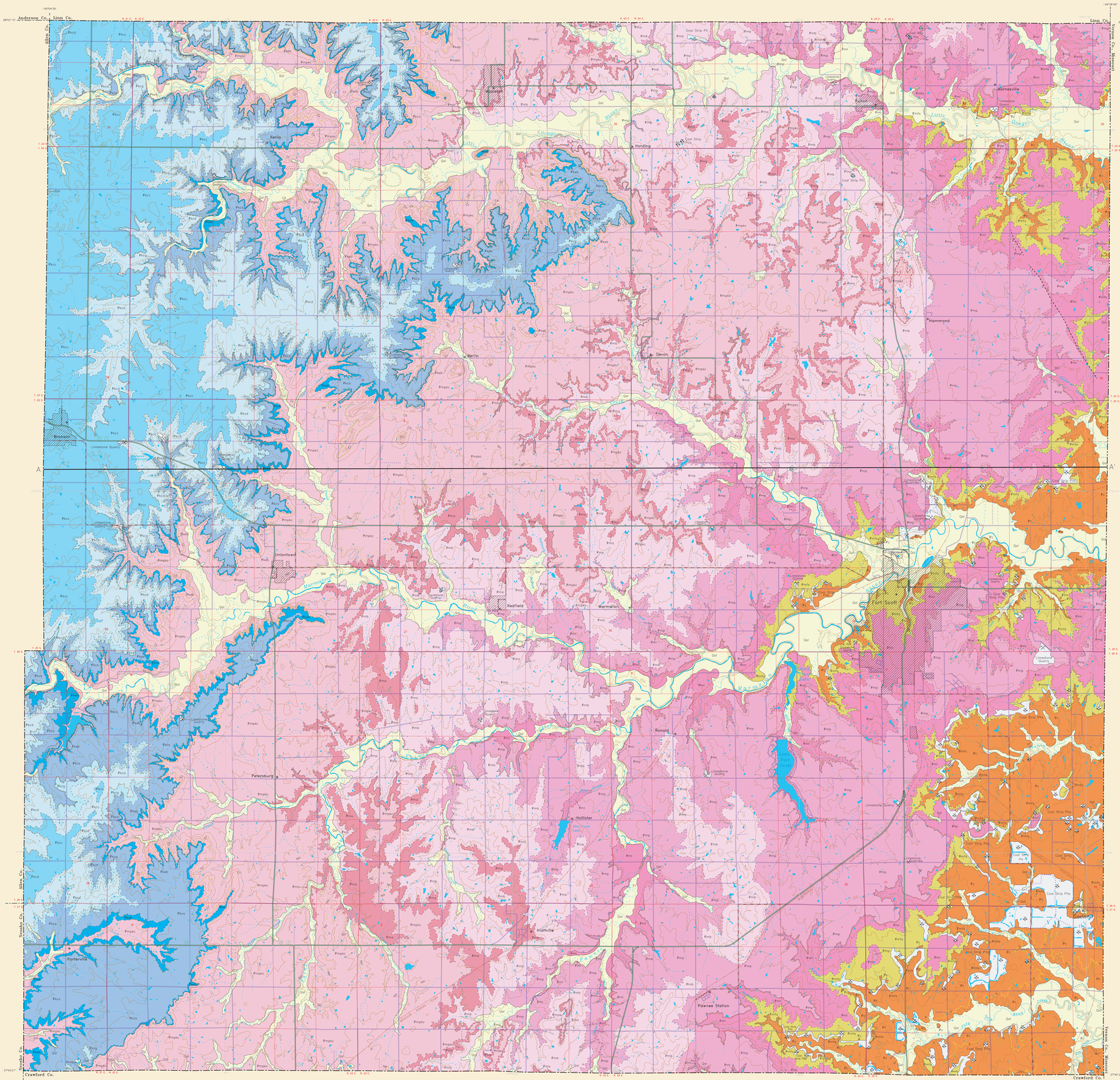
KANSAS GEOLOGICAL SURVEY
THE UNIVERSITY OF KANSAS
MAP M-97

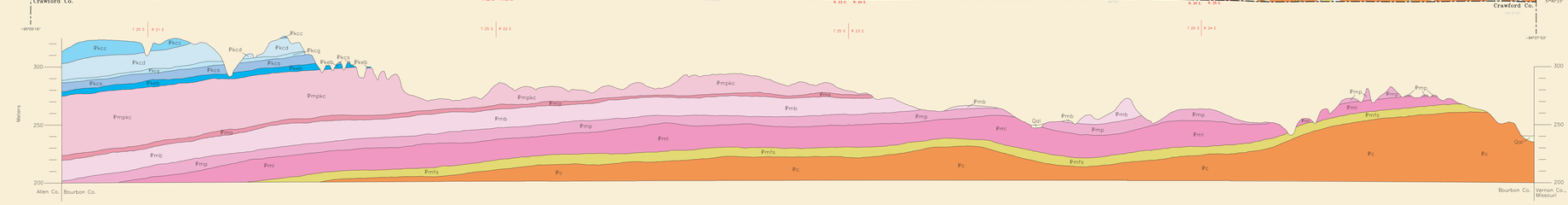
GEOLOGIC MAP OF BOURBON COUNTY, KANSAS

2002

Ronald R. West
Robert S. Sawin

Computer compilation
and cartography by
Jorgina A. Ross
Mieko Ono
David Means

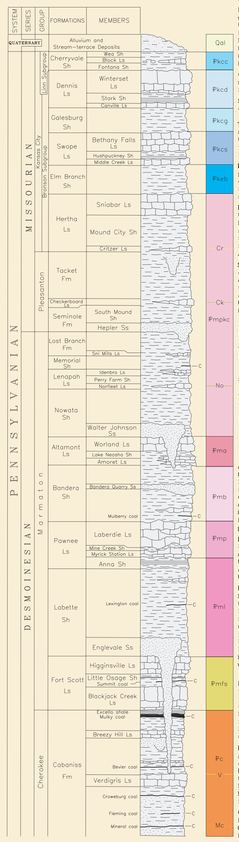




The stratigraphic sequence in Bourbon County extends from below the Mineral coal in the Cabaniss Formation (Cherokee Group) to the lower part of the Cherryvale Shale (Kansas City Group). Overlying these Pennsylvanian rocks are Quaternary alluvium and stream-terrace deposits. Although a number of changes have been proposed for the names of lithostratigraphic units in this interval, especially those associated with the Desmoinesian–Missourian boundary, such suggestions are, at this time, informal. The terminology used herein is that given by Zeller (1968) with two exceptions: the Holdenville shale has been divided into the Memorial Shale below and the Lost Branch Formation above (Heckel, 1991), and the Ladore Shale has been changed to the Elm Branch Shale (Heckel and Watney, 2002).

Stratigraphic terminology appears on the left side of the graphic column. On the right side of the column are the units and beds as shown on this map. It is important to note that this map indicates what the authors consider mappable lithostratigraphic units. No temporal, generic, or related depositional aspects are meant or implied.

The bedrock geology of Bourbon County was mapped on U.S.G.S. topographic quadrangle maps at a scale of 1:24,000. Data points used in mapping the bedrock geology are available in Open-file Report 2002-02 (West and Sawin, 2002) at the Kansas Geological Survey. Some measured stratigraphic sections and descriptions of cores in Bourbon County are contained in Kansas Geological Survey Open-file Report 94-37 (West and Sawin, 1994). Alluvial deposits, quarries, and strip pits were mapped using the Soil Survey of Bourbon County, Kansas (Bell and Fortner, 1981). Alluvium and stream-terrace deposits 5 feet or greater in thickness were mapped as Qal. These deposits included sand, gravel, silt, and clay that were deposited on floodplains by streams, creeks, and rivers. These soil maps, along with data from the Kansas Department of Transportation, were also used to locate and identify bedrock units.



Cherryvale Shale Overlying the Dennis Limestone are the mudrocks of the lower Cherryvale Shale. This unit occurs only in the northwestern part of Bourbon County, and like the other mudrock units in Bourbon County, it is mostly covered. A thin, hard, dense limestone bed, probably the Block Limestone Member, is occasionally exposed.

Dennis Limestone The lowest member of the Dennis Limestone, the Canville Limestone Member, is a thin, slabby, hard, slightly fossiliferous limestone 1 foot or less in thickness. Above the Canville Limestone Member, the Stark Shale Member is lithologically similar (black shale and gray mudrock) to, but thinner than, the Hushpuckney Shale Member of the Swope Limestone. Overlying the Stark Shale Member is the Winterset Limestone Member, a medium- to thick-bedded, light-gray to whitish, fossiliferous, often algal limestone that is 3 to 20 feet thick. A crossbedded oolitic limestone occurs in the upper part of the Winterset. Chert may also occur in the middle and upper parts. The Dennis Limestone is well exposed in the northwestern part of the county and is 25 to 50 feet thick.

Galesburg Shale Separating the Swope Limestone from the Dennis Limestone is the Galesburg Shale, a medium- to dark-gray to yellowish-brown, platy to blocky mudrock that may be silty and/or sandy. Like the Elm Branch Shale below, the Galesburg is commonly covered, rarely seen, and ranges from 2 to 15 feet thick.

Swope Limestone At the base of the Swope Limestone, the Middle Creek Limestone Member is a hard, dense, bluish-gray, sparsely fossiliferous limestone between 1 and 2 feet thick. It is easily identified because of its position just below the dark-gray to black, platy to fissile shale of the Hushpuckney Shale Member. The lower part of the Hushpuckney is a black shale and the upper part is a yellowish-gray mudrock. In northeastern Bourbon County, the Hushpuckney is up to 8 feet thick, but commonly it is thinner. Overlying the Hushpuckney Shale Member is the Bethany Falls Limestone Member, consisting of 15 to 35 feet of thin, wavy-bedded, light-gray, fossiliferous limestone. The upper 10 to 12 feet of the Bethany Falls is more thickly bedded and is whitish-gray with darker-gray mottling. Oolitic beds may also be present.

Elm Branch Shale The Elm Branch Shale ranges from 5 to 15 feet thick. Most often this unit is covered and its position and thickness determined by the top of the underlying Sniabar Limestone Member and the base of the overlying Middle Creek Limestone Member of the Swope Limestone. Where seen, the Elm Branch is a medium- to dark-gray to yellowish-brown, platy to blocky mudrock. In places it may be slightly silty and sandy.

Hertha Limestone The Hertha Limestone is composed of three members which are, in ascending order, the Critzer Limestone Member, the Mound City Shale Member, and the Sniabar Limestone Member. The Critzer Limestone Member is thin or absent in Bourbon County, and the Mound City Shale Member is often indistinguishable from the underlying Tacket Formation. The Sniabar Limestone Member is a gray, medium- to thick-bedded, fossiliferous limestone that ranges from 5 to 10 feet. The Sniabar is commonly an algal limestone with numerous vugs. Abundant iron oxide gives it a dark-reddish-brown weathered color.

Tacket Formation, Checkerboard Limestone, Seminole Formation, Lost Branch Formation, Memorial Shale, Lenapah Limestone, and Nowata Shale Between the base of the Sniabar Limestone Member of the Hertha Limestone and the top of the Altamont Limestone, several thin, discontinuous limestones occur within this dominantly siliciclastic interval. The thickness ranges from 100 to over 180 feet. Some of these limestones (the Norfleet Limestone Member of the Lenapah Limestone, the Checkerboard Limestone, and the Critzer Limestone Member of the Hertha Limestone) are locally mappable but are not continuous throughout the county. The boundary between the Desmoinesian and Missourian series occurs within this interval, but lithostratigraphic evidence for separating them was not found.

The Tacket Formation is a gray, thin-bedded micaceous siltstone (Sievers, 1969). Because the Checkerboard Limestone is thin or absent, it is difficult to separate the Tacket from the underlying Seminole Formation. Sequences of interbedded thin, hard, dense, dark-gray, unfossiliferous limestones and medium-gray mudrocks, referred to in the literature as the Bourbon flags, occur in the upper part of the Tacket. The stratigraphic position of the Bourbon flags is unclear, and may be, in part, equivalent to the Critzer Limestone Member of the Hertha Limestone. The occurrence of the Bourbon flags is not consistent.

The Checkerboard Limestone is thin, discontinuous, and poorly exposed in Bourbon County.

The Seminole Formation contains two members, the Hepler Sandstone Member and the South Mound Shale Member. The Hepler Sandstone Member is sometimes recognized in outcrop.

The Memorial Shale and Lost Branch Formation are not well exposed in Bourbon County. Jewett (1945) suggested the combined thickness of these gray, bedded, slightly blocky clay mudrock units is generally less than 30 feet.

The Lenapah Limestone consists of two limestones and an intervening mudrock. They are, in ascending order, the Norfleet Limestone Member, the Perry Farm Shale Member, and Idenbro Limestone Member. In Bourbon County, both limestones vary in lithology and are thin (less than 2 feet) or absent.

Overlying the Altamont Limestone is the Nowata Shale, which is lithologically similar to the Labette and Bandera Shales, and like these units, varies in thickness from several feet to several tens of feet. An incised valley-fill sandstone, the Walter Johnson Sandstone Member, occurs in the lower part of the Nowata and in places appears to cut out part, or all, of the Altamont.

Altamont Limestone In general, the Altamont Limestone thins in Bourbon County, ranging from 10 to 15 feet thick (Jewett, 1945). In ascending order, the Altamont Limestone is composed of the Amoret Limestone Member, the Lake Neosho Shale Member, and the Worland Limestone Member. The Amoret Limestone Member is absent or represented by a poorly developed nodular limestone. In the northwestern part of the county, it is a thin conglomerate to brecciated carbonate; in southeast Bourbon County, the Amoret is better developed and the three members of the Altamont are clearly recognized. The prominent Worland Limestone Member is a hard, medium-gray, slightly fossiliferous, medium-bedded limestone. Between the Worland and Amoret limestones, the Lake Neosho Shale Member is a yellow-brown to light-gray mudrock that contains dark phosphatic nodules.

Bandera Shale The Bandera Shale overlies the Pawnee Limestone and ranges from 40 to over 60 feet thick. Essentially a siliciclastic sequence, the lower part of the Bandera Shale contains a thin coal, the Mulberry, and in the southern part of the county, a thin, dark-brown, fossiliferous limestone that occurs just above the Mulberry. This limestone may be what has been informally called the Edna limestone in adjacent counties. A thick sandstone, the Bandera Quarry Sandstone Member, is a conspicuous component of this formation, though its occurrence is restricted. West of Redfield, Kansas, it is quarried for building stone.

Pawnee Limestone Units herein mapped as the Pawnee Limestone are, in ascending order, the Myrick Station Limestone Member, Mine Creek Shale Member, and Laberdie Limestone Member. The combined thickness of these three members in Bourbon County ranges from 20 to 30 feet. Although the Anna Shale Member is formally recognized (Zeller, 1968) as the basal member of the Pawnee Limestone, this study does not support the mappability of the base of the Anna Shale Member. The thickness of the Anna is variable and sometimes it is absent. The top of the Labette is often a black to very dark-gray mudrock or shale, making it difficult to distinguish from the overlying Anna. The Myrick Station Limestone Member is a thin-bedded, gray, fossiliferous limestone that weathers into reddish-orange-brown blocks. The Mine Creek Shale Member, a dark-gray fossiliferous mudstone, is sometimes thin or absent. The Laberdie Limestone Member is responsible for most of the thickness of the Pawnee Limestone in Bourbon County. The Pawnee thickens where concentrations of algal debris occur in the light-to medium-gray, hard, thin- to medium- and thick-bedded fossiliferous Laberdie.

Labette Shale The Labette Shale is a siliciclastic sequence that ranges from 30 to 75 feet thick. Although it is mostly mudrock, a sandstone (the Englevale Sandstone Member) occurs in the lower part; a thin coal, the Lexington coal, occurs near the middle; and a thin limestone may be present in the upper part. This thin limestone may be the unit that has informally been called the Winer School limestone in adjacent counties. The Englevale Sandstone Member appears to be an incised valley-fill deposit (formerly referred to in the literature as a channel sandstone) that, in places, cuts out the lower Labette Shale, the Fort Scott Limestone, and the Cabaniss Formation down to the top of the Verdigris Limestone Member (Schoewe, 1959).

Fort Scott Limestone The Fort Scott Limestone consists of two prominent limestone members and a dark-gray to black intervening mudrock and shale. The Fort Scott Limestone is stratigraphically the lowest conspicuous limestone in the county, and ranges from 20 to 30 feet thick. The lowest member, the Blackjack Creek Limestone Member, is thinly bedded in the upper part with the lower part more medium to to thickly bedded. The Blackjack Creek Limestone Member, and the upper member, the Higginsville Limestone Member, are hard, dense, gray, fossiliferous limestones. Between these two limestones is the Little Osage Shale Member, a dark-gray to yellowish-brown mudrock in the upper part and a black, platy to fissile shale in the lower part. A thin coal, the Summit coal, sometimes occurs within this member.

Cabaniss Formation The Cabaniss Formation in Bourbon County is informally separated by the Verdigris Limestone Member, the only reliable marker in the upper part of the formation. Below the Verdigris, the Cabaniss consists of sandstones and mudrocks with three named coal beds. The coals are, in ascending order, the Mineral, Fleming, and Croweburg. Calcareous, pyritic beds often overlie these coals and form caprocks. The Mineral and Croweburg have been extensively mined, and the Fleming is poorly developed in the county. Below the Verdigris, 10 to 45 feet of Cabaniss is exposed in Bourbon County.

The Verdigris Limestone Member is up to 3 feet thick and is easily recognized where it is exposed in the southeastern part of the county. According to Howe (1956), the Verdigris consists of one to three beds of hard, dark-gray to black, fossiliferous limestone that weather a dark orange-brown. This interval is sometimes informally subdivided; the thick limestone is regarded as the Verdigris and the other one or two, thinner, limestone beds and associated black shale are referred to as the V-shale, a unit widely recognized in the subsurface.

The Cabaniss Formation above the Verdigris is lithologically very similar to the Cabaniss below, except that it contains a thick sandstone bed and several thin, dark-gray to black, clayey limestones. It ranges in thickness from 80 to 100 feet. The most conspicuous limestone in this interval is the Breezy Hill Limestone Member and the prominent coal is the Mulky. Another coal, the Bevier, is also present 1 to 2 feet above the Verdigris in some parts of the county. These coals have also been extensively mined. Overlying the Mulky coal is a black, platy to fissile shale, informally called the Excello shale, that is useful in recognizing the position of the base of the Fort Scott Limestone.

STRATIGRAPHIC SECTION EXPLANATION

Sandstone
Mudrock
Black shale
Coal
Siltstone
Limestone

References

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Geologic unit boundaries

1 – Observed geologic contact
2 – Inferred geologic contact
3 – Concealed geologic contact*
* Does not appear on this map

Hydrology and topography

1 – Intermittent stream
2 – Perennial stream
3 – Areal hydrology
4 – Elevation contours (10-meter interval)
5 – Elevation contours (50-meter interval)

Geologic structure

1 – Fault
2 – Anticline *
3 – Syncline *
(solid where observed)
(dashed where inferred)
* Does not appear on this map

Resource development

1 – Limestone quarry
2 – Sandstone quarry
3 – Coal strip pit
4 – Oil well*
5 – Gas well*
6 – Water well*
* Does not appear on this map

Index reference features

1 – 1:24,000 map edge
2 – Line of cross section

INDEX TO PUBLIC LAND SURVEY

Range: 21E 22E 23E 24E 25E
Township: 27S 28S 29S 30S 31S

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Diagram of a township showing numbering of sections

Transportation

1 – Interstate highway
2 – Federal highway
3 – State highway
4 – Medium-duty roads
5 – Light-duty secondary road
6 – Unimproved secondary road
7 – Railroad
8 – Airport or landing strip

Boundaries and locations

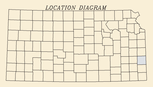
1 – State line
2 – County line
3 – Township/Range line
4 – Section line
5 – Locality
6 – Populated area population >500

INDEX TO 1:24000 SCALE MAPS

1 Blue Mound – 1966
2 Mapleton – 1966
3 Mantry – 1958 (7R PR)
4 Prescott – 1958 (7R PR)
5 Hume – 1991
6 Bronson – 1966
7 Xenia – 1966
8 Devon – 1958
9 Hammond – 1958 (7T PI)
10 Richards – 1942
11 Moran SE – 1966
12 Uniontown – 1966
13 Marmaton – 1958 (7R PR)
14 Fort Scott – 1958 (7R PR)
15 Deerfield – 1991
16 Porterville – 1973
17 Hepler – 1973
18 Hiattville – 1964
19 Cato – 1959 (7R PR)
20 Garland – 1991

PR Photorevised
PI Photoinspected

LOCATION DIAGRAM



CONVERSION TABLE

feet	meters	kilometers	miles
1	0.3048	0.0003	0.00019
3.2808	1	0.001	0.00062
3280.8	1000	1	0.6214
5280	1609.4	1.6094	1

To convert feet to meters multiply by 0.3048
To convert meters to feet multiply by 3.2808
To convert kilometers to miles multiply by 0.6214
To convert miles to kilometers multiply by 1.6094

GN MN
1°08' 6°

Convergence (GN) and 1981 magnetic declination (MN) at center of map
Diagram is approximate

Scale 1:50,000

Lambert Conformal Conic Projection with standard parallels at 33° and 45°

0 1 2 3 Kilometers
0 1 2 Miles

Elevation contours are presented for general reference. They are taken from USGS Digital Line Graph (DLG) files compiled from base maps at a scale of 1:100,000. In some places the contours from the DLG's may be more generalized than the base maps used for compilation of geologic outcrop patterns. Outcrop patterns on the map will typically reflect topographic variation more accurately than the associated contour lines. Repeated fluctuation of an outcrop line across a contour line should be interpreted as an indication that the mapped rock unit is maintaining a relatively constant elevation along a generalized contour.

The geology was mapped in the field using USGS 7.5-min. 1:24,000-scale topographic maps.

This map was produced by computer-aided cartography using the GINMAP (Geodata Interactive Management Map Analysis and Production) system developed at the Kansas Geological Survey.

Roads and highways are shown on the base map as represented by Bartholomew's 1:100,000-scale series. Other features derived primarily from USGS 7.5-min. 1:24,000-scale topographic maps. As accurate data are acquired, the base map will be revised to reflect new highway construction (not yet represented on USGS maps).

The Kansas Geological Survey does not guarantee this map to be free from errors or inaccuracies and disclaims any responsibility or liability for interpretations made from the map or decisions based thereon.

Suggested reference to this map:
West, R. R., and Sawin R. S., 2002, Geologic Map of Bourbon County, Kansas: Kansas Geological Survey, Map M-97, scale 1:50,000.

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