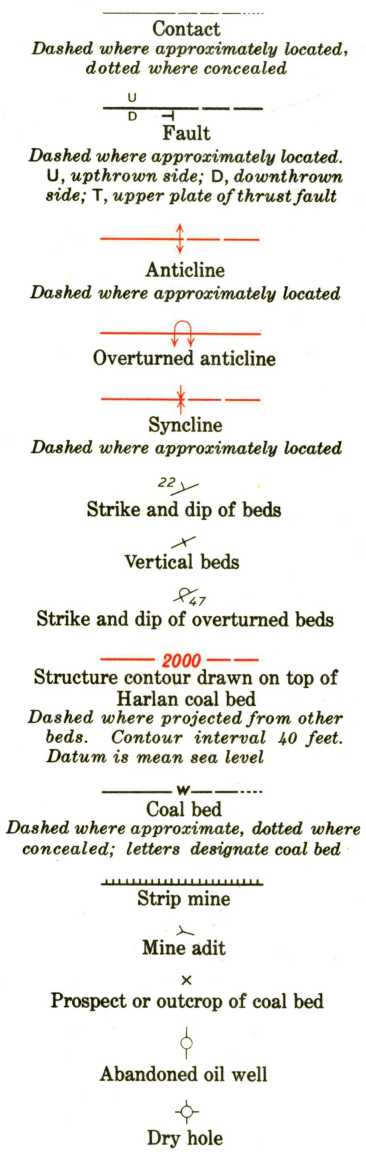
Ewing Quadrangle

The formal citation for this source.

> Englund, K. J., Smith, H. L., Harris, L. D., and Stephens, J. G., 1963, Geology of the Ewing Quadrangle, Kentucky and Virginia: U.S. Geological Survey, Bulletin 1142-B, scale 1:24,000 (*GRI Source Map ID 2480*).

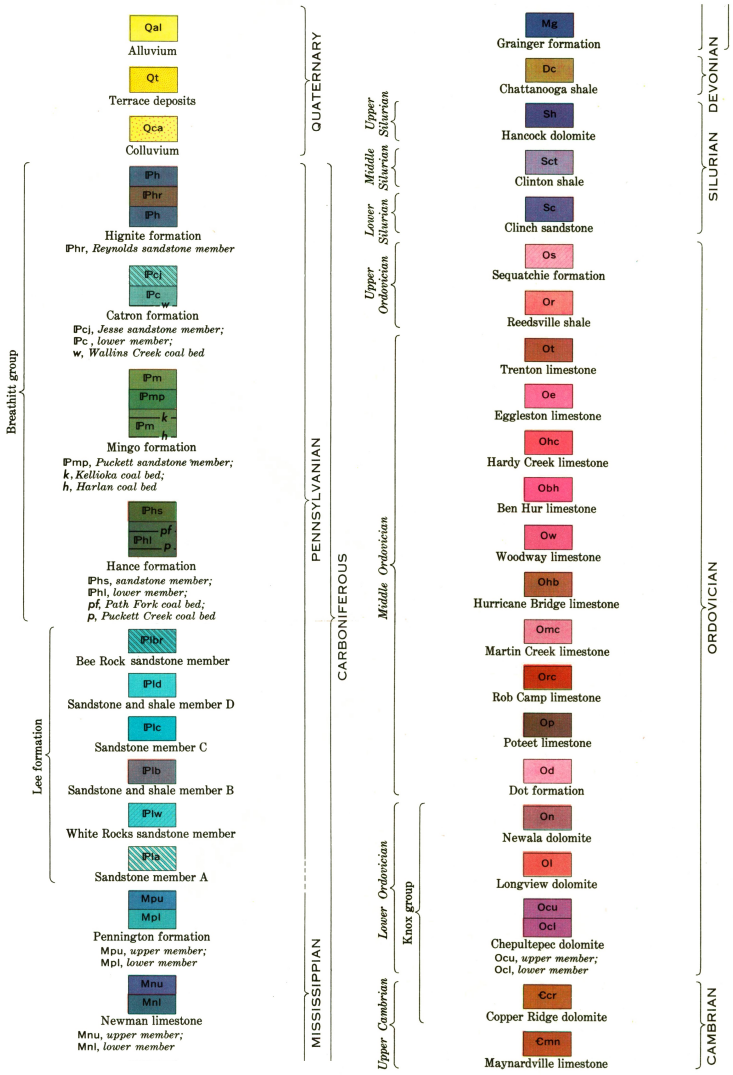
Prominent graphics and text associated with this source:

Map Legend



Graphic from source map: Ewing Quadrangle

Correlation of Map Units



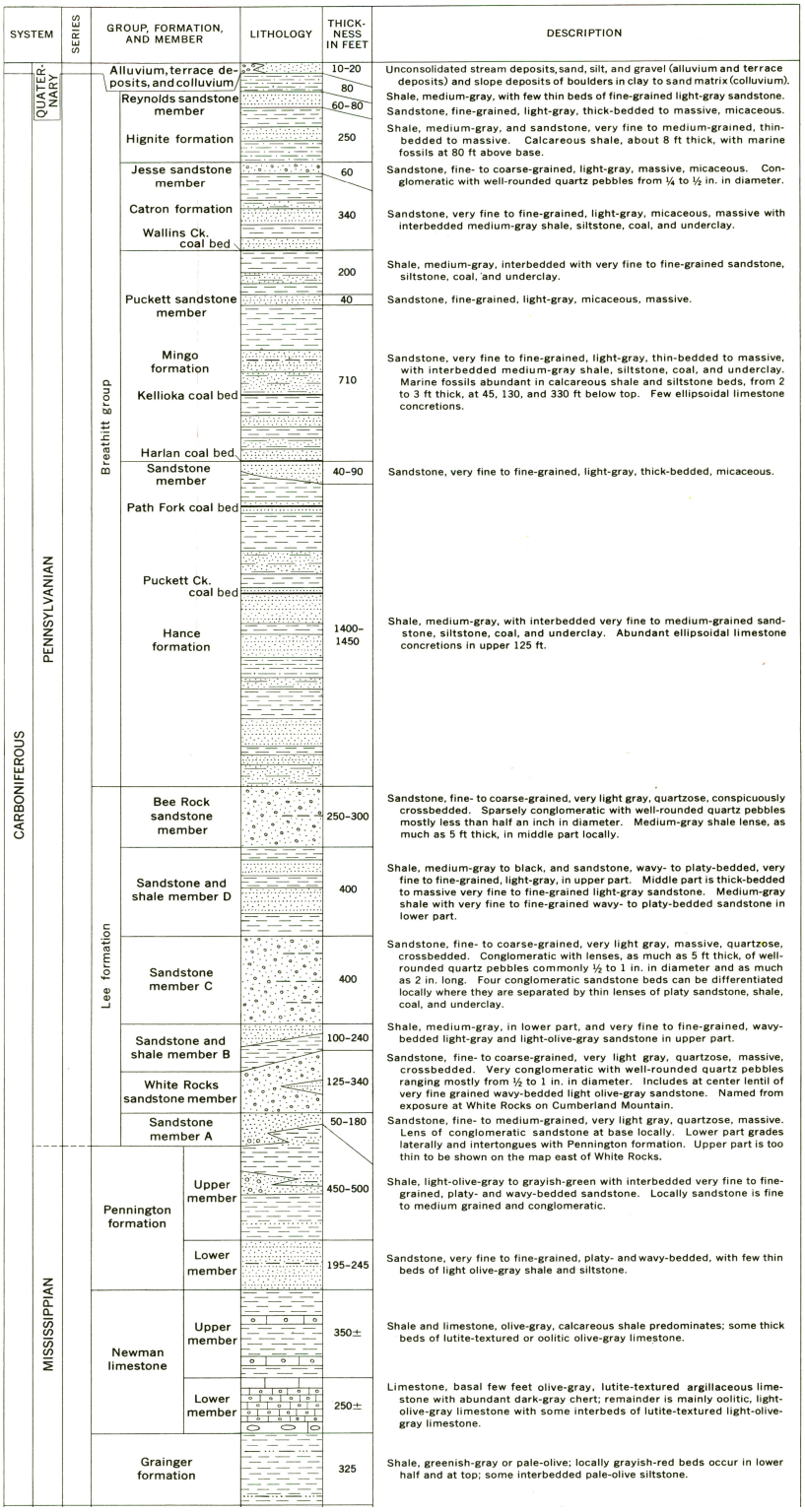
Graphic from source map: Ewing Quadrangle

Economic Geology

Coal has been mined in the Ewing quadrangle for more than 50 years, mostly from a few large underground mines which are served by railroad. In recent years this production has been supplemented by the operation of strip, auger, and truck mines. The coal is of high volatile A bituminous rank and occurs principally in five beds. These are: the Puckett Creek and Path Fork coal beds in the Hance formation, the Harlan and Kellioka coal beds in the Mingo formation, and the Wallins Creek coal bed in the Catron formation. The total estimated original reserves contained in these beds are more than 196 million tons of which approximately one-third is estimated mined and lost in mining. Assuming 50 percent recovery, the remaining recoverable reserves are more than 67 million tons.

Text from source map: Ewing Quadrangle

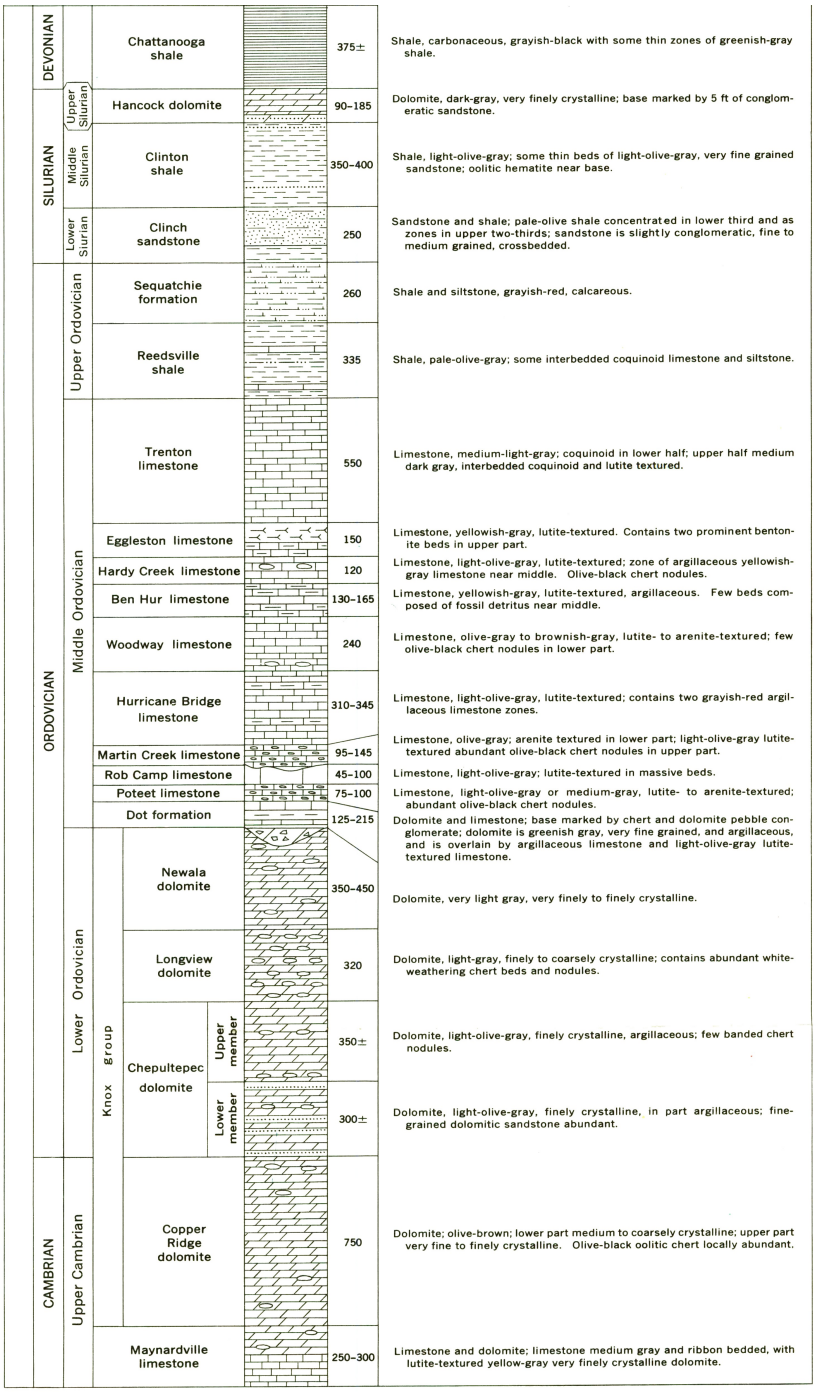
Stratigraphic Section, top portion



SYSTEM	SERIES	GROUP, FORMATION, AND MEMBER	THICKNESS IN FEET	DESCRIPTION
CARBONIFEROUS	QUATERNARY	Alluvium, terrace deposits, and colluvium	10–20	Unconsolidated stream deposits, sand, silt, and gravel (alluvium and terrace deposits) and slope deposits of boulders in clay to sand matrix (colluvium).
	PENNSYLVANIAN	Breathitt group: Reynolds sandstone member	80	Shale, medium-gray, with few thin beds of fine-grained light-gray sandstone.
			60–80	Sandstone, fine-grained, light-gray, thick-bedded to massive, micaceous.
		Hignite formation	250	Shale, medium-gray, and sandstone, very fine to medium-grained, thin-bedded to massive. Calcareous shale, about 8 ft thick, with marine fossils at 80 ft above base.
		Jesse sandstone member	60	Sandstone, fine- to coarse-grained, light-gray, massive, micaceous. Conglomeratic with well-rounded quartz pebbles from ¼ to ½ in. in diameter.
		Catron formation; Wallins Ck. coal bed	340	Sandstone, very fine to fine-grained, light-gray, micaceous, massive with interbedded medium-gray shale, siltstone, coal, and underclay.
			200	Shale, medium-gray, interbedded with very fine to fine-grained sandstone, siltstone, coal, and underclay.
		Puckett sandstone member	40	Sandstone, fine-grained, light-gray, micaceous, massive.
		Mingo formation; Kellioka coal bed; Harlan coal bed	710	Sandstone, very fine to fine-grained, light-gray, thin-bedded to massive, with interbedded medium-gray shale, siltstone, coal, and underclay. Marine fossils abundant in calcareous shale and siltstone beds, from 2 to 3 ft thick, at 45, 130, and 330 ft below top. Few ellipsoidal limestone concretions.
		Sandstone member	40–90	Sandstone, very fine to fine-grained, light-gray, thick-bedded, micaceous.
		Path Fork coal bed; Puckett Ck. coal bed; Hance formation	1400–1450	Shale, medium-gray, with interbedded very fine to medium-grained sandstone, siltstone, coal, and underclay. Abundant ellipsoidal limestone concretions in upper 125 ft.
		Lee formation: Bee Rock sandstone member	250–300	Sandstone, fine- to coarse-grained, very light gray, quartzose, conspicuously crossbedded. Sparsely conglomeratic with well-rounded quartz pebbles mostly less than half an inch in diameter. Medium-gray shale lense, as much as 5 ft thick, in middle part locally.
		Sandstone and shale member D	400	Shale, medium-gray to black, and sandstone, wavy- to platy-bedded, very fine to fine-grained, light-gray, in upper part. Middle part is thick-bedded to massive very fine to fine-grained light-gray sandstone. Medium-gray shale with very fine to fine-grained wavy- to platy-bedded sandstone in lower part.
		Sandstone member C	400	Sandstone, fine- to coarse-grained, very light gray, massive, quartzose, crossbedded. Conglomeratic with lenses, as much as 5 ft thick, of well-rounded quartz pebbles commonly ½ to 1 in. in diameter and as much as 2 in. long. Four conglomeratic sandstone beds can be differentiated locally where they are separated by thin lenses of platy sandstone, shale, coal, and underclay.
		Sandstone and shale member B	100–240	Shale, medium-gray, in lower part, and very fine to fine-grained, wavy-bedded light-gray and light-olive-gray sandstone in upper part.
		White Rocks sandstone member	125–340	Sandstone, fine- to coarse-grained, very light gray, quartzose, massive, crossbedded. Very conglomeratic with well-rounded quartz pebbles ranging mostly from ½ to 1 in. in diameter. Includes at center lentil of very fine grained wavy-bedded light olive-gray sandstone. Named from exposure at White Rocks on Cumberland Mountain.
		Sandstone member A	50–180	Sandstone, fine- to medium-grained, very light gray, quartzose, massive. Lens of conglomeratic sandstone at base locally. Lower part grades laterally and intertongues with Pennington formation. Upper part is too thin to be shown on the map east of White Rocks.
	MISSISSIPPIAN	Pennington formation: Upper member	450–500	Shale, light-olive-gray to grayish-green with interbedded very fine to fine-grained, platy- and wavy-bedded sandstone. Locally sandstone is fine to medium grained and conglomeratic.
		Lower member	195–245	Sandstone, very fine to fine-grained, platy- and wavy-bedded, with few thin beds of light olive-gray shale and siltstone.
		Newman limestone: Upper member	350±	Shale and limestone, olive-gray, calcareous shale predominates; some thick beds of lutite-textured or oolitic olive-gray limestone.
		Lower member	250±	Limestone, basal few feet olive-gray, lutite-textured argillaceous limestone with abundant dark-gray chert; remainder is mainly oolitic, light-olive-gray limestone with some interbeds of lutite-textured light-olive-gray limestone.
		Grainger formation	325	Shale, greenish-gray or pale-olive; locally grayish-red beds occur in lower half and at top; some interbedded pale-olive siltstone.

Graphic from source map: Ewing Quadrangle

Stratigraphic Section, bottom portion



Graphic from source map: Ewing Quadrangle

Ewing Quadrangle (digital)

The formal citation for this source.

> Mullins, J. E., 2003, Spatial Database of the Ewing Quadrangle, Kentucky, Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_172, scale 1:24,000 (*GRI Source Map ID 69706*).

The above digital data was digitized and modified from USGS Bulletin 1142-B by the Kentucky Geological Survey. The Kentucky Geological Survey has updated this map with current stratigraphic classifications and geologic interpretation.

No additional information from this source map is presented here.

Fork Ridge Quadrangle

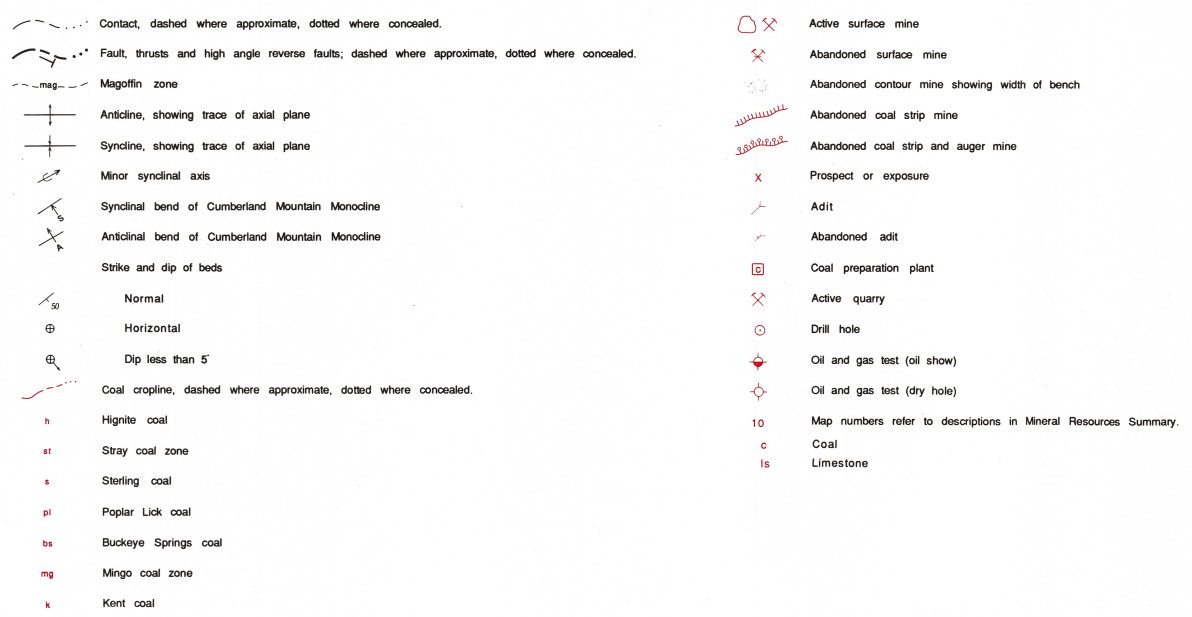
The formal citation for this source.

> Kohl, M. S., Sykes, C. R., 1991, Geologic Map and Mineral Resources Summary of the Fork Ridge Quadrangle, Tennessee: Tennessee Division of Geology, Geologic Quadrangle Map 144 SE, scale 1:24,000 (*GRI Source Map ID 68311*).

The pamphlet associated with this publication contains mineral resource descriptions and additional information about point and line data being depicted on the map. It is available here.

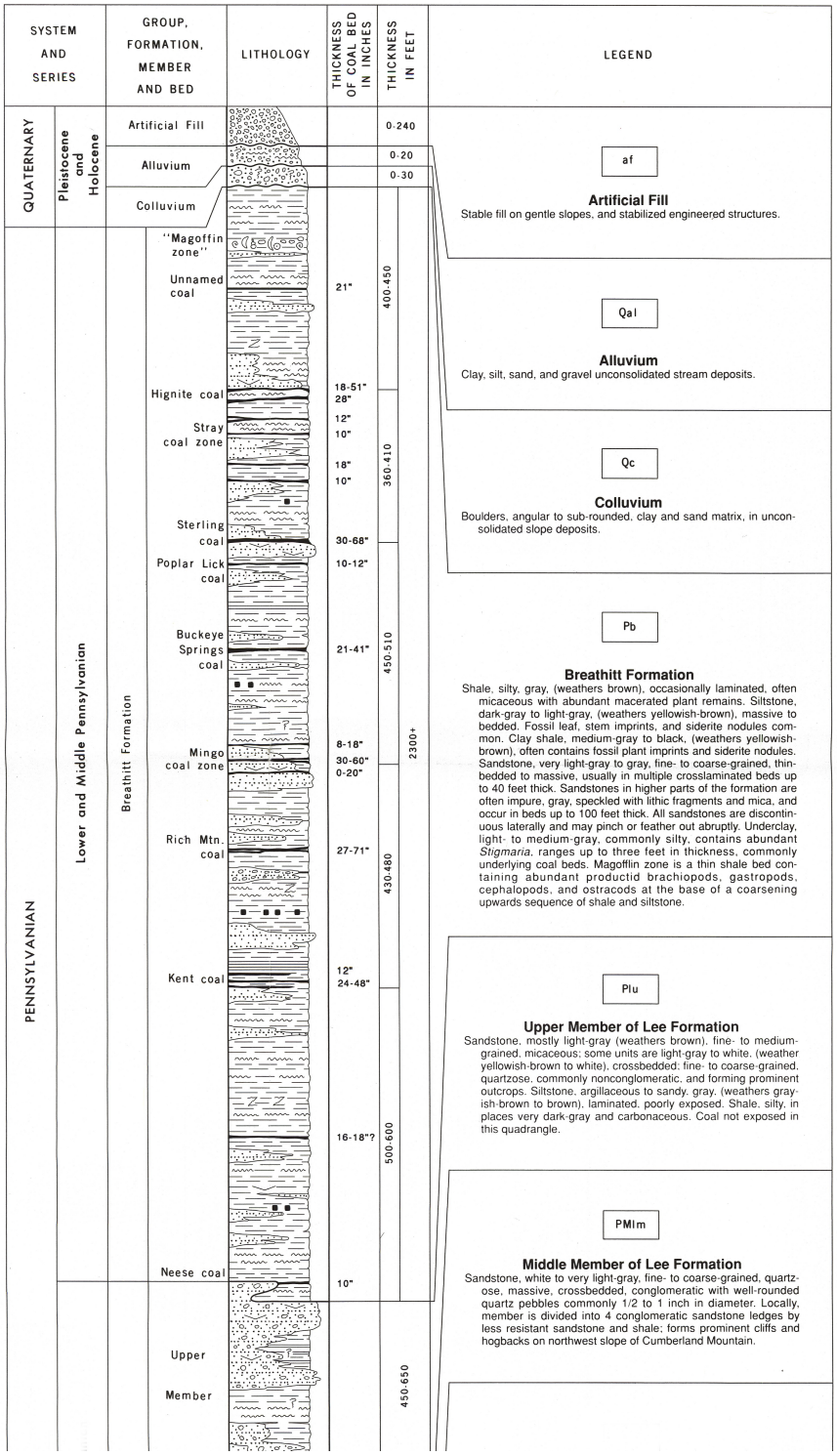
Prominent graphics associated with this source:

Map Legend



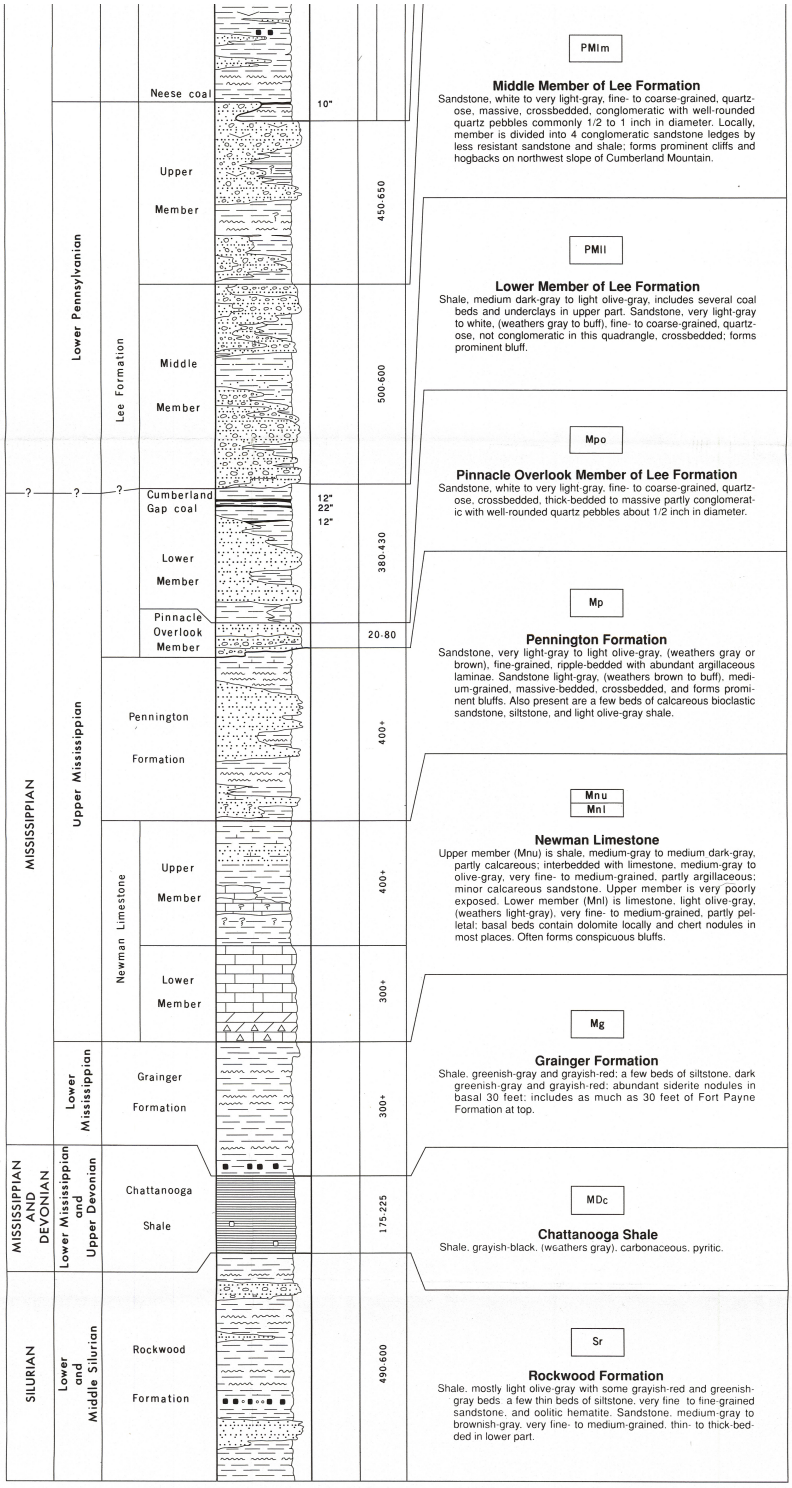
Graphic from source map: Fork Ridge Quadrangle

Correlation of Map Units and Stratigraphic Section, part 1



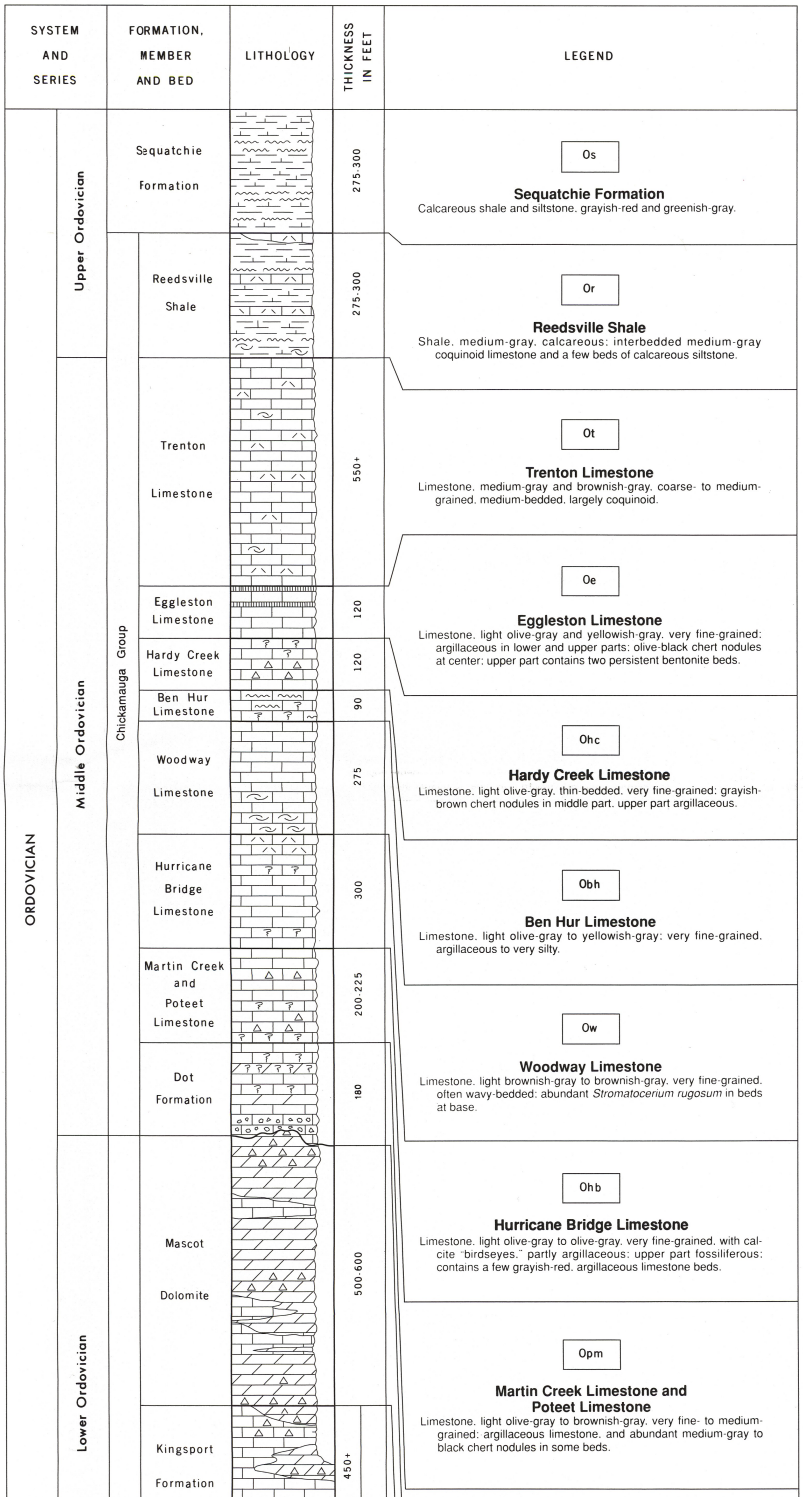
Graphic from source map: Fork Ridge Quadrangle

Correlation of Map Units and Stratigraphic Section, part 2



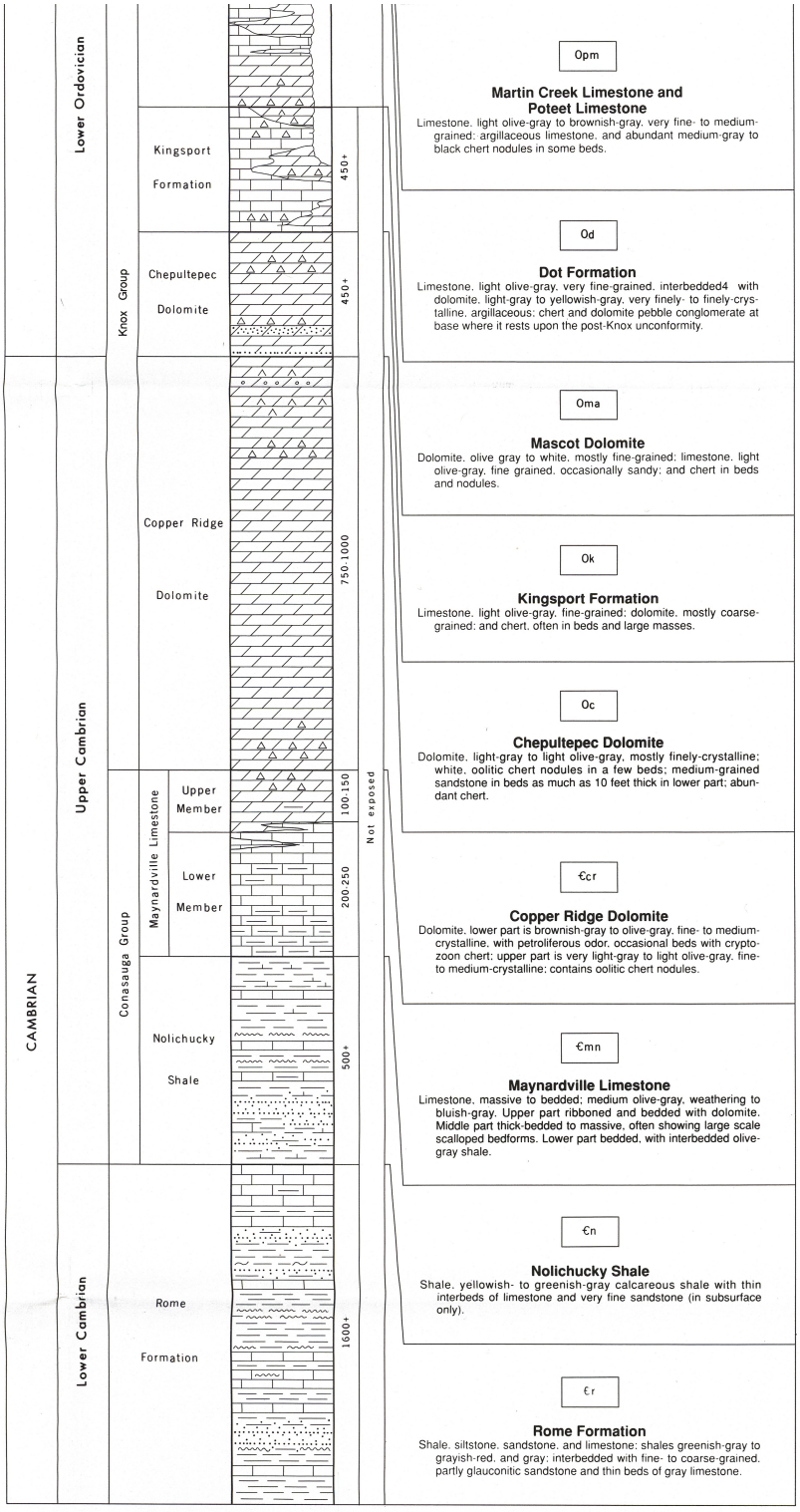
Graphic from source map: Fork Ridge Quadrangle

Correlation of Map Units and Stratigraphic Section, part 3



Graphic from source map: Fork Ridge Quadrangle

Correlation of Map Units and Stratigraphic Section, part 4



Graphic from source map: Fork Ridge Quadrangle

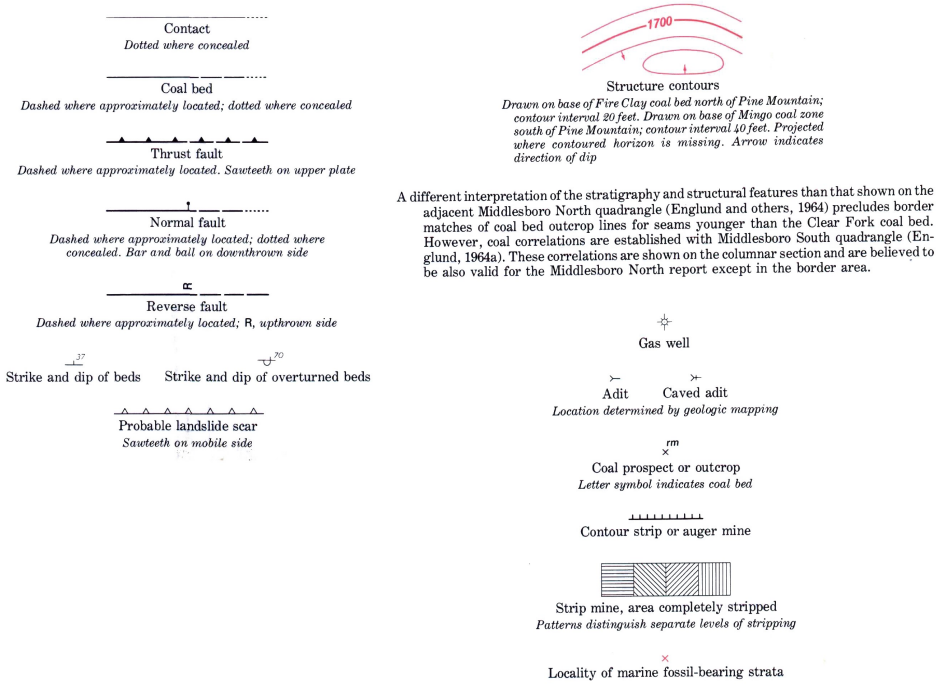
Kayjay Quadrangle and part of the Fork Ridge Quadrangle

The formal citation for this source.

> Rice, C.L., and Maughan, E.K, 1978, Geologic Map of the Kayjay Quadrangle and part of the Fork Ridge Quadrangle, Bell and Knox Counties, Kentucky: U.S.Geological Survey, Geologic Quadrangle Map GQ-1505, scale 1:24,000 (*GRI Source Map ID 2483*).

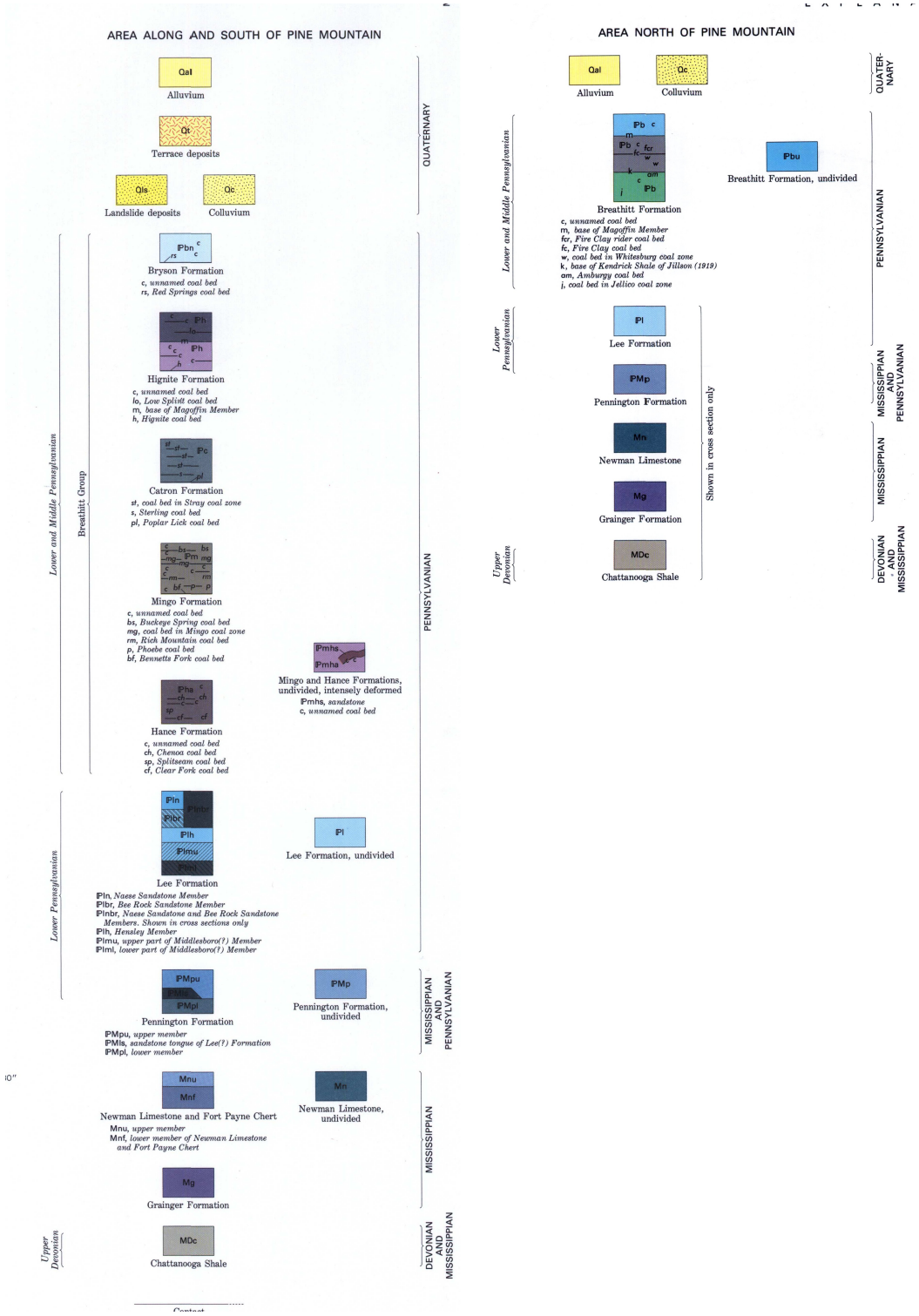
Prominent graphics and text associated with this source:

Map Legend



Graphic from source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle

Correlation of Map Units



Graphic from source map: [Kayjay Quadrangle and part of the Fork Ridge Quadrangle]

Economic Geology

Coal has been mined on a large scale in the mapped area since late in the 19th century. Early mining activity is summarized by Ashley and Glenn (1906) and a later summary is provided by Huddle and others (1963). North of Pine Mountain large underground mines were worked near Kayjay. South of Pine Mountain there were large underground mines near Middlesboro on Bennetts Fork, and in the Middlesboro-Garmeada area on Stony Fork, Rockhouse Branch, and Hignite Creek. Extensive underground workings were also opened near Fonde on Clear Fork. On the south side of Clear Creek, large mines operated near Chenoa on Bear Creek and at Davisburg. Many small underground mines have been worked throughout the area. In 1977 most coal production was by surface strip mining, and a major underground mine was being opened in the Buckeye Spring seam in Hignite Creek. All coal beds for which there are data are high-volatile A bituminous rank (Huddle and others, 1963, p. 160-166).

Coal production north of Pine Mountain: No coal has been mined from strata above the Fire Clay rider coal bed; prospect pits have exposed only thin or shaly coal beds, or carbonaceous shale.

The Fire Clay rider coal bed is generally very thin or shaly and has been worked at only a few places in conjunction with mining of the Fire Clay coal bed. The Fire Clay is the only coal bed that has been mined on a large scale; it was worked in large underground mines in the Kayjay and Wheeler areas. The bed has also been strip mined and augered along most of its outcrop and remaining reserves are probably small.

The Whitesburg and Amburgy coal beds are thin; none are known to have been mined except for local use.

A coal bed in the Jellico zone was mined on Greasy Creek about 2 miles southwest of Ingram. A coal bed in the zone has also been mined for house coal on Greasy and Brush Creeks in the Artemus quadrangle (Rice, 1964) adjacent to the north, but in the Kayjay quadrangle the coal beds are probably thin, channelled out, or below drainage.

The Blue Gem coal bed lies about 100 feet below the Jellico and does not crop out in the mapped area. Regional data indicate that it probably underlies most of the area north of Pine Mountain where it may be of good quality and thickness for mining.

Coal production south of Pine Mountain: There are more than a dozen coal beds in the Bryson Formation above the Red Springs coal bed; these are probably generally less than a foot thick. The Red Springs seam has been strip mined over most of its outcrop and underground mining has been extensive, especially in the area between Garmeada and Chenoa. In 1977, stripping practices included mountain top removal; all coal beds between and including the Red Springs and Low Splint seams were being stripped together in the same cut in the head of Little Clear Creek and on Fork Ridge. However, no attempt has been made to show on the map more than the cut through the ridge at the Red Springs level in the Little Clear Creek area, where some 14 separate coal beds are reported in the Red Springs-Low Splint interval. The Low Splint coal bed is widespread although it varies considerably in thickness. It has been strip mined and augered at a few places and at least one subsurface mine is on Canada Ridge northeast of the upper part of Hignite Creek.

A coal bed locally called the Copper Spur occurs about 135 feet above the Hignite seam and has been mined near the head of Stony Fork where it is about 30 inches thick. The Hignite coal bed is persistent and one of the most commercially important in the mapped area. It has been extensively deep mined in the Log Mountains between Garmeada and Chenoa. Numerous underground mines are scattered elsewhere, especially along Fork and Canada Ridges, but it probably has not been extensively deep mined in the vicinity of Canada Peak and adjacent parts of Canada Ridge. It has been stripped and augered in many parts of the quadrangle. In 1971 and 1972 deep mines were active in the Hignite bed on

Maiden Ridge and near the head of Rockhouse Branch. Several relatively thick coal beds occur above the Hignite seam in the central part of the area; drill-hole data show that although these seams contain shale partings, as much as 150 inches of coal including the Hignite coal locally occurs in a 50-foot interval. This zone has been stripped locally in the upper parts of Little Clear Creek. Several deep mines were worked in a seam about 50 feet above the Hignite coal bed near the head of Stony Fork.

The Stray coal zone contains at least two coal beds that have been deep mined. Both have been mined in the Garmeada area, the upper in Marsee Branch near Fonde, and the lower southwest of Edgewood along Stony Fork. These seams have also been strip mined locally and in at least one place, in the head of Bens Fork of Little Clear Creek, four beds totalling 52 inches of coal are being stripped together in a 48-foot interval.

The Sterling coal bed has been deep mined and stripped and augered on Fork Ridge and in the area east of Fonde. In the Bens Fork area, the Sterling, although thin, is stripped with the underlying Poplar Lick seam.

The Poplar Lick coal bed is one of the most persistent coal beds in the mapped area. It has been mined extensively, especially in large underground mines at Garmeada, along Hignite Creek near the head of Bear Creek, north of Fonde, and in strip and auger mines along much of the outcrop. Both the Sterling and Poplar Lick seams are high in sulfur (1 to 3 percent) relative to other coal beds of this area (Huddle and others, 1963, p. 163, 164).

The Buckeye Spring coal bed has been mined at several places along Stony Fork and its tributaries and at scattered places elsewhere in the mapped area. At the time of mapping, exploration for the development of a major deep mine in this seam in the Hignite Creek area and the area north of Stony Fork had been underway for several years. The "jackrock" (sandstone) parting in the seam has inhibited its development in the past because of cutting and hauling difficulties; as a result the Buckeye Spring coal bed represents the largest known reserve of minable coal in the mapped area.

Coal beds in the Mingo zone have been mined extensively. At most places north of Bennetts Fork the zone contains two coal beds, each of which may have one or several thin shale partings; the upper coal bed is as much as 25 feet above the lower and is generally much thinner. Ashley and Glenn (1906, p. 69-72) described the Mingo coal bed along Bennetts Fork as a single bed as much as 10 feet thick with thin shale partings. The lower Mingo coal bed was deep mined near Davisburg and eastward along Clear Creek. East of the mines on Webb Branch along the south side of Clear Creek and the mine on Jack Branch of Little Clear Creek, it thins but has been opened for house coal at many places; in 1976, the lower Mingo seam was stripped above Fuson Chapel where it was 30 inches thick. Along Bennetts Fork it has been the chief coal mined in the subsurface; most openings are south of the state boundary. In 1977 both coal beds were being stripped south and northeast of Bennetts Fork Church. The lower Mingo coal bed has been mined, stripped, and augered in the Fonde area.

The Rich Mountain coal bed is generally thinner than 2 feet in most parts of the mapped area, except south of Bennetts Fork. It has been mined commercially just south of the Kentucky state line in Bennetts Fork where it is locally as much as 4 feet thick, and north and south of Edgewood on Stony Fork; it has been stripped locally near Fonde. It has been mined elsewhere for house coal, particularly east of Little Clear Creek. The Phoebe seam is generally less than 2 feet thick; it has also been developed for house coal in the Little Clear Creek area.

The Bennetts Fork coal bed has been mined commercially at Premier and Fonde. The seam appears to have been mined out in these areas and few exposures were seen; for detailed description of the Bennetts Fork seam, see Ashley and Glenn (1906, p. 68). Small truck mines and mines for house coal were made in this seam just west of Middlesboro and in Beans Fork. In most parts of the Clear Creek area the Bennetts Fork seam is probably less than 18 inches thick.

The Chenoa seam where mined at Chenoa was described by Ashley, and Glenn (1906, p. 94) as a lenticular pod of coal more than 7 feet thick including as much as 52 inches of canneloid coal. The seam is much thinner in other parts of the quadrangle but it has been mined together with a lower seam for house coal at the mouth of Beans Fork where the coal beds are less than 18 inches thick.

A gas well was drilled near the east border of the Kayjay quadrangle about 3 miles north of Middlesboro on the south flank of a large dome. It was completed in the Newman Limestone in the fall of 1976 with a shut-in pressure of 980 lbs. per square inch and a natural open flow of 9 MMcf per day (L. R. Ponsetto, Kentucky Geol. Survey, oral commun. , 1977). Two other wells have been completed nearby in the Middlesboro North quadrangle, but neither was in production by the middle of 1977.

Limestone suitable for use as building stone, road metal, and concrete aggregate is available from the lower member of the Newman Limestone along the north face of Pine Mountain. Newman Limestone has been quarried in the adjacent Middlesboro North and South, Pineville, and Frakes quadrangles.

Large quantities of sand and gravel are available in the pebbly quartzose sandstone beds of the Lee Formation; these beds have been locally quarried and processed into high-quality quartz sand and concrete aggregate in other areas along Pine Mountain. Sand and gravel are available in small quantities in the alluvial deposits. Pulverized and deeply weathered rock of the Mingo and Hance Formations, undivided, within the Middlesboro basin is easily dug and is used as semi-pervious fill; however, it is within the urbanized area of the town of Middlesboro and much of it is inaccessible.

Analyses of samples from adjacent quadrangles suggest that some clay and shale of the Breathitt Formation and Group may be suitable for the production of lightweight aggregate, sewer pipe, and various kinds of brick and tile (Walker, 1953, and McGrain, 1957). Most underclays of coal beds are too thin to be of commercial value.

Groundwater availability in the area is summarized by Kilburn, Price, and Mull (1962); most wells are adequate for a minimum domestic water supply, and nearly all wells drilled in valley bottoms are adequate for a modern domestic supply. Sandstone beds of the Lee Formation generally are aquifers with large supplies of water, and wells drilled into this formation along the south side of Pine Mountain have artesian flow. Two large perennial springs issue from the base of the Newman Limestone, and several seeps and small springs issue from faults of the Pine Mountain overthrust fault zone.

Landslides occur along the south flank of Pine Mountain as glide blocks with movement chiefly along bedding planes within claystone units of the Naese Sandstone Member of the Lee Formation and in the lower part of the Hance Formation. Very recent movement of the block adjacent to Carter Branch is indicated by freshly opened fissures.

The Middlesboro basin is described by Englund and Roen (1962) as a meteorite impact scar. Within the basin the disturbed ground, ranging from small rotated fault blocks to highly fractured and pulverized rock, seems adequate to support residences and similar small structures; however, excavations into this weakened rock have created unstable slopes where hazardous landslides, slumps, and flows have occurred.

Text from source map: Kayjay Quadrangle and part of the Fork Ridge Quadrangle

Kayjay Quadrangle and part of the Fork Ridge Quadrangle (digital)

The formal citation for this source.

> Conley, T. J., 2003, Spatial Database of the Kayjay Quadrangle and part of the Fork Ridge Quadrangle, Bell and Knox Counties, Kentucky: Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_1505, scale 1:24,000 (*GRI Source Map ID 69704*).

The above digital data was digitized and modified from USGS Geologic Quadrangle Map GQ-1505 by the Kentucky Geological Survey. The Kentucky Geological Survey has updated this map with current stratigraphic classifications and geologic interpretation.

No additional information from this source map is presented here.

Kentucky Oil and Gas Well Locations

The formal citation for this source.

> Kentucky Geological Survey, 2023, Kentucky Oil and Gas Well Location Shapefile: Kentucky Geological Survey Oil and Gas Well Search, accessed 02/2023, scale 1:100,000 (*GRI Source Map ID 80004*).

Oil and gas well point data were extracted from this dataset within the extent of the Digital Geologic-GIS Map of Cumberland Gap National Historical Park and Vicinity.

No additional information from this source map is presented here.

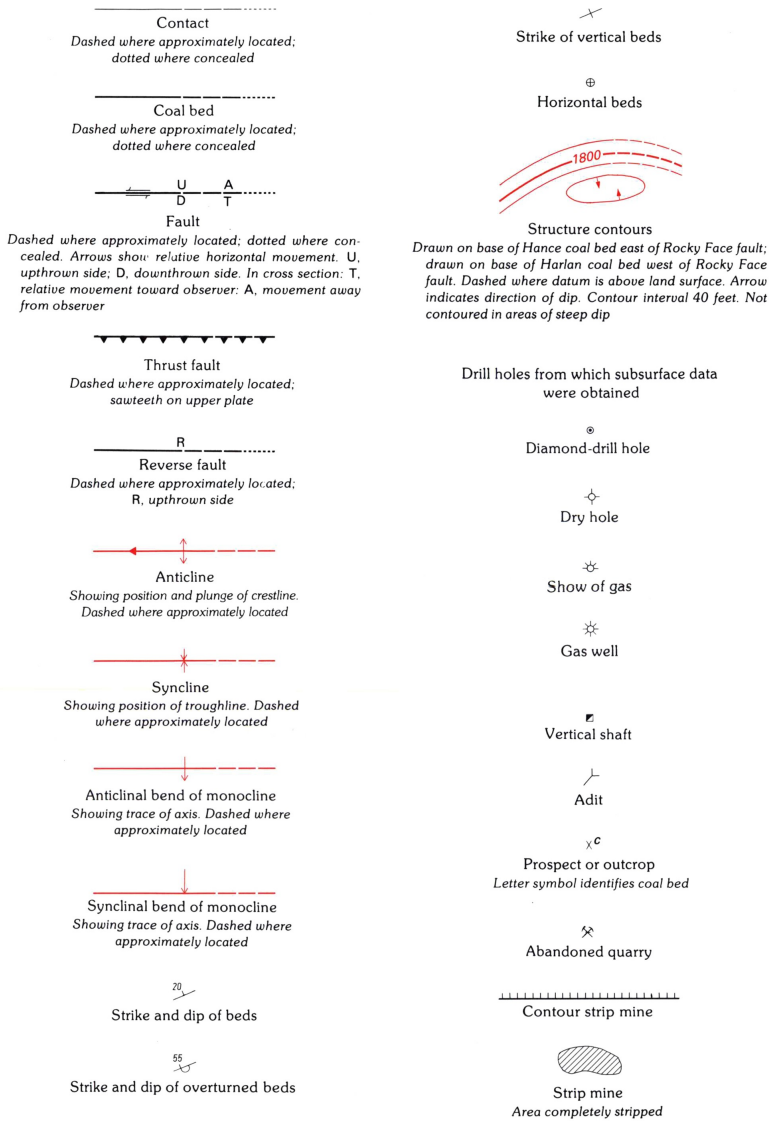
Middlesboro North Quadrangle

The formal citation for this source.

> Rice, C.L., and Ping, R.G., 1989, Geology of the Middlesboro North Quadrangle, Kentucky: U.S. Geological Survey, Geologic Quadrangle Map GQ-1663, scale 1:24,000 (*GRI Source Map ID 2484*).

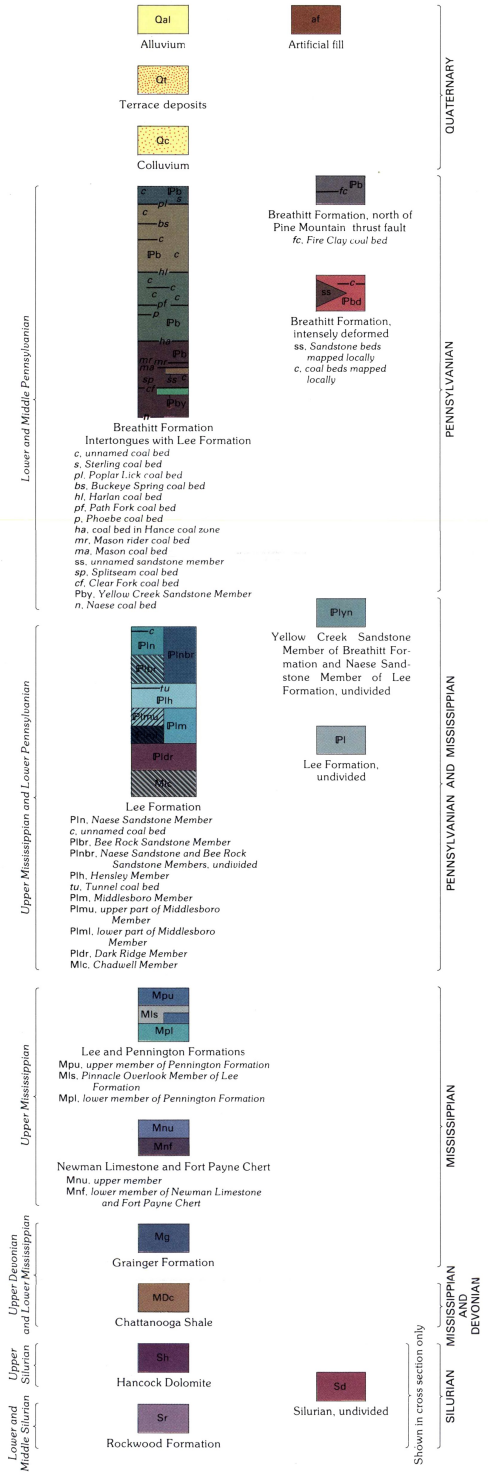
Prominent graphics and text associated with this source:

Map Legend



Graphic from source map: Middlesboro North Quadrangle

Correlation of Map Units



Graphic from source map: Middlesboro North Quadrangle

Economic Geology

Coal has been mined commercially in the quadrangle during the past 60 years. Early production came mostly from underground mines with drift entries in the vicinity of Colmar and Dark Ridge and from vertical shaft mines at Low Ash Hollow and Meldrum. Numerous truck mines have operated intermittently in many areas of the quadrangle, and the only underground mining in 1960 and 1961 was in several of these mines. Most production in recent years has come from strip and auger mines located principally near Colmar. The coal is of high volatile A bituminous rank, commonly contains less than 4 percent ash, and has a calorific value of more than 14,000 btu. It occurs largely in 10 beds which range mostly from 20 to 40 inches in thickness, in the Lee, Hance, and Mingo Formations.

The Tunnel coal is the only bed of significant thickness in the Lee Formation and has been worked, probably for local use, in two small mines on the east slope of Rocky Face.

The Hance Formation contains nearly all of the commercially important coal in the quadrangle. Only the Naese coal bed, present locally near the base of the formation, lacks commercial development. It is relatively thin and its maximum thickness is 22 inches along Cumberland River.

The Clear Fork coal bed has been exploited at several truck mines, most of which are abandoned, along Clear Fork in the southeast part of the quadrangle. The coal ranges from 18 to 22 inches thick in this vicinity and is thinner in other areas.

The Splitseam coal bed has been mined extensively in the area from Low Ash Hollow to Meldrum where it is known locally as the Barner coal. The coal is at a depth of 25 to 75 feet below the valley bottoms anti was reached by vertical shafts. Here the coal averages about 36 inches thick but in other parts of the quadrangle it is mostly less than 14 inches in thickness.

The Mason coal bed has been mined by strip, auger, and underground methods in the Colmar area where the bed ranges from 20 to 52 inches in thickness. The name Mason is used in this map as it is applied in the area east of the Rocky Face Fault. West of the fault the name has previously referred to at least 2 other coal beds.

The Mason rider coal bed is generally 40 to 50 feet above the Mason coal bed and is relatively thin in most areas. On Cannon Creek a possible correlative of the bed is as much as 32 inches thick and is actively mined at one locality.

The Hance coal bed is mined by combined strip and auger operations in the Colmar area. An upper split, at about 25 feet above the main or lower bench of coal, is also mined. The interval between the two benches of coal increases west of the Rocky Face Fault and the Hance coal thins to an average thickness of about 20 inches.

The Path Fork coal bed occurs only on the upper hill slopes in the area west of the Rocky Face Fault and is often referred to as the Mason or Yellow Creek coal bed. The coal averages about 30 inches thick, and areas of thick coal have been depleted by underground and strip mining.

The Harlan coal bed, at the base of the Mingo Formation, underlies small areas of hill tops west of the Rocky Face Fault, where it is known locally as the Mingo or Mason coal bed. Areas where the coal averages about 36 inches or more in thickness are largely mined out.

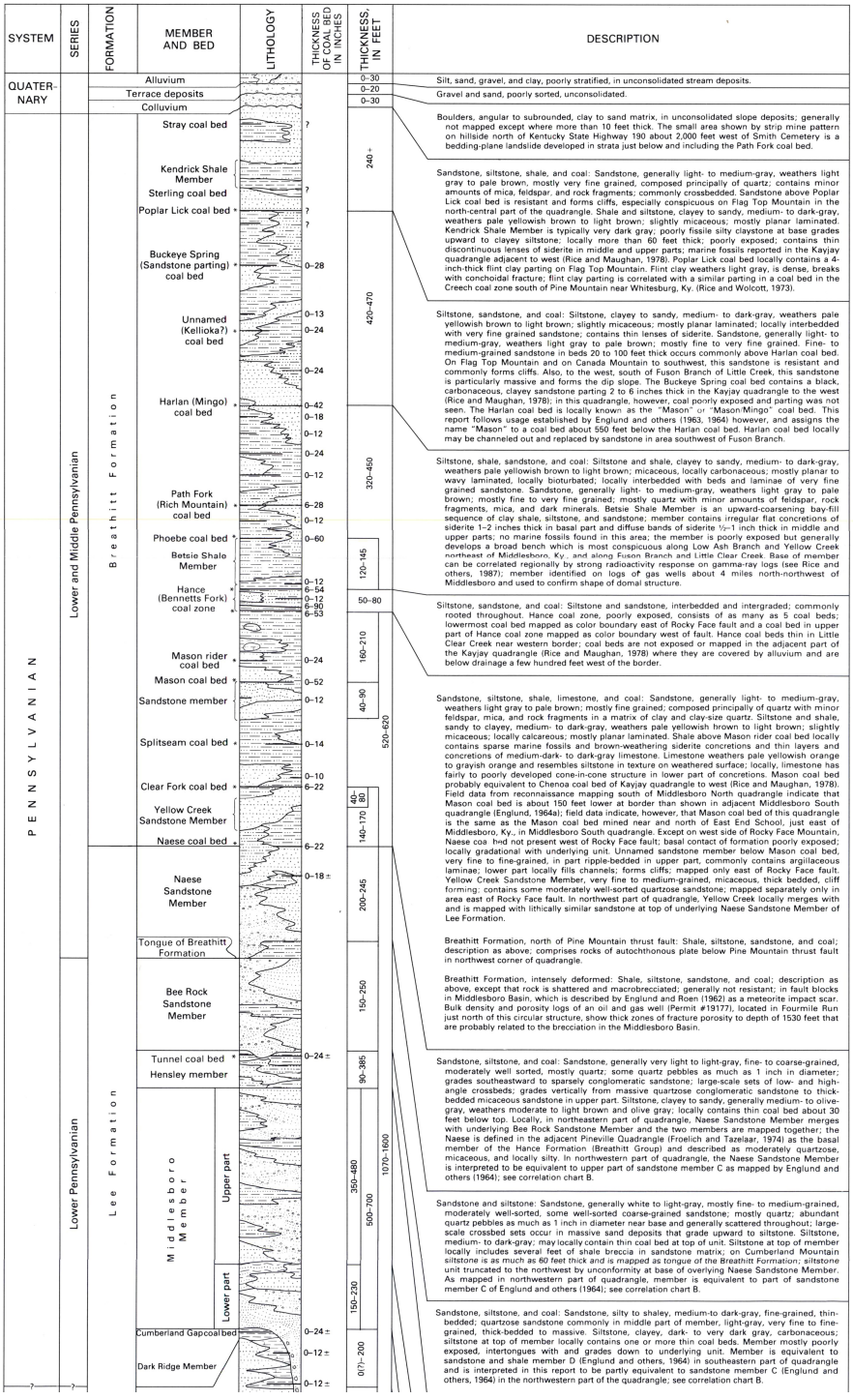
The estimated original reserves calculated for the 10 principal coal beds of 14 inches or more in thickness are approximately 155 million tons, about 10 percent of which has been mined or lost in mining. Assuming 50 percent recovery, the remaining recoverable resources are nearly 70 million tons.

Four test holes have been drilled in the search for oil and gas in the quadrangle. The first was drilled on Lick Fork in 1925 to a depth of 1,600 feet. Little data are available on the test, and in 1962 it was flowing water with some gas. The Hurst No. 1 test was drilled in 1955 on the east side of Rocky Face to a depth of 5,697 feet and was abandoned as a dry hole. The Asher No. 1 test was drilled in 1959 on Cranes Creek to a depth of 3,375 feet and shows of gas were noted. The deepest test in southeastern Kentucky, the Knuckles No. 2, was drilled in 1960 on the south slope of Pine Mountain near the north edge of the quadrangle. It reached a depth of 10,034 feet, and several shows of gas and oil were reported. The latter 3 holes penetrated the Pine Mountain overthrust fault (shown on cross section). Two domes are indicated by structure contours in the Middlesboro syncline near the west and east edges of the quadrangle. These may reflect subsurface structures favorable for oil or gas accumulation.

The lower member of the Newman Limestone was quarried in the extreme northwest corner of the quadrangle and was used as gravel on roads.

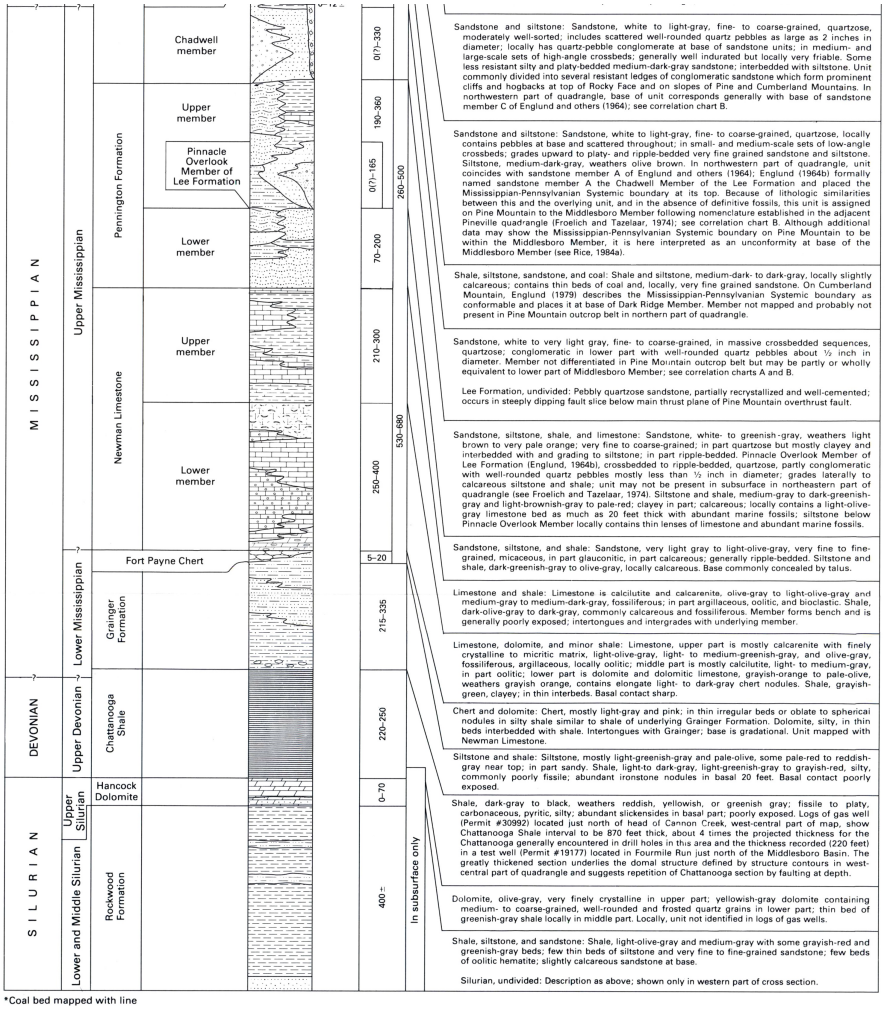
Text from source map: Middlesboro North Quadrangle

Stratigraphic Section, top portion



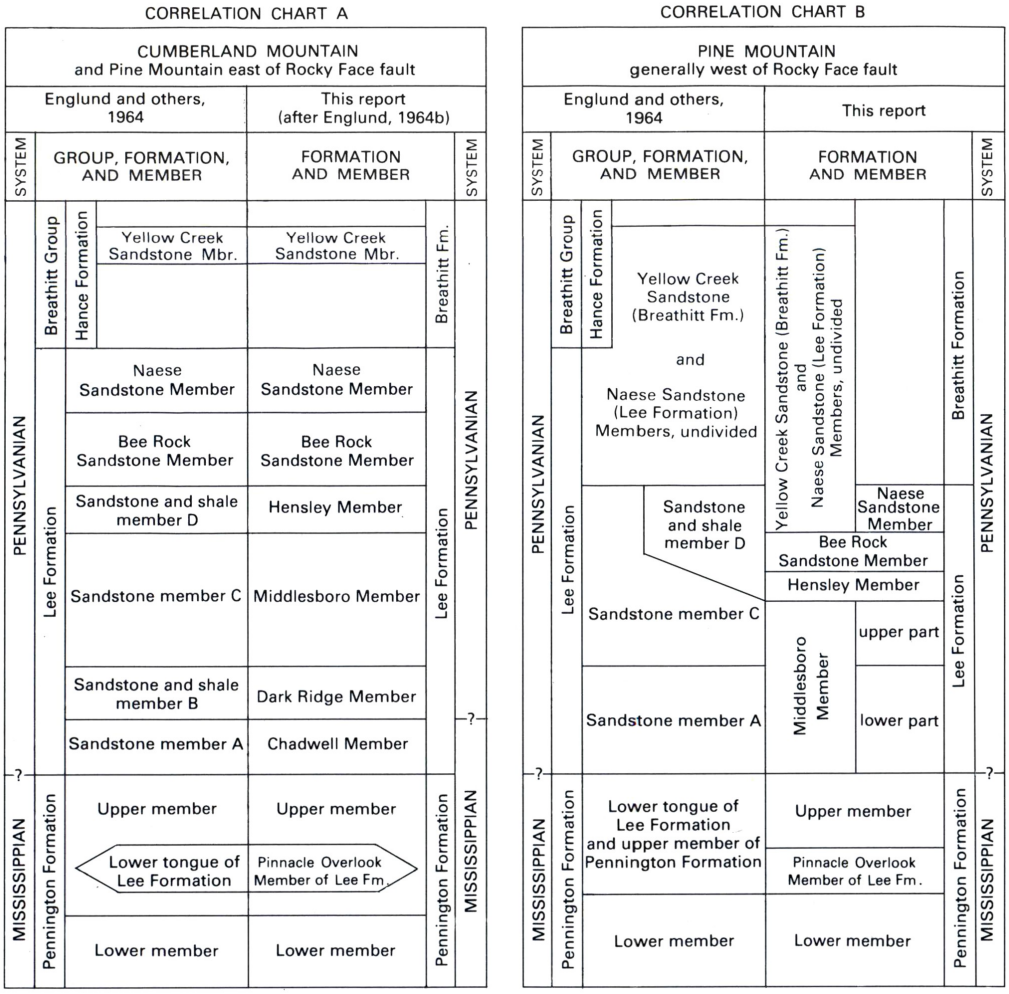
Graphic from source map: Middlesboro North Quadrangle

Stratigraphic Section, bottom portion



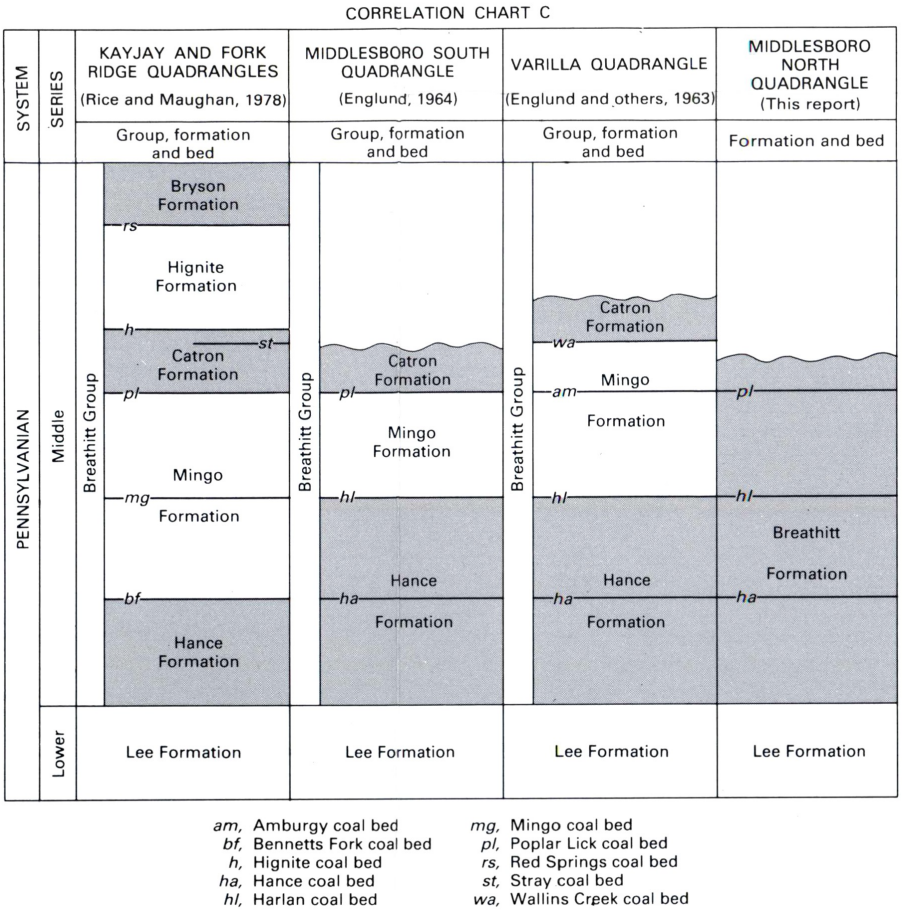
Graphic from source map: [Middlesboro North Quadrangle]

Correlation Chart A and B



Graphc from source map: [Middlesboro North Quadrangle]

Correlation Chart C



Graphic from source map: Middlesboro North Quadrangle

Middlesboro North Quadrangle (digital)

The formal citation for this source.

> Sparks, T. N., Lambert, J. R., 2003, Spatial Database of the Middlesboro North Quadrangle, Kentucky: Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_1663, scale 1:24,000 (*GRI Source Map ID 69705*).

The above digital data was digitized and modified from USGS Geologic Quadrangle Map GQ-1663 by the Kentucky Geological Survey. The Kentucky Geological Survey has updated this map with current stratigraphic classifications and geologic interpretation.

No additional information from this source map is presented here.

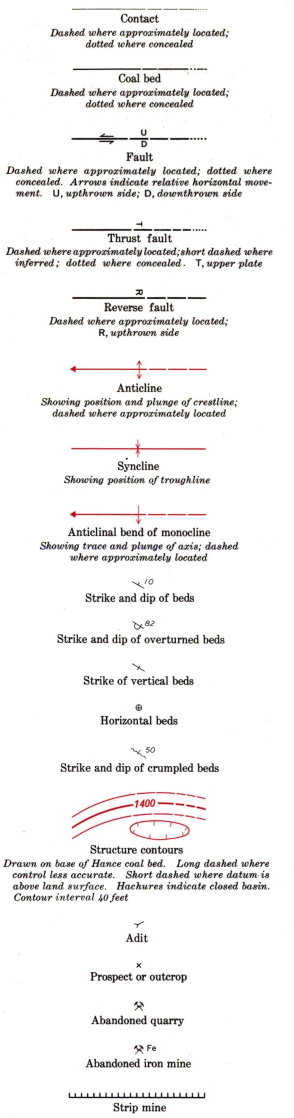
Middlesboro South Quadrangle

The formal citation for this source.

> Englund, K. J., 1964, Geology of the Middlesboro South Quadrangle, Tennessee, Kentucky andVirginia: U.S. Geological Survey, Geologic Quadrangle Map GQ-301, scale 1:24,000 (*GRI Source Map ID 2477*).

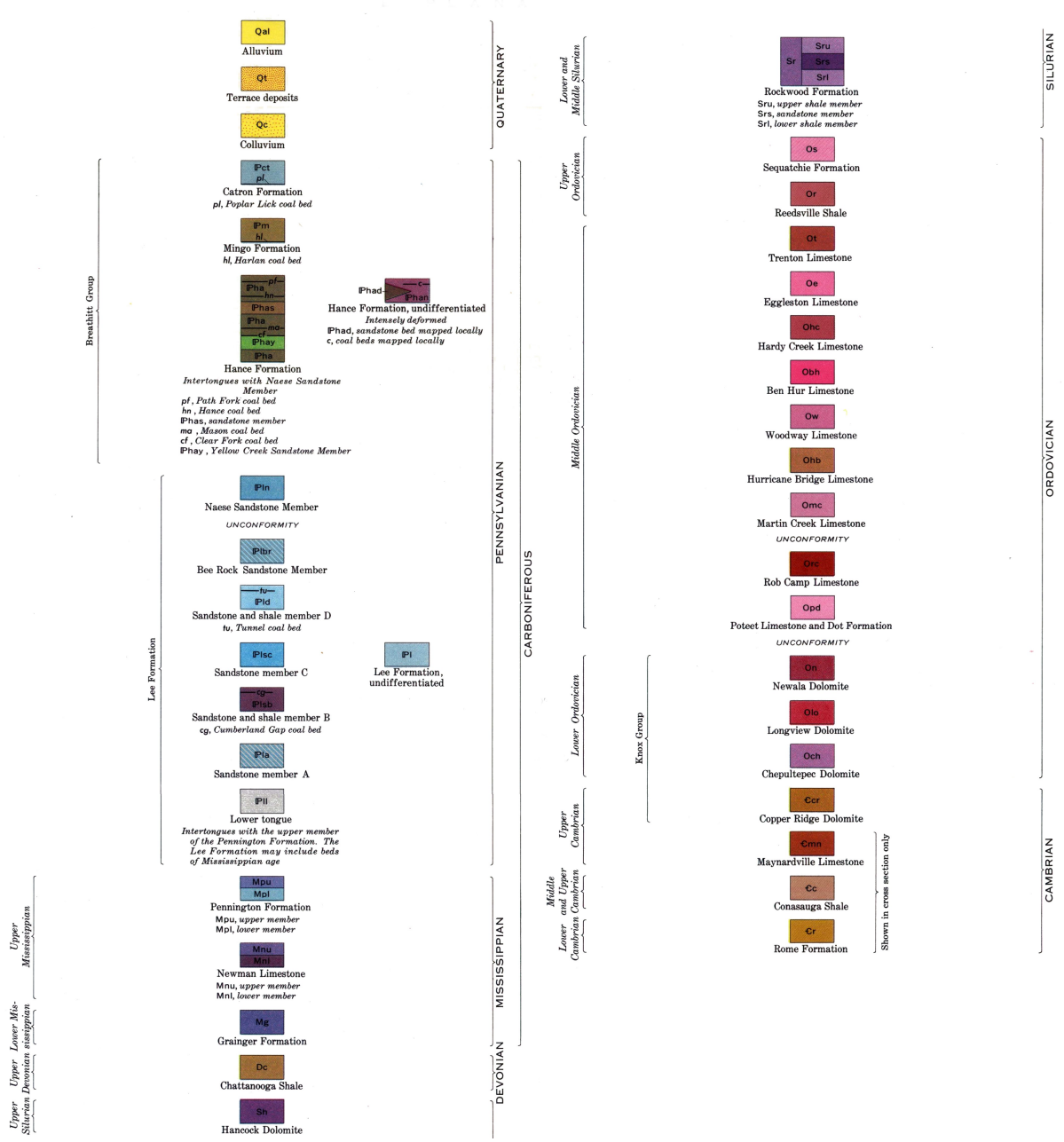
Prominent graphics and text associated with this source:

Map Legend



Graphic from source map: Middlesboro South Quadrangle

Correlation of Map Units



Graphic from source map: [Middlesboro South Quadrangle]

Economic Geology

The development of mineral resources in the quadrangle consists of coal and iron ore mining and small-scale quarrying of limestone and sandstone.

Coal mining began shortly after 1900 in the Mingo Mountains area and has continued intermittently until recent years. Areas of thick coal have been largely depleted and presently the only coal produced is from small drift adits for local use. The coal is of high volatile A bituminous rank and occurs in 16 beds ranging from a few inches to about 4 feet in thickness in the Lee Formation and the Breathitt Group.

The Cumberland Gap and Tunnel coal beds in the Lee Formation crop out on the northwest slope of Cumberland Mountain and have been mined in the vicinity of Cumberland Gap where the Cumberland Gap coal bed averages about 45 inches in thickness and the Tunnel coal bed is as much as 36 inches thick. The mine workings are caved and mining may have been discouraged by the dip of the beds which ranges from 24 to 60 degrees and by fractures in the coal which resulted from the folding of rocks along Cumberland Mountain. As these coal beds of the Lee Formation have not been core drilled or widely prospected, they may underlie additional areas suitable for mining. The Mason and Hance coal beds are the only coals in the Breathitt Group that have been extensively prospected and mined. The relative thinness of the Mason coal has limited development to several small mines which supply coal for local household use. The Hance coal bed, also locally known as the Bennett Fork or Turner coal bed, is mostly mined out. Nearly all of the mining has been in the lower of two benches of coal that are about 25 feet apart. Other coal beds of the Lee Formation and the Breathitt Group are relatively thin or underlie small hilltop areas where prospecting is sparse. The coal beds in rocks that underlie the Middlesboro Basin are intensely fractured, folded, and faulted, which has inhibited commercial development of the coal.

The estimated original reserves calculated for the Cumberland Gap, Tunnel, Mason, and Hance coal beds, in excess of 14 inches in thickness, are approximately 27 million tons, about 12 percent of which has been mined or lost in mining. Assuming 50 percent recovery, the remaining recoverable reserves are about 12 million tons.

Sedimentary hematite beds of the Rockwood Formation were a source of iron ore for early mining operations. The mines were abandoned nearly 40 years ago and are now caved. Sedimentary iron ore was also mined near Tiprell from the lower part of the Chattanooga Shale.

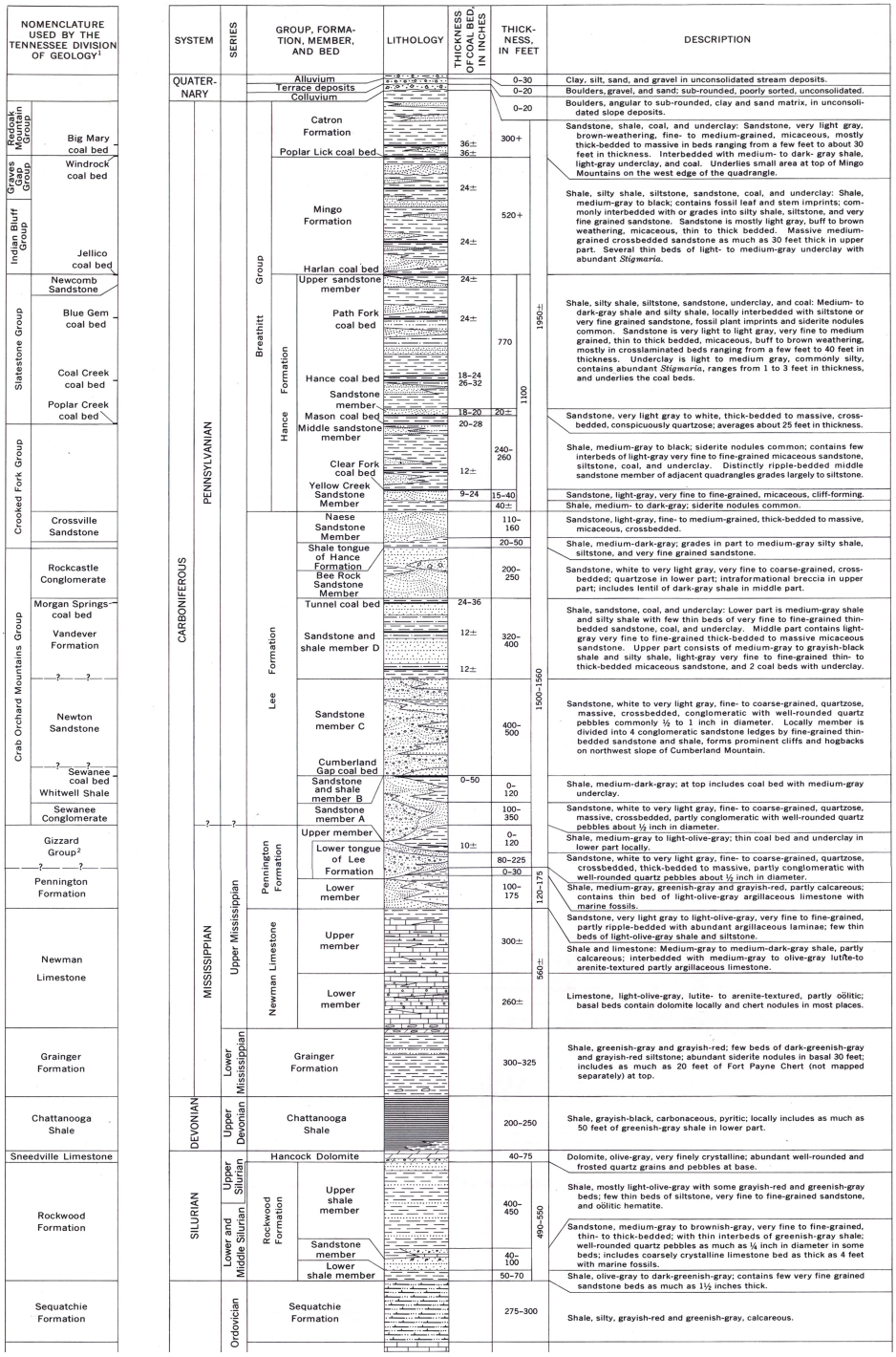
Several abandoned quarries, located on the outcrop belts of the Woodway, Trenton, and Newman Limestones,were local sources of crushed limestone.

Construction sand has been obtained from the quartzose sand- stone beds of the Lee Formation in the vicinity of Cumberland Gap where friable, weathered sandstone was readily mined in a few small open pits.

Although several potential oil and gas zones occur in the rocks ranging from Ordovician to Mississippian in age, there has been no test drilling for oil and gas in the quadrangle. Local mineralization in the Copper Ridge Dolomite was prospected at one locality on Kings Bend in the southeast corner of the quadrangle. Small amounts of galena, pyrite, and possible sphalerite were found.

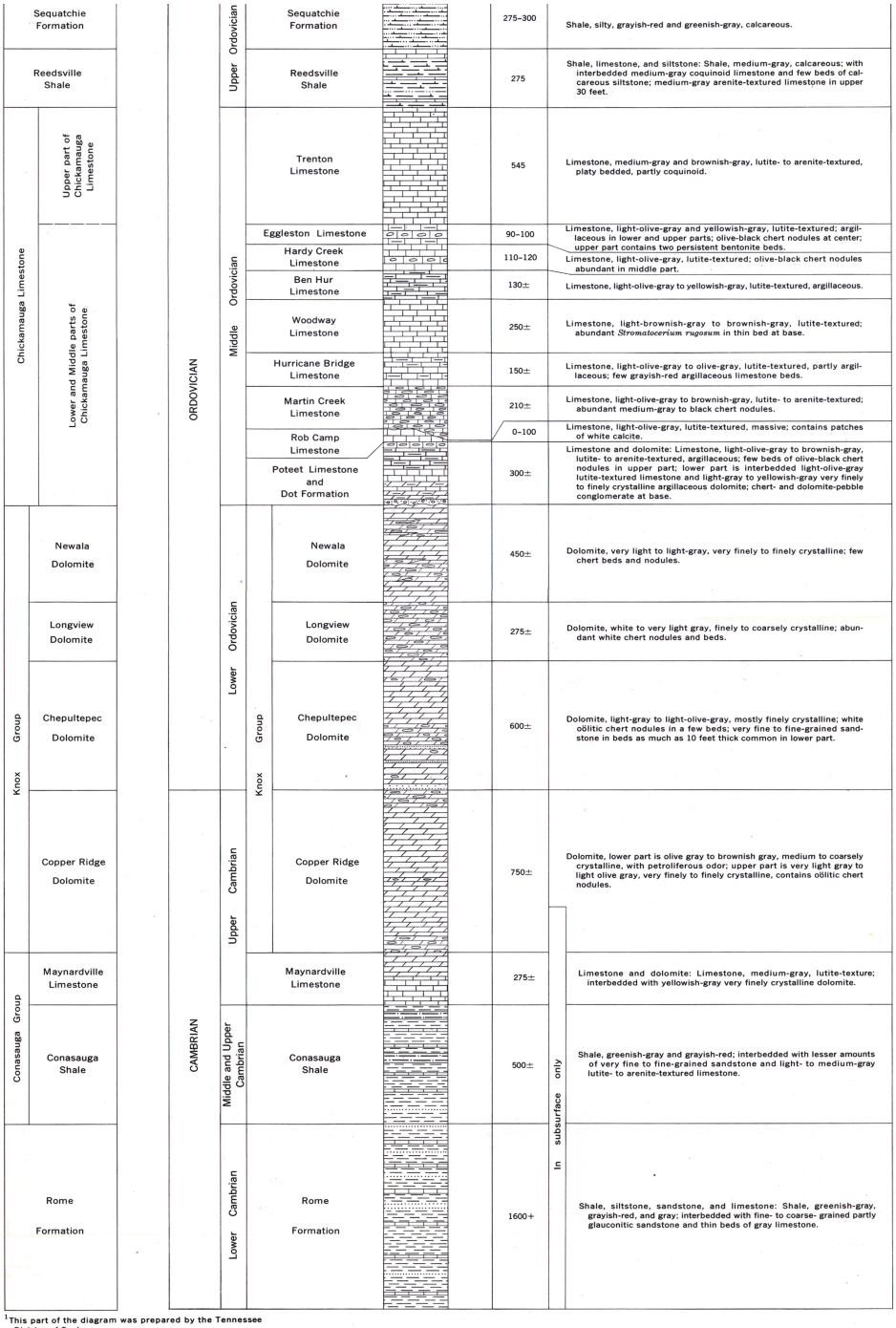
Text from source map: Middlesboro South Quadrangle

Stratigraphic Section, top portion



Graphic from source map: [Middlesboro South Quadrangle]

Stratigraphic Section, bottom portion



Graphic from source map: [Middlesboro South Quadrangle]

Middlesboro South Quadrangle (digital)

The formal citation for this source.

> Thompson, M. F., 2003, Spatial Database of the Middlesboro South Quadrangle, Kentucky: Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_301, scale 1:24,000 (*GRI Source Map ID 69708*).

The above digital data was digitized and modified from USGS Geologic Quadrangle Map GQ-301 by the Kentucky Geological Survey. The Kentucky Geological Survey has updated this map with current stratigraphic classifications and geologic interpretation.

No additional information from this source map is presented here.

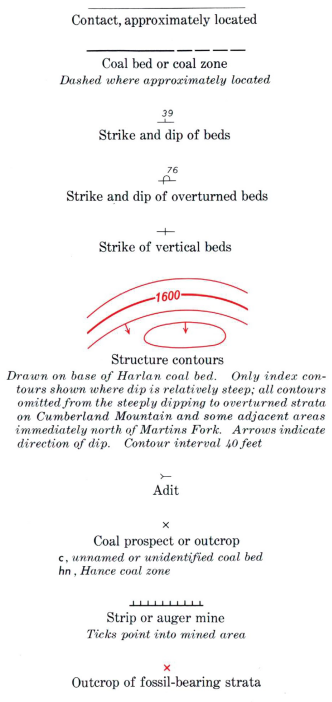
Part of the Rose Hill Quadrangle

The formal citation for this source.

> Maughan, E.K., and Tazelaar, J.F, 1973, Geologic Map of part of the Rose Hill Quadrangle, Harlan County, Kentucky: U.S.Geological Survey, Geologic Quadrangle Map GQ-1121, scale 1:24,000 (*GRI Source Map ID 2482*).

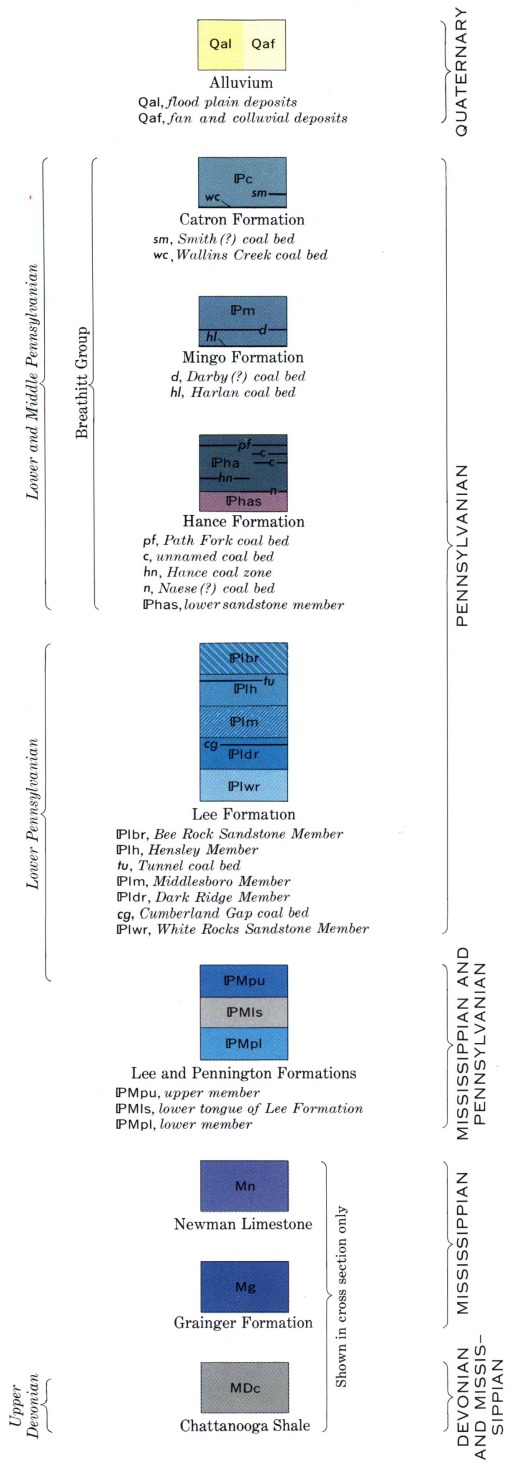
Prominent graphics and text associated with this source:

Map Legend



Graphic from source map: part of the Rose Hill Quadrangle

Correlation of Map Units



Graphic from source map: [part of the Rose Hill Quadrangle]

Economic Geology

Coal is the most valuable known mineral resource in the quadrangle. It has been mined underground since the early 1930's; strip and auger mining have been employed intermittently since the mid-1950's. The Little Black Mountain anticline may reflect subsurface structure favorable for oil or gas accumulation.

The Harlan coal bed has been the source of most coal mined in the quadrangle, chiefly from large underground mines. Large underground mines in the Darby(?), the Wallins Creek and the Smith(?) coal beds have supplied smaller amounts. Small mines, all now abandoned, have been operated sporadically in the Tunnel, Hance, and Path Fork coal beds, and have supplied coal chiefly for local use as house coal. At the time of mapping, only the Harlan and Wallins Creek coal beds were being worked by strip mining and augering. Some prospecting of the Darby('?) coal bed in the vicinity of Liggett has been reported by local miners. According to Huddle and others (1963, p. 7) the coal in this area is high-volatile A or B rank and is common banded with local lenses of non-banded coal.

The Harlan coal bed, where currently being mined at Liggett and augered between Harris and Board Branches near Smith, seldom exceeds 3 feet in thickness. A maximum thickness of 41/2 feet was measured in an abandoned mine in Sue Hollow. In Middleton Branch valley, the Harlan coal bed locally consists of an upper seam 11 inches thick and a lower seam 30 inches thick, separated by 2 feet of shale; elsewhere partings in the coal seldom exceed 1 inch in thickness.

The Wallins Creek coal bed has been correlated with the Fire Clay coal bed on the basis of a widespread flint-clay parting near its base (Huddle and others, 1963, p. 158). On Double Spur, where the coal was being augered and deep mined at the time of mapping, this parting, which is 4 to 10 inches thick, separates an upper coal seam averaging 40 inches thick from a lower seam 18 inches thick. The same coal bed has been deep mined and augered near Catron Gap where its thickness ranges from 21/2 to 6 feet.

A coal bed 60 to 120 feet above the Wallins Creek coal bed is the upper Wallins Creek coal bed of local operators; it may be equivalent to the Smith 11-foot coal bed reported by Ashley and Glenn (1906, p. 42). Near Catron Gap this Smith(?) coal bed averages 3 feet in thickness and has been mined underground and strip mined and augered. It is thin else- where in the quadrangle and is absent at places.

According to local sources, the maximum thickness of the Darby(?) coal bed occurs on Upper Double Branch near Liggett. The coal bed has been deep mined and augered south of Catron Gap. The paucity of openings in the coal bed east of Catron Gap may reflect thinning or splitting of the coal into interstratified thin beds of coal, shale, siltstone, and sandstone. The Darby(?) coal bed was not being worked within the mapped area at the time of mapping. No bloom nor other evidence of the Kellioka coal bed was found; however, coal operators report the occurrence of this bed in the northwestern part of the quadrangle where it is 40 to 50 feet below the Darby(?) coal bed; its thickness is less than 2 feet.

The Path Fork coal bed, locally called the Mason coal bed, is exposed at several places along Martins Fork valley. North and northeast of Smith, it thickens and has been mined locally. This coal bed may be the largest single source of coal remaining in the map area.

The Hance coal zone, correlated with the Puckett Creek coal bed (Englund and others, 1961), consists of several coal beds of varying thickness and continuity. Individual beds may range from 2 to 3 feet in thickness, and several beds within the zone commonly are separated only- by thin shaly sandstone partings. Locally, at Sampson, the coal in the Hance zone has been mined where three coal beds apparently have coalesced to form a 10-foot-thick bed. Other coal beds indicated by either prospects or small workings are thin or impure, and data from some are insufficient to indicate thickness, quality, or

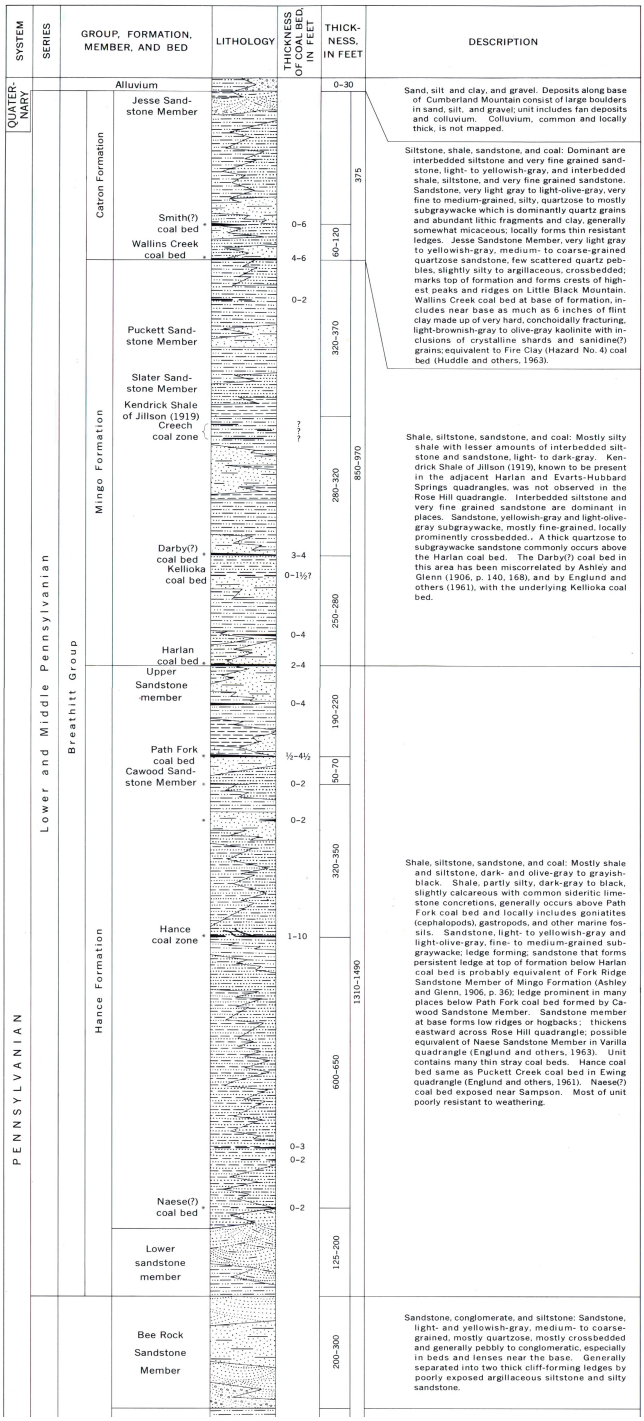
reserves.

Availability of ground water in the quadrangle and surrounding areas is discussed by Price and others (1962). Nearly all wells are drilled in valley bottoms. Of those drilled in bedrock, more than three-quarters are adequate for a modern domestic supply (more than 500 gpd). Wells in alluvium are generally dug; most can supply minimum domestic needs (more than 100 gpd). On hillsides, nearly all wells drilled in bedrock provide adequate water for a minimum domestic requirement.

Cumberland Mountain, with its many spectacular sandstone cliffs and hogbacks, is among the most scenic places in southeastern Kentucky and adjacent areas. This rugged beauty is worthy of preservation and development for outdoor recreational purposes.

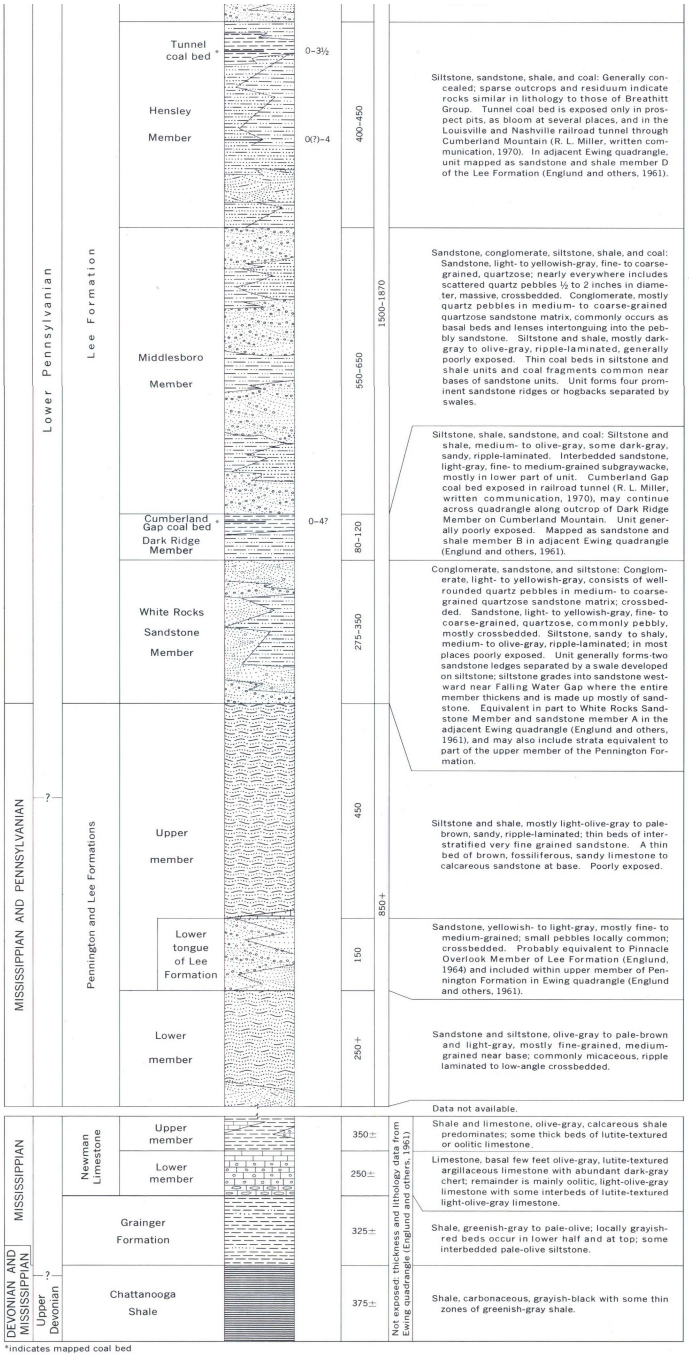
Text from source map: part of the Rose Hill Quadrangle

Stratigraphic Section, top portion



Graphic from source map: part of the Rose Hill Quadrangle

Stratigraphic Section, bottom portion



Graphic from source map: [part of the Rose Hill Quadrangle]

Rose Hill Quadrangle (digital)

The formal citation for this source.

> Crawford, M. M., 2003, Spatial Database of the Rose Hill Quadrangle, Harlan County, Kentucky: Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_1121, scale 1:24,000 (*GRI Source Map ID 69198*).

The above digital data was digitized and modified from USGS Geologic Quadrangle Map GQ-1121 by the Kentucky Geological Survey. The Kentucky Geological Survey has updated this map with current stratigraphic classifications and geologic interpretation.

No additional information from this source map is presented here.

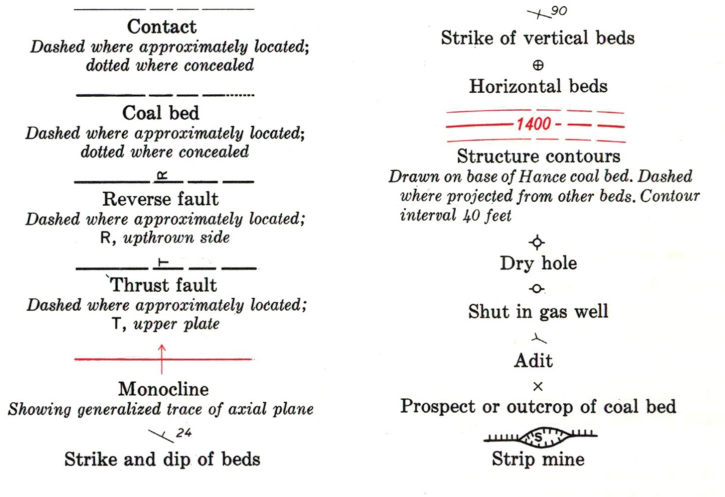
Varilla Quadrangle

The formal citation for this source.

> Englund, K. J., Landis, E. R., and Smith, H. L., 1963, Geology of the Varilla Quadrangle, Kentucky and Virginia: U.S. Geological Survey, Geologic Quadrangle Map GQ-190, scale 1:24,000 (*GRI Source Map ID 2478*).

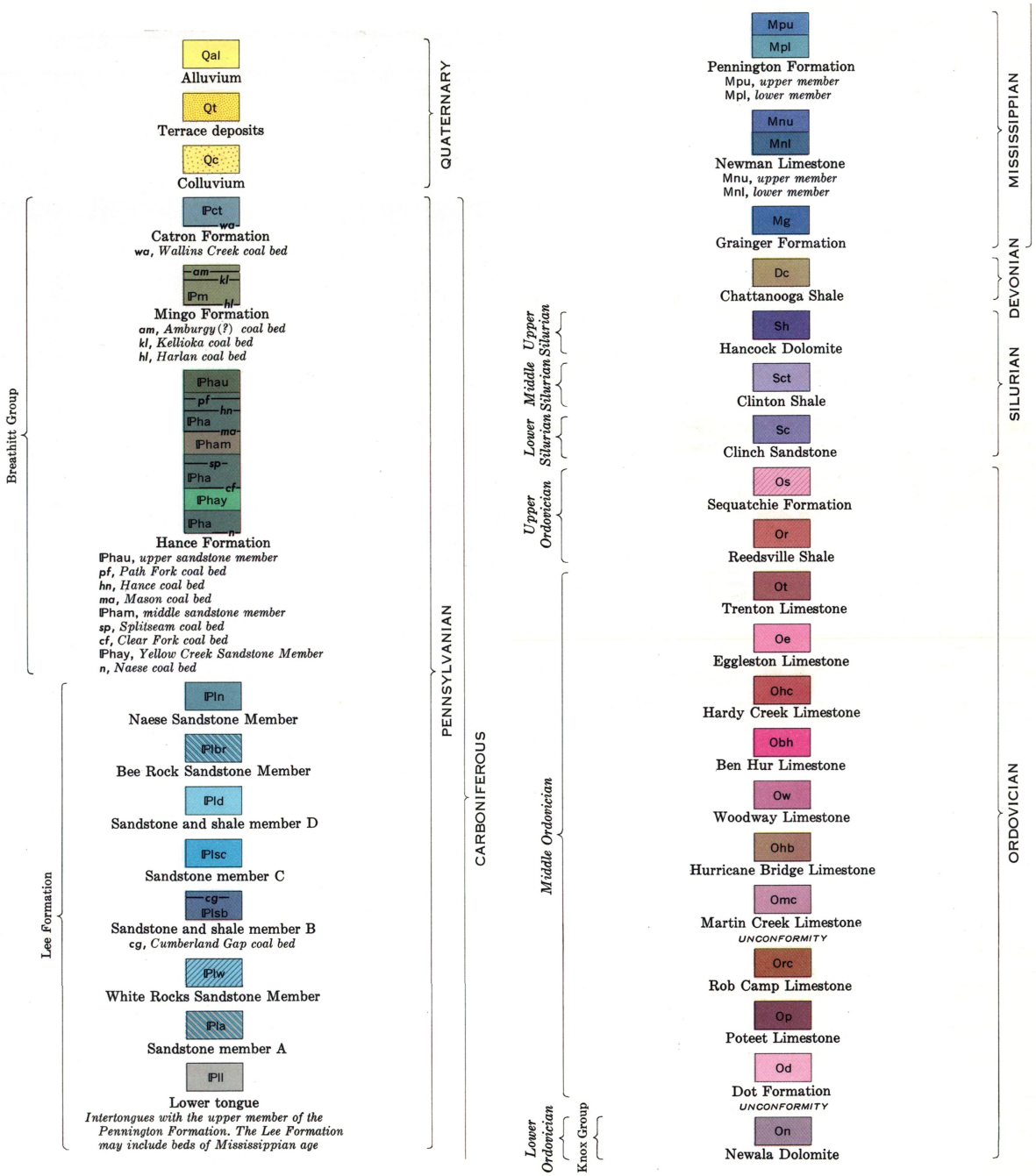
Prominent graphics and text associated with this source:

Map Legend



Graphic from source map: Varilla Quadrangle

Correlation of Map Units



Graphic from source map: Varilla Quadrangle

Economic Geology

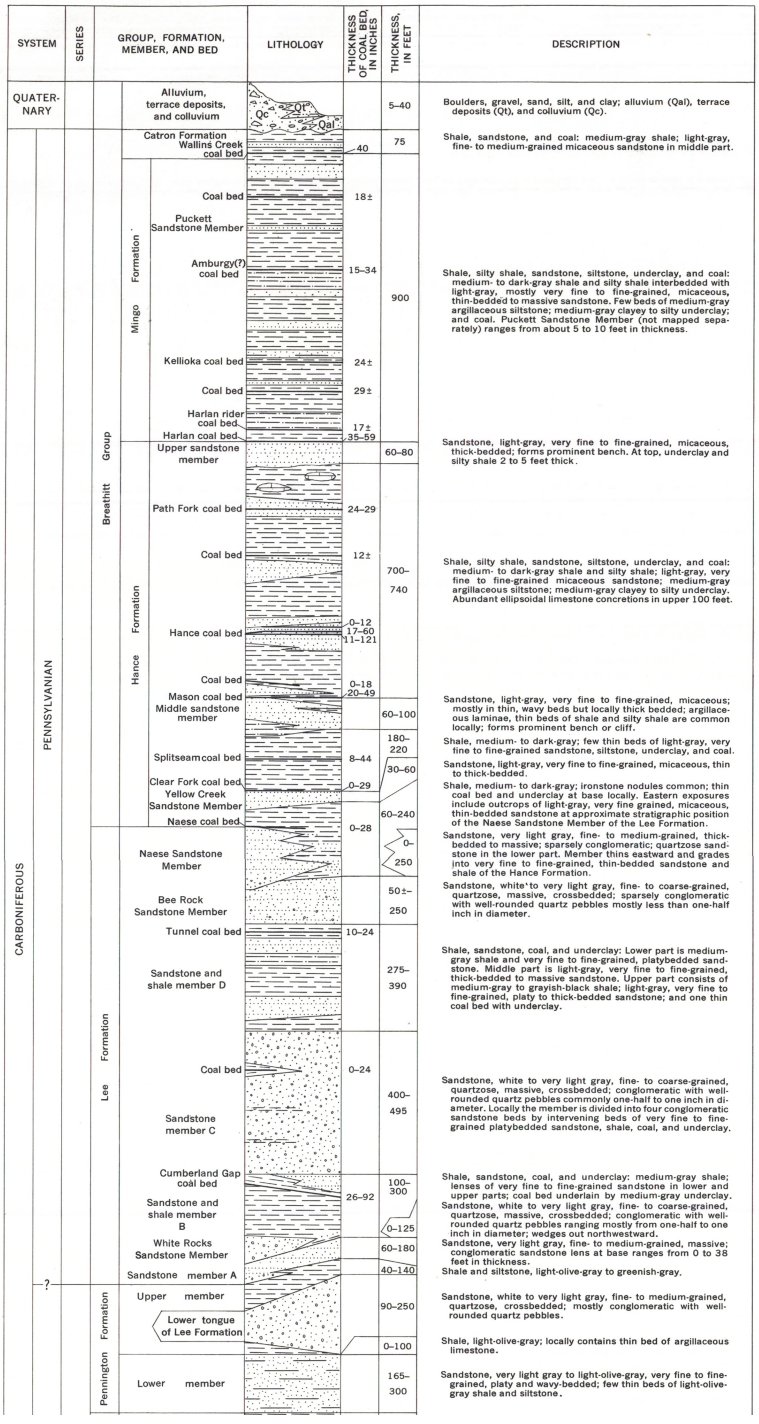
Coal is the principal mineral deposit of economic value in the quadrangle. It is of high volatile A bituminous rank and occurs in at least 12 beds, ranging mostly from about 1 to 4 feet in thickness, in the Lee, Hance, Mingo, and Catron Formations. The coal has been mined in relatively flat-lying beds of the Hance and Mingo Formations in the central part of the Middlesboro syncline; developments are most extensive in the Mason, Hance, and Harlan coal beds. Underground mining with railroad transportation has been supplemented in recent years by strip and auger mining with truck haulage out of the area. The estimated original reserves calculated for 10 principal coal beds in the quadrangle are approximately 222 million tons, about 7 percent of which is mined and lost in mining. Assuming 50 percent recovery, the remaining recoverable reserves are nearly 105 million tons.

Exploration for oil and gas in the quadrangle has resulted in the drilling of two wells in the Middlesboro syncline. The Asher No. 1 well on Sugarcamp Branch in the north-central part of the quadrangle encountered gas in the Newman Limestone and is presently capped (1962). The Asher No. 2 well drilled in 1960 at the head of Elk Branch was abandoned as a dry hole. Both of these wells penetrated the Pine Mountain overthrust fault (shown on cross section). The Brush Mountain monocline and the dome in surface rocks on the south end of Hances Ridge may reflect sub- surface structures favorable for oil or gas accumulation.

Limestone beds of Middle Ordovician age in the southern part of the quadrangle are quarried for crushed stone and agricultural lime.

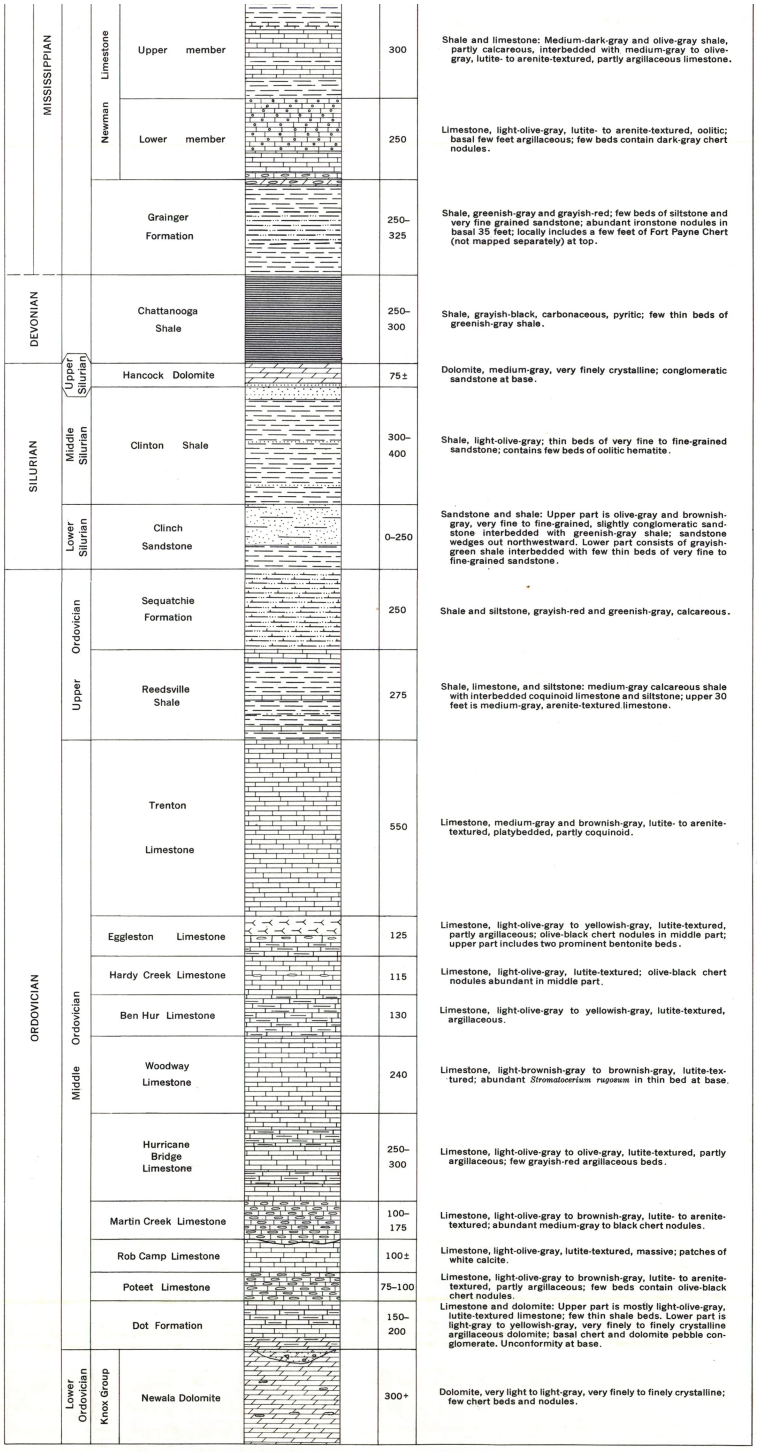
Text from source map: Varilla Quadrangle

Stratigraphic Section, top portion



Graphic from source map: Varilla Quadrangle

Stratigraphic Section, bottom portion



Graphic from source map: Varilla Quadrangle

Varilla Quadrangle (digital)

The formal citation for this source.

> Johnson, T. L., 2003, Spatial Database of the Varilla Quadrangle, Kentucky, Kentucky Geological Survey, Digitally Vectorized Geological Quadrangle DVGQ-12_190, scale 1:24,000 (*GRI Source Map ID 69707*).

The above digital data was digitized and modified from USGS Geologic Quadrangle Map GQ-190 by the Kentucky Geological Survey. The Kentucky Geological Survey has updated this map with current stratigraphic classifications and geologic interpretation.

No additional information from this source map is presented here.

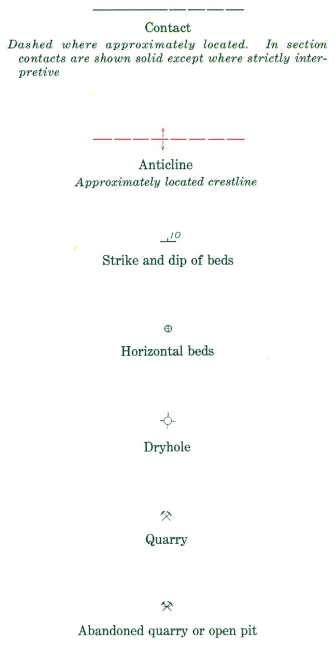
Wheeler Quadrangle

The formal citation for this source.

> Harris, L. D., 1965, Geologic Map of the Wheeler Quadrangle, Claiborne County, Tennessee and Lee County, Virginia: U.S. Geological Survey, Geologic Quadrangle Map GQ-435, scale 1:24,000 (*GRI Source Map ID 8179*).

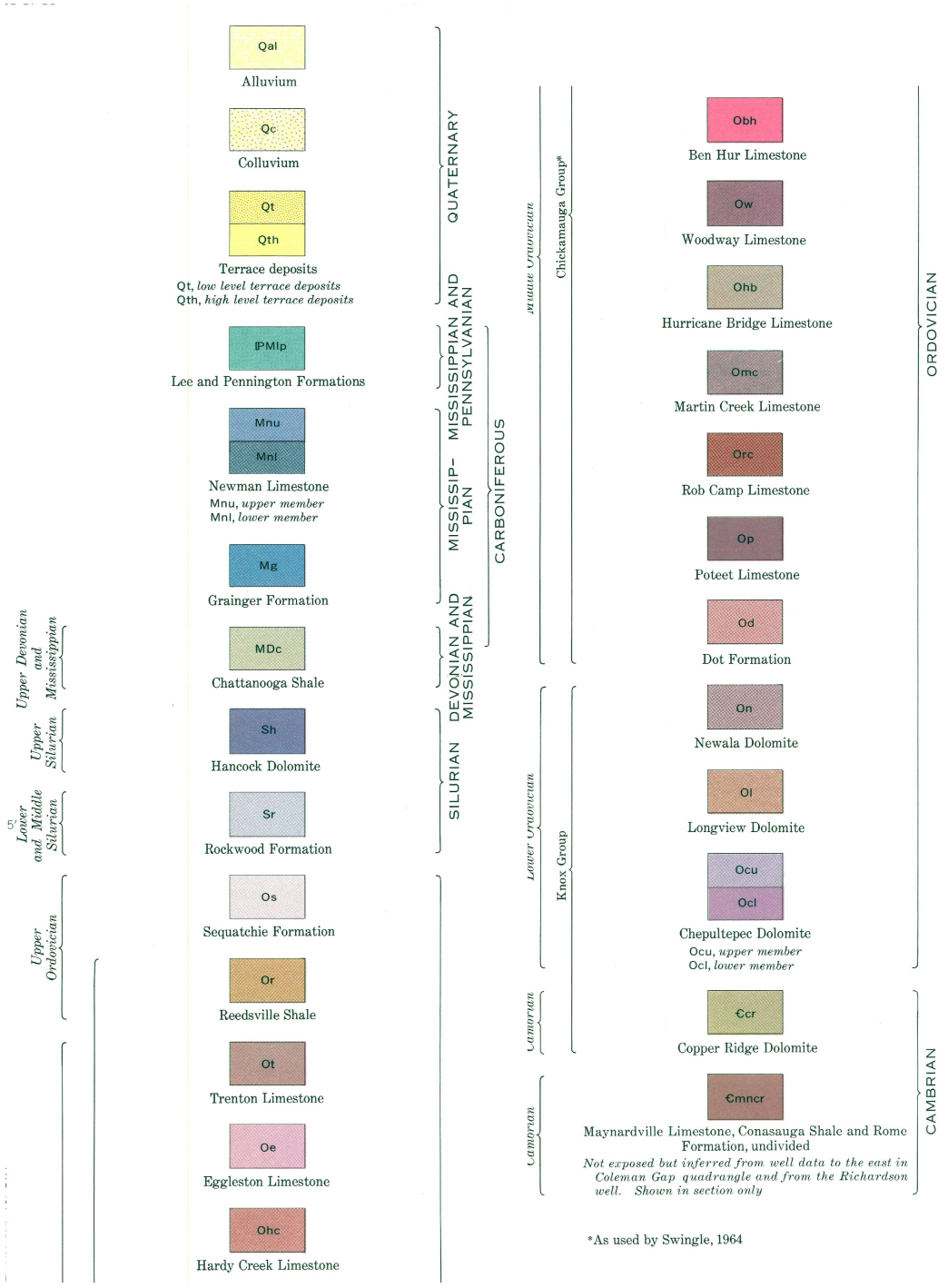
Prominent graphics and text associated with this source:

Map Legend



Graphic from source map: Wheeler Quadrangle

Correlation of Map Units



Graphic from source map: Wheeler Quadrangle

Economic Geology

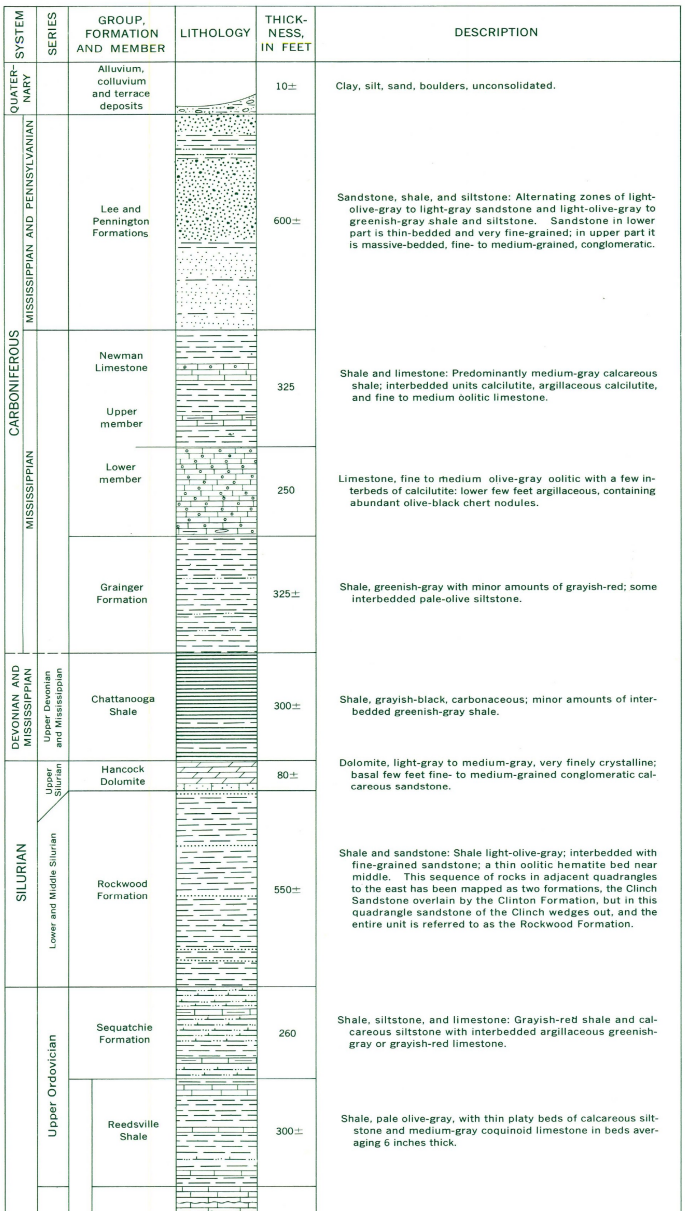
Limestone and dolomite of a quality suitable for crushed stone are abundant in this quadrangle. At present, there is only one active quarry, located in the Hurricane Bridge Limestone near the west edge of the quadrangle just north of the Louisville and Nashville Railroad. In the past, four small quarries were opened, at various times, to supply local need for road metal. Two of these are in the lower part of the Chepultepec Dolomite, on either side of Simmons Ridge near the center of the quadrangle. The other two are in the Hurricane Bridge Limestone in the northern part of the quadrangle.

Probably in the period from 1890 to 1915 oolitic hematite from near the middle of the Rockwood Formation was mined by open pit methods along Station Creek in the northwestern part of the quadrangle. No reliable measurement of the ore bed was obtained because walls of the pits are badly slumped. How- ever, pieces of hematite as much as six inches thick were found on the mine dumps.

In 1947 one well was drilled in the quadrangle in the exploration for oil and gas. This well, the A. A. Richardson No. 1, is located about one mile southeast of Bacchus along Blair Creek in the southern part of the quadrangle. After having drilled about 1100 feet, the operators experienced financial difficulty and the well was abandoned. The well collared near the base of the Chepultepec Dolomite, apparently penetrating the entire Copper Ridge Dolomite and bottomed in the upper dolomite member of the Maynardville Formation.

Text from source map: Wheeler Quadrangle

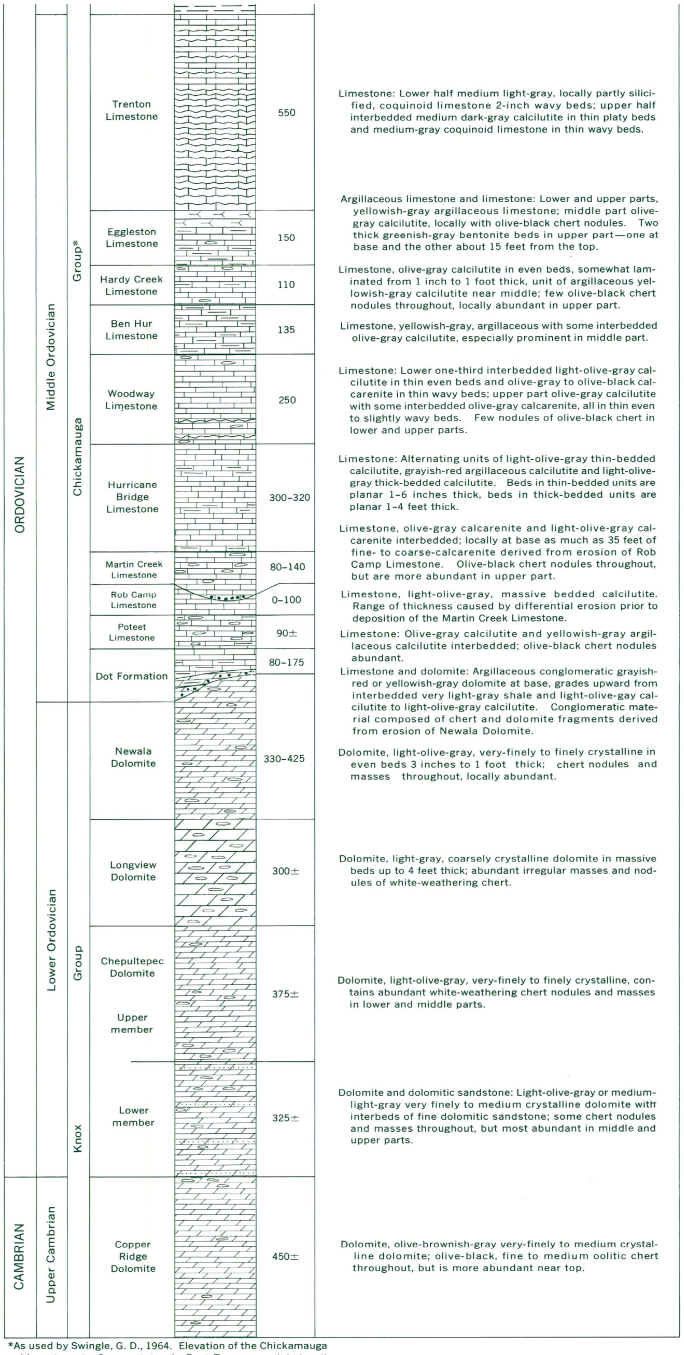
Stratigraphic Section, top portion



SYSTEM	SERIES	GROUP, FORMATION AND MEMBER	THICKNESS, IN FEET	DESCRIPTION
QUATERNARY		Alluvium, colluvium and terrace deposits	10±	Clay, silt, sand, boulders, unconsolidated.
CARBONIFEROUS	MISSISSIPPIAN AND PENNSYLVANIAN	Lee and Pennington Formations	600±	Sandstone, shale, and siltstone: Alternating zones of light-olive-gray to light-gray sandstone and light-olive-gray to greenish-gray shale and siltstone. Sandstone in lower part is thin-bedded and very fine-grained; in upper part it is massive-bedded, fine- to medium-grained, conglomeratic.
	MISSISSIPPIAN	Newman Limestone, Upper member	325	Shale and limestone: Predominantly medium-gray calcareous shale; interbedded units calcilutite, argillaceous calcilutite, and fine to medium oolitic limestone.
		Lower member	250	Limestone, fine to medium olive-gray oolitic with a few interbeds of calcilutite: lower few feet argillaceous, containing abundant olive-black chert nodules.
		Grainger Formation	325±	Shale, greenish-gray with minor amounts of grayish-red; some interbedded pale-olive siltstone.
DEVONIAN AND MISSISSIPPIAN	Upper Devonian and Mississippian	Chattanooga Shale	300±	Shale, grayish-black, carbonaceous; minor amounts of interbedded greenish-gray shale.
SILURIAN	Upper Silurian	Hancock Dolomite	80±	Dolomite, light-gray to medium-gray, very finely crystalline; basal few feet fine- to medium-grained conglomeratic calcareous sandstone.
	Lower and Middle Silurian	Rockwood Formation	550±	Shale and sandstone: Shale light-olive-gray; interbedded with fine-grained sandstone; a thin oolitic hematite bed near middle. This sequence of rocks in adjacent quadrangles to the east has been mapped as two formations, the Clinch Sandstone overlain by the Clinton Formation, but in this quadrangle sandstone of the Clinch wedges out, and the entire unit is referred to as the Rockwood Formation.
	Upper Ordovician	Sequatchie Formation	260	Shale, siltstone, and limestone: Grayish-red shale and calcareous siltstone with interbedded argillaceous greenish-gray or grayish-red limestone.
		Reedsville Shale	300±	Shale, pale olive-gray, with thin platy beds of calcareous siltstone and medium-gray coquinoid limestone in beds averaging 6 inches thick.

Graphic from source map: Wheeler Quadrangle

Stratigraphic Section, bottom portion



*As used by Swingle, G. D., 1964. Elevation of the Chickamauga Limestone to Group status in East Tennessee (abstract) Tenn. Acad. Sci., Jour., vol 39, no 2., p 66.

Graphic from source map: Wheeler Quadrangle

GRI Digital Data Credits

This document was developed and completed by Eli Crocker and Jim Chappell (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by Jim Chappell and Stephanie O'Meara (Colorado State University).

The information in this document was compiled from GRI source maps, and is intended to accompany the digital geologic-GIS maps and other digital data for Cumbeland Gap National Historical Park, Kentucky, Tennessee and Virginia (CUGA) developed by Jim Chappell; Shea Slonkosky; Stephanie O'Meara and Heather I. Stanton (Colorado State University) (see the GRI Digital Maps and Source Map Citations section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS maps).

GRI finalization by Jim Chappell (Colorado State University).

GRI program coordination and scoping provided by Bruce Heise, Jason Kenworthy and Tim Connors (NPS GRD, Lakewood, Colorado).