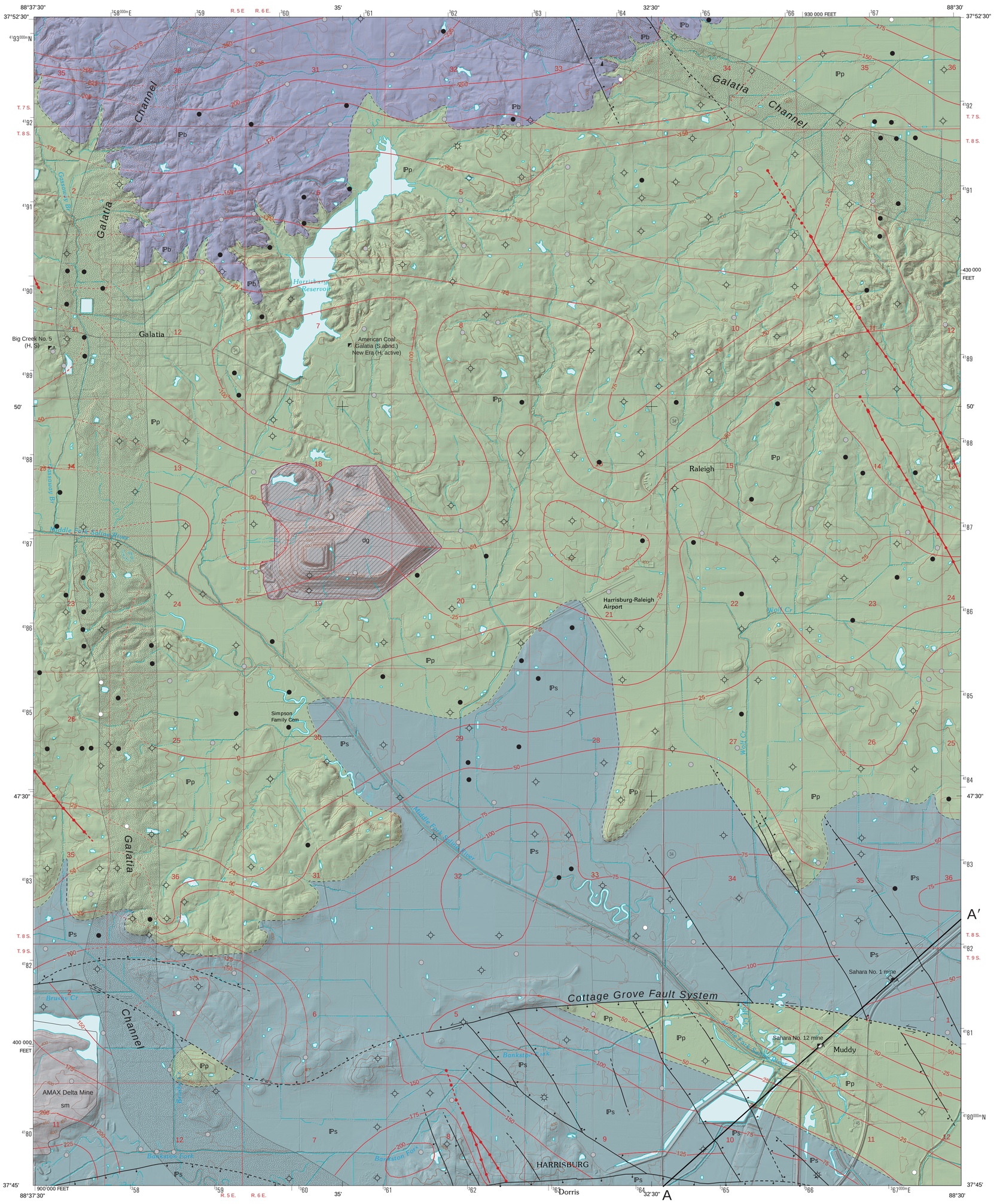
BEDROCK GEOLOGY OF GALATIA QUADRANGLE
SALINE COUNTY, ILLINOIS

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

W. John Nelson and F. Brett Denny
2015

STATEMAP Galatia-BG



EXPLANATION

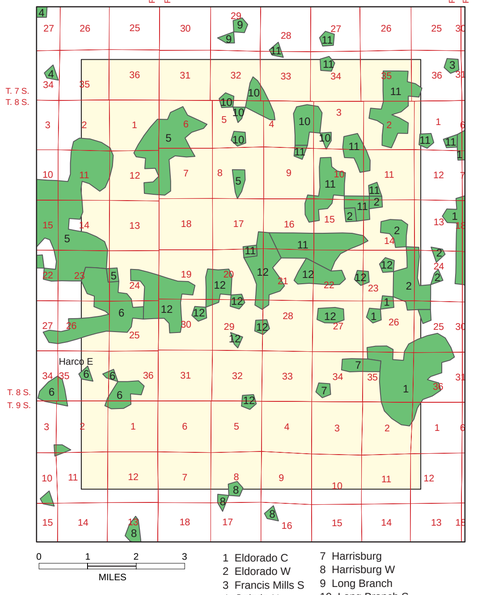
- dg — Disturbed ground
- sm — Surface mine
- Pennsylvanian
  - Missourian
    - IPb — Bond Formation
    - IPp — Patoka Formation
  - Desmoinesian
    - IPs — Shelburn Formation

Symbols

- Oil well
- Coal boring
- Dry note
- Coal bed methane boring
- Shaft mine
- A — Abandoned shaft mine
- Outcrop of special note, shown where contact or map unit was well exposed at time of mapping

Line Symbols
dashed where inferred, dotted where concealed

- Igneous dike (Permian age)
- Contact
- Fault, direction of throw unknown
- Normal fault: bar and ball on downthrown side
- Strike-slip fault
- 400 — Structure contour of the top of the Springfield Coal (contour interval is 25 feet)
  Stippled areas show the Galatia channel; Pennsylvanian paleochannel where Springfield Coal is absent
- A—A′ — Line of cross section



1 Eldorado C
2 Eldorado W
3 Francis Mills S
4 Galatia N
5 Harco
6 Harco E
7 Harrisburg
8 Harrisburg W
9 Long Branch
10 Long Branch S
11 Raleigh
12 Raleigh S

Figure M1 Oil Fields located in Galatia Quadrangle

Base map compiled by Illinois State Geological Survey from digital data (2012 U.S. Topo) provided by the United States Geological Survey. Contours and shaded relief derived from LiDAR data provided by Saline County (2011).

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator
10,000-foot ticks: Illinois Coordinate System of 1983, east zone
1,000-meter ticks: Universal Transverse Mercator grid system, zone 16

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SCALE 1:24,000

1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 KILOMETER

BASE MAP CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology based on field work by W. John Nelson, F. Brett Denny, and Scott D. Elrick, 2015.

Digital cartography by Jennifer E. Carrell, Donald E. Luman, and Trisha S. Rentschler, Illinois State Geological Survey.

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This map has not undergone the formal Illinois Geologic Quadrangle map review process. Whether or when this map will be formally reviewed and published depends on the resources and priorities of the ISGS.

ROAD CLASSIFICATION

- U.S. Route
- State Route
- Local road

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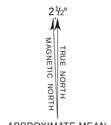
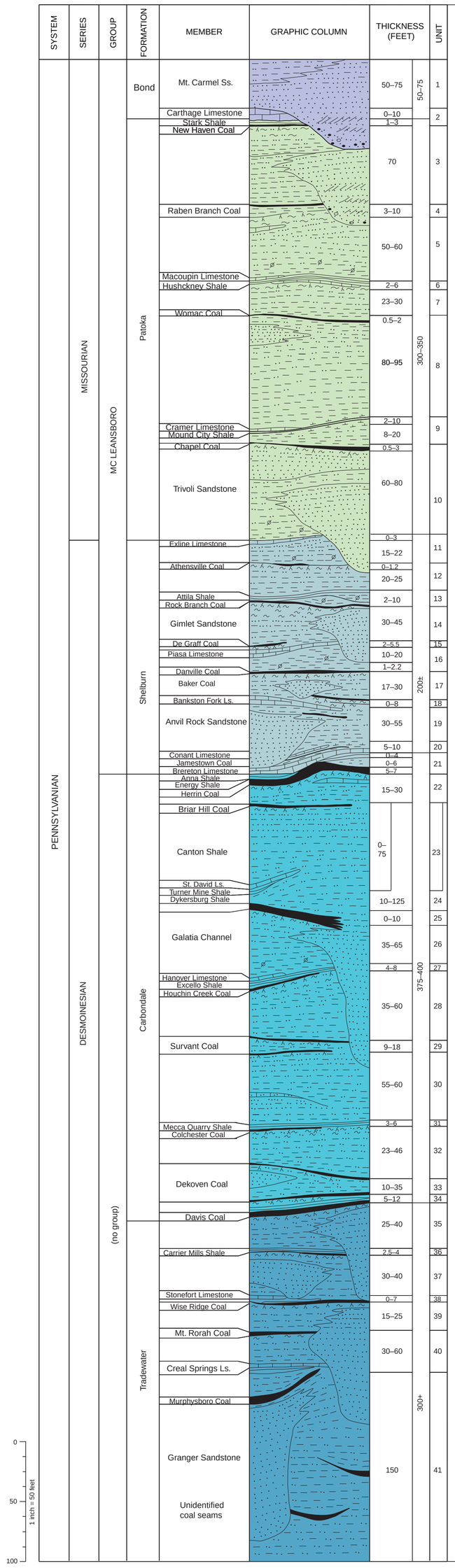
1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Akin
2 Walpole
3 Broughton
4 Harco
5 Eldorado
6 Carrier Mills
7 Harrisburg
8 Rudement



APPROXIMATE MEAN DECLINATION, 2015



1. Mt. Carmel Sandstone. The interval is largely sandstone, with lesser amounts of siltstone and silty shale. In outcrops the sandstone is yellowish to light brownish gray. The upper part is fine grained, thinly bedded, and shaly. The lower part is medium to coarse-grained, micaceous, "mealy" or friable, and massive to crossbedded. Basal conglomerate of siderite, shale, and limestone clasts is commonly present. The lower contact is erosive, truncating the Carthage Limestone and Stark Shale. Where the Carthage is absent, the base of the sandstone is considered to be the base of the Bond Formation.

2. Carthage Limestone and associated strata. The limestone is light to medium gray, medium bedded, and fossiliferous. The Stark Shale Member, directly beneath the limestone, is black, fissile, hard, well jointed, and contains conodonts and burrows. The thin New Haven Coal Member occurs at the base of the Stark Shale. G.H. Cady and H.R. Wanless described outcrops of these strata in ravines near the center of Sec. 33, T7S, R6E. Drilling records elsewhere in the quadrangle indicate that the Carthage, Stark, and New Haven have been eroded and replaced by the Mt. Carmel Sandstone.

3. Clastic interval. Beneath the New Haven Coal is well-developed underclay that exhibits root casts, slickensides, and carbonate nodules. Below this is an upward-coarsening succession of shale and siltstone approximately 20 feet thick. In some places, the lower part of unit 3 is a second upward-coarsening sequence of shale and siltstone. In other places, this portion of the unit consists of sandstone closely similar in lithology to the Mt. Carmel Sandstone. The sandstone is fine-grained and thinly bedded above, becoming thick-bedded to massive in the lower part and showing large-scale crossbedding. A basal conglomerate of siderite, shale, and coal clasts marks the erosive lower contact, which truncates the Raben Branch Coal.

4. Raben Branch Coal. Two thin coal seams are separated by shale 3 to 10 feet thick. The upper coal varies from a few inches to about 1 foot thick and may be bright-banded to dull and shaly. Laminated gray shale below the coal contains abundant fossil plants, mostly stems. The lower coal varies from a streak to a few inches thick, and rests on a well developed underclay.

5. Clastic interval. Beneath the Raben Branch is blocky, slickensided mudstone containing root traces and siderite and limestone nodules, grading downward to sandstone at the top of an upward-coarsening sequence. Some wireline logs indicate limestone at the top of this sequence. Cores in the adjacent Harco quadrangle reveal marine fossils in this limestone, which has not been described elsewhere in the Illinois Basin. The lower part of the succession grades from light and medium gray siltstone or silty shale in the upper part to dark gray, sideritic, silt-free shale in the lower part.

6. Macoupin Limestone and Hushpuckney Shale. This interval comprises (1) a very thin (inches), lenticular upper limestone considered to be the Macoupin, (2) the Hushpuckney Shale, 2 to 5 feet thick, and (3) a lower limestone less than 1 foot thick but more widespread than the upper limestone. The Hushpuckney stands out with its very high readings on gamma-ray logs. Cores and mine exposures in adjacent quadrangles show the Hushpuckey to be black, highly fissile, hard shale having phosphatic lenses and laminae. The upper and lower limestone beds are lime mudstone to wackestone containing diverse marine faunas.

7. Clastic interval. As shown by cores in adjacent areas, the upper part of the interval is a well-developed paleosol composed of blocky, slickensided claystone as thick as 10 feet, containing root traces, siderite nodules, and limestone nodules. Locally, a very thin coal layer or carbonaceous shale occurs near the top of the claystone. The underclay grades downward to siltstone or silty shale, which in turn grades downward to dark gray, silt-free, sideritic shale. Abundant well-preserved fossil foliage occurs in the lower part of the shale just above the Womac Coal.

8. Womac Coal and interval. The coal is bright banded to somewhat dull and shaly. Directly beneath is laminated, grayish-black carbonaceous shale that contains abundant, well-preserved fossil plants. The remainder of the unit coarsens upward, with light to medium gray siltstone in the upper part grading downward to dark gray shale.

9. Cramer Limestone to Chapel Coal. As shown by core drilling, the Cramer Limestone is less than one foot thick and is described as medium to dark gray, argillaceous, and fossiliferous. The limestone is seldom thick enough to register on wireline logs. The Mound City Shale, below the Cramer, is 1 to more than 3 feet thick and consists of black, laminated shale that produces high readings on gamma-ray logs. Argillaceous limestone a few inches thick locally occurs at the base of the Mound City. Separating the Mound City from the Chapel Coal is 8 to 23 feet of dark gray shale that is partly calcareous and contains unidentified fossils. The Chapel Coal is generally bright-banded and varies from less than 1 foot to nearly 3 feet thick.

10. Trivoli Sandstone and unnamed clastic interval. A well-developed paleosol composed of blocky, rooted claystone to siltstone underlies the Chapel Coal. This grades downward to the Trivoli Sandstone, which is an upward-fining unit 15 to 30 feet thick. The lower contact is erosive onto a second upward-fining sequence, the base of which commonly cuts out the Exline Limestone and locally the Athensville Coal. Where the Exline is present, the overlying strata consist of upward-coarsening shale and siltstone.

11. Exline Limestone and clastic interval. Cores show the Exline to be limestone that is medium to dark gray argillaceous wackestone, with brachiopods and echinoderm fragments. Between the Exline (or its horizon) and the Athensville Coal is an interval of gray, sideritic shale that becomes increasingly silty and sandy upward. Plant fossils have been observed near the base in cores.

12. Athensville Coal and clastic interval. The Athensville seldom exceeds one foot thick, but the coal (or its position) is readily identified on wireline logs as a sharp inflection between two upward-coarsening sequences. Below the coal is mottled gray to green claystone about 2 to 3 feet thick having roots, limestone nodules, and a network of fractures filed with siderite. The remaining strata coarsen upward, in transition from siltstone or very fine, shaly sandstone above to dark gray, silt-free shale below.

13. Attila Shale and Rock Branch Coal. The Attila is black, hard, highly fissile, phosphatic shale that is 2 to 5 feet thick and yields extremely high readings on gamma-ray logs. The type locality is in the Pittsburg quadrangle (Nelson, 2007). Normally the Attila rests directly on the Rock Branch Coal, but gray, silty, sideritic shale as thick as 6 feet separates black shale from coal in a few wells. Also, several well records, including cores, show two layers of black shale separated by several feet of gray, sideritic shale. The Rock Branch Coal varies from a few inches to about one foot thick and is bright-banded to dull and shaly.

14. Clastic interval. The Rock Branch overlies a remarkably well-developed paleosol that is thicker than 10 feet in several cored test holes. The claystone may be greenish gray or variegated and contains numerous limestone nodules. One core log reported kaolinite that may be flint clay. Two markedly different sequences underlie the paleosol. More widespread is an upward-coarsening sequence of siltstone and shale having thin dark gray to black shale that yields high gamma-ray readings near the base. The thin (less than 0.5 foot) DeGraff Coal is locally present near the base. Less commonly an upward-fining sandstone-dominated sequence fills valleys eroded into or through the Bankston Fork Limestone. The Gimlet Sandstone, which fills these channels, is very fine to medium-grained, laminated to crossbedded, and exhibits basal conglomerate of shale, coal, and limestone pebbles.

15. Piasa Limestone. In cores, the limestone is described as being light gray to yellowish gray, micritic, slightly fossiliferous (mainly crinoid fragments), and nodular to massive.

16. Clastic interval and Danville Coal. At the top of the interval is shale that is mottled in dark gray to black and greenish gray, weakly to highly fissile, and yields very high readings on gamma-ray logs. The remainder is medium to dark gray, silt-free, sideritic shale that has pectenoid bivalves near the base. The Danville is bright banded, pyritic coal 1.0 to 2.2 feet thick.

17. Clastic interval and Baker Coal. The interval contains variable gray, greenish gray, and olive-gray non-fissile mudstone, fissile shale, siltstone, and argillaceous sandstone. One or two thin coal layers, correlative with the Baker coal bed of western Kentucky, commonly are present in the lower part of the unit. Thickness ranges from a streak to about 1 foot, the lower coal being the thicker of the two, and both resting on rooted underclay.

18. Bankston Fork Limestone. The limestone is generally light gray, dense and micritic, and sparsely fossiliferous (crinoids). The lower part tends to be argillaceous and nodular. The Bankston Fork is absent in a number of boreholes, apparently as a result of non-deposition.

19. Anvil Rock Sandstone. Varying proportions of gray shale, siltstone, and sandstone make up this interval. Sandstone bodies are lenticular, and may either fine upward or coarsen upward. Non-fissile claystone commonly occurs at the top. A few drillers' logs and cores indicate shaly coal, up to about one foot thick, in the upper part of the unit. This apparently intergrades with grayish-black shale that exhibits moderately high readings on gamma-ray logs. The lower contact may be gradational or slightly erosive, scoured into the Brereton Limestone.

20. Conant Limestone, Jamestown Coal, and Brereton Limestone. Less than one foot thick, the Conant is dark gray, argillaceous limestone to calcareous shale that contains brachiopods and crinoid fragments. The Jamestown Coal is only a few inches thick, and overlies dark gray to black, fossiliferous, calcareous shale that varies from a few inches to several feet thick. Ranging from about 3 to 8 feet thick, the Brereton is medium to dark gray, argillaceous lime mudstone to wackestone with brachiopods, crinoid fragments, and fusulinids. Bedding is wavy, marked by dark gray shaly laminae. Base of the Brereton is base of the Carbondale Formation, according to Tri-State Committee (2001).

21. Anna Shale, Energy Shale, and Herrin Coal. The Anna is black, highly fissile, phosphatic shale 0 to 4 feet thick, producing very high inflections on gamma-ray logs. Medium gray, weakly fissile, slightly silty shale of the Energy Member occurs as isolated lenses up to 6 feet thick. The Herrin Coal is consistently 5 to 7 feet thick and is bright-banded with several persistent layers of hard pyritic claystone. Large masses of calcareous coal balls have been encountered underground in the New Era Mine in the northern part of the quadrangle.

22. Clastic interval and Briar Hill Coal. The Herrin underclay is commonly 3 to 5 feet thick, reaching 12 feet. Nodular masses of micritic limestone commonly occur in the lower part, grading downward to gray siltstone and silty shale. A few inches to a little over 2 feet thick, the Briar Hill Coal is commonly shaly and rests on weakly developed underclay.

23. Canton Shale, St. David Limestone and Turner Mine Shale. The Canton Shale consists of gray, laminated siltstone and silty shale. The St. David is limestone that is medium to dark gray, argillaceous lime mudstone to wackestone with marine fossils. The Turner Mine is black, fissile shale that exhibits high gamma-ray log readings. These units are absent in most of the map area. Logs near the northeast corner indicate the Turner Mine and St. David occurring within 10 feet of the top of the Springfield Coal. A few logs and core descriptions in the southern part of the quadrangle show the limestone and/or the black shale overlying 30 or more feet of Dykersburg Shale. Where Turner Mine and St. David are absent, the Canton and Dykersburg Shales cannot be differentiated.

24. Dykersburg Shale. Medium-light to medium-dark gray silty shale, siltstone, and very fine to fine-grained sandstone make up this unit. Although sandstone is more common in the upper Dykersburg, there is no consistent grain-size pattern. Planar, wavy, ripple, and contorted lamination appear in cores and in underground mines. Tidal rhythmites with neap-spring cyclicity are strongly developed. Well-preserved fossil foliage is common near the base, and upright tree stumps are rooted in the top of the coal. Contact to the Springfield Coal can be (1) sharp and planar, (2) interfingering, or (3) gradational through 10 feet or more of highly carbonaceous shale with coal laminae. The latter condition is confined to margins of the Galatia channel along the southern part of the east border of the map area.

25. Springfield Coal. In general, the coal is bright banded and has low (less than 2% and commonly less than 1%) sulfur content. The coal is absent in a contemporaneous paleochannel, the Galatia channel, as shown on the map. Approaching the channel margin, a multitude of dark gray to black shale partings and laminae appear in the coal, in transition to clastic sediments of the channel proper. Locally, large-scale "splitting" takes place with the seam divided into two or more "benches" separated by clastic strata as thick as 20 feet.

26. Clastic interval. Away from the Galatia channel, this interval is an upward-fining sequence of shale, siltstone, and minor sandstone, capped by rooted underclay of the Springfield Coal. Near the channel, an upward-fining sequence of dominantly sandstone fills a deeply incised valley that truncates strata as old as the Survant Coal. This channel apparently was a direct precursor to the Galatia channel, which persisted during the time of Springfield peat formation.

27. Hanover Limestone, Excello Shale, and Houchin Creek Coal. Absent or too thin to identify in most logs, the Hanover is less than 2 feet thick and composed of dark gray argillaceous lime mudstone to wackestone that is burrowed and contains brachiopods and other bioclasts. The Excello Shale, 3 to 6 feet thick, is black, hard, highly fissile, phosphatic shale having large septarian limestone concretions. Gamma-ray log readings are very high, as with other black shales. The Houchin Creek is bright-banded, pyritic coal that ranges from zero to about 2 feet thick.

28. Houchin Creek to Survant interval. This interval consistently coarsens upward and is capped by well-developed paleosol (underclay), which contains root casts, limestone nodules, and a network of fractures filled with siderite. The remainder grades from very fine to fine-grained, argillaceous sandstone at the top through siltstone and silty shale to dark gray silt-free sideritic shale. Sandstone and siltstone exhibit planar and flaser lamination, burrows, and plant fragments. Shale near the base contains "pyrite trails" but no fossils are recorded in core descriptions.

29. Survant Coal. The Survant Coal in this quadrangle comprises two coal seams that represent separate cycles of sedimentation. The upper coal is more widely continuous and ranges from 1 to 2.5 feet thick. It is bright- to dull-banded and shaly, and slightly pyritic. Underclay is absent or thin, commonly just a zone of rooting in laminated siltstone or silty shale. The clastic interval between the two coal beds is 8 to 15 feet thick and typically coarsens upward. The lower coal 0 to about 1½ feet thick and is discontinuous.

30. Clastic interval. This interval is either a single upward-coarsening sequence or two such sequences of roughly equal thickness. The upper sequence includes thin underclay, upper siltstone or silty shale, and lower dark gray silt-free, sideritic, pyritic shale. The lower sequence contains much sandstone, and in some wells is almost entirely sandstone. Limestone as thick as 4 feet caps the lower sequence in a number of boreholes. Where sandstone is less prevalent, the lower part of the interval, approaching the Mecca Quarry Shale, grades to dark gray, sideritic clay-shale that contains brachiopods and bivalves along with thin lenses of micritic limestone.

31. Mecca Quarry Shale and Colchester Coal. The black, hard, highly fissile, phosphatic Mecca Quarry Shale is generally 3 to 5 feet thick and like other such units, yields very high readings on gamma-ray logs. The Colchester Coal is absent or too thin to register on most logs. Where recorded, it is bright-banded with a few dull laminae, calcite cleat-facings, and pyrite lenses.

32. Colchester to Dekoven interval. The Colchester rests on well-developed underclay of blocky, slickensided claystone that contains limestone nodules and locally, layers of dense micritic limestone. The remainder of the interval is shale, siltstone and sandstone that either coarsens upward, or includes sandstone bodies that fine upward from erosive lower contacts.

33. Dekoven Coal. Throughout the Galatia quadrangle, the Dekoven comprises two distinct seams of coal separated by an interval of clastic strata. The upper coal is 1 to 3 feet thick, bright-banded, and slightly pyritic. Its underclay is thin or absent. The clastic interval ranges from 10 to 30 feet thick, increasing northward, and typically coarsens upward. The lower Dekoven "bench" is 1.5 to 3 feet thick and rests on thicker, better developed underclay than the upper "bench".

34. Interval and Davis Coal. Separating the lower Dekoven from the Davis Coal is an interval 5 to 10 feet thick, the upper part of which is gray claystone or weakly bedded shale. The lower part is grayish-black shale that is hard, fissile, pyritic, and 2 to 3 feet thick. Gamma-ray log readings are nearly as high as for the Mecca Quarry and Excello Shales. The Davis Coal is bright-banded, slightly pyritic coal 2 to 4 feet thick.

35. Interval. The underclay of the Davis Coal is gray claystone to siltstone containing abundant root casts and scattered small carbonate nodules. The underclay grades downward to gray, laminated silty shale and siltstone. In places, sandstone fills channels below the Davis, truncating units as old as the Wise Ridge Coal.

36. Carrier Mills Shale. The shale is black, hard, fissile, and pyritic, yielding very high readings on gamma-ray logs. Bright-banded coal a few inches thick occurs directly beneath the black shale in a few boreholes.

37. Interval. The interval is mostly gray, laminated silty shale and siltstone, which may be interlaminated with sandstone. These strata may coarsen upward, or maintain fairly uniform texture top to bottom.

38. Stonefort Limestone, black shale, and Wise Ridge Coal. The limestone is present in only a few boreholes, where it is less than 2 feet thick. No core records are available. Several gamma-ray logs indicate "hot" shale that is probably black and fissile, ranging up to about 4 feet thick. The Wise Ridge Coal ranges from a streak to about 2 feet thick and is more persistent than either the limestone or shale.

39. Interval. In the northern part of the quadrangle, a valley-fill succession as thick as 120 feet occurs below the Wise Ridge Coal. The upper 30 to 40 feet of this succession is shale and siltstone, whereas the remainder is permeable sandstone of uniform grain size (as inferred from gamma-ray logs). In the southern part of the map area, the interval between the Wise Ridge and Mt. Rorah Coal comprises shale, siltstone, and sandstone 15 to 25 feet thick.

40. Mt Rorah to Murphysboro Coal. Coal believed to be the Mt. Rorah is less than 2 feet thick and commonly missing through either erosion or non-deposition. Ten to 20 feet deeper, several logs indicate limestone 2 to 3 feet thick overlying a similar thickness of shale that produces very high gamma-ray readings. Coal believed to be the Murphysboro may directly underlie the "hot" shale or occur as much as 20 feet lower, ranging up to 6 feet thick.

41. Older Tradewater strata. Two unidentified coal seams that reach 4 feet thick occur approximately 180 to 210 feet below the Carrier Mills Shale. Tracing these beds from one log to the next is difficult even across short distances. A major sandstone body, the Granger Sandstone fills valleys that commonly cut out older coal layers.