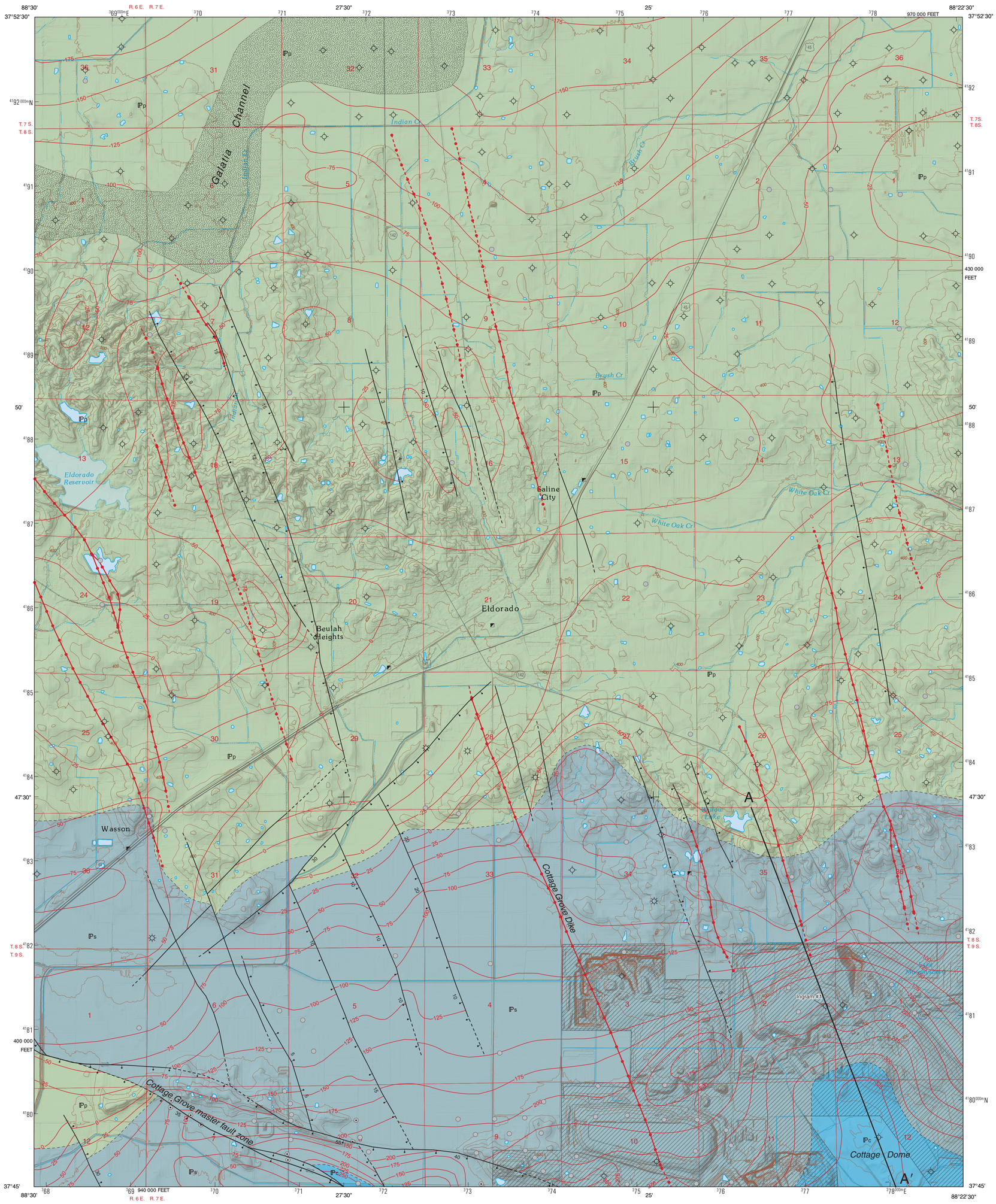
Bedrock Geology of Eldorado Quadrangle
Saline County, Illinois

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

STATEMAP Eldorado-BG

W. John Nelson and F. Brett Denny
2016



EXPLANATION

- dg — Disturbed ground
- Pennsylvanian
  - Missourian
    - IPp — Patoka Formation
  - Desmoinesian
    - IPs — Shelburn Formation
    - IPc — Carbondale Formation

Symbols

- Coal boring
- Oil and gas test hole
- Coal mine methane hole
- Shaft mine

Line Symbols
dashed where inferred, dotted where concealed

- Igneous dike, dotted where interpreted from geophysical data
- Contact
- Fault, from coal mine data, direction of throw unknown
- Normal fault: bar and ball on downthrown side. Number indicates throw in feet
- 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

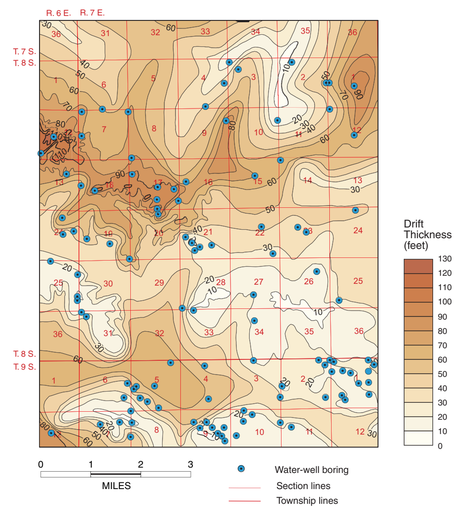


Figure M1 Thickness of Quaternary sediments in Eldorado Quadrangle

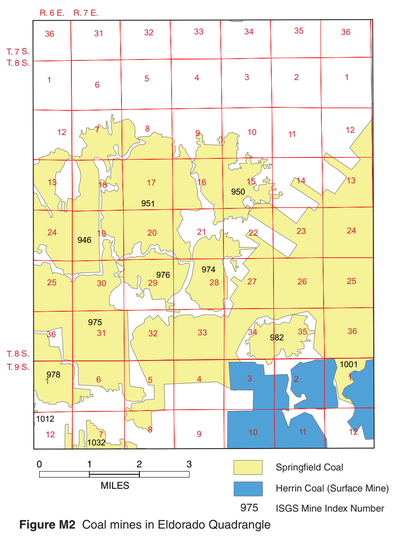


Figure M2 Coal mines in Eldorado Quadrangle

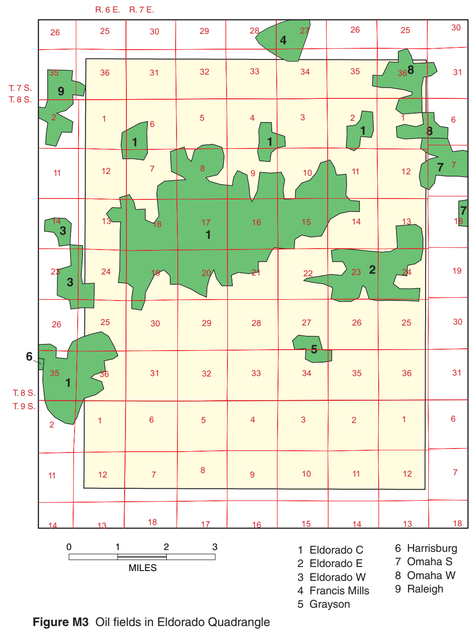


Figure M3 Oil fields in Eldorado Quadrangle

Base map compiled by Illinois State Geological Survey from digital data (2015 US Topo) provided by the United States Geological Survey. Shaded relief derived from 2011 LiDAR elevation data.

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

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SCALE 1:24,000
1 — 1/2 — 0 — 1 MILE
1000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — 6000 — 7000 FEET
1 — .5 — 0 — 1 KILOMETER

BASE MAP CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1988

Geology based on field work by W. John Nelson and F. Brett Denny, 2015–2016.

Digital cartography by Timothy A. Kropp and Jennifer E. Carrell, 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.

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1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Walpole
8 Equality
2 Broughton
3 Norris City
4 Galatia
5 Ridgway
6 Harrisburg
7 Rudement

2½° TRUE NORTH MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2016

ROAD CLASSIFICATION
U.S. Route
State Route
Local road

Geologic Structure

Geologic structure in the Eldorado Quadrangle is depicted by elevation contours on the top of the Springfield Coal. Contours are based on data from test holes for coal and petroleum, supplemented by survey data from underground coal mines in the southern part of the quadrangle. Faults and igneous dikes are plotted where they intersect the Springfield Coal, based largely on data from the mines, including observations made by the authors and other ISGS geologists.

The map area lies along the southern flank of the Illinois Basin. Regional dip is northward, toward the center of the basin. A nearly level terrace in the central part of the quadrangle separates gentle northward dips in the northern part from relatively steeper north-northwest dips in the southern part of the area.

Cottage Grove Fault System

Faults within the Eldorado Quadrangle belong to the Cottage Grove fault system, a broad zone of fractures that extends from Gallatin to Jackson County, Illinois, a distance of approximately 70 miles. The “master fault zone”, which crosses the southwestern corner of the quadrangle and trends west-northwest, contains the largest displacements. Nearly 2,000 feet wide in places, the master fault zone is composed of high-angle normal and reverse faults having overall displacement down to the south. As observed in mines immediately south of the map area, fault surfaces dip nearly vertical and bear horizontal slickensides and mullion.

North of the master fault is an array of subsidiary faults that strike N 10° W to N 30° W, the trend becoming more northerly toward the east. As exposed in underground and surface coal mines, faults dip 60° or steeper and the large majority are normal faults having throws that range from less than an inch to about 30 feet. Most faults exhibit little or no drag and contain zones of gouge and breccia along with calcite veins. Striations on fault surfaces plunge vertically, or nearly so in most cases. However, examples of reverse faults and “scissors faults” are present. A fault in the NE¼ of Sec. 32, T8S, R7E is an example of scissoring; the downthrown side changes from northeast to southwest. Also, a fault in the Cottage Grove surface mine displayed normal displacement (east side down) below the Danville Coal and reverse displacement (east side up) above the Danville. Interrupting the prevalent NNW fault trend is a set of faults that strike northeast, with throw mainly down to the southeast. Details on the style of faulting are not available.

Igneous Intrusions

Numerous igneous dikes accompany NNW-striking faults in the Eldorado Quadrangle, as in the Galatia and Harco quadrangles to the west (Nelson and Denny, 2015a and b). As encountered in coal mines, dikes are vertically or nearly so and range up to about 60 feet wide. They are composed mainly of pyroxene, olivine, and brown mica and have been classified as mica peridotite (Clegg and Bradbury, 1956). The igneous rocks have also been classified as ultramafic lamprophyre, aillikite (Maria, et al., 2012) and alnöite (Sparlin and Lewis, 1994). They typically are dark-green to light-gray with an inequigranular porphyritic texture. The rocks are fine grained where highly altered to porphyritic with ¼-inch phenocrysts. In most places rocks have been extensively altered, making classification difficult. The rocks have a green tint that probably results from alteration of primary minerals to serpentine and chlorite. Replacement by calcite is extensive and the rocks usually effervesce when dilute hydrochloric acid is applied. Geochemical and petrographic investigations indicate the presence of serpentine (altered from olivine), apatite, phlogopite, titanite, chromite, magnetite, chlorite, perovskite, garnet, and calcite (Denny 2005). Country rock adjacent to the dikes and sills have undergone contact metamorphism, coal being heavily mineralized and converted to natural coke (Clegg, 1955). Some other igneous dikes of this area appear to be autolithic breccia made of angular clasts of country rocks with very fine grained igneous material between the clasts.

Igneous rock from a drill core near the southern edge of the Eldorado Quadrangle yielded a potassium-argon date of 261± 9 Ma. Ages of 262 ± 9 Ma. and 246 ± 9 Ma. were reported from two other peridotite samples farther west within the Cottage Grove fault system (Nelson and Lumm, 1984, p. 79). The work of Goldhaber et al. (1997) reported age dates of 272.1 ± 0.7 Ma. and 272.7 ± 0.7 Ma. on the Downey’s Bluff Sill in Hardin County. Using more recent radiometric age determinations, Denny (2005) reported ^{40}Ar/^{39}Ar isochron age date of 269.61 +/- 0.39 Ma. for the Cottage Grove Dike. The Cottage Grove Dike was emplaced at the beginning of the Guadalupian Series (Gradstein et al. 2012). The recent modern analyses indicate the ultramafic rocks probably were emplaced in the region from 269 to 273 Ma. which would be at the very end of the Cisuralian and the beginning of the Guadalupian Series.

Because ultramafic rocks are rich in magnetic minerals, magnetic surveys are an excellent method to locate intrusions in the subsurface. A detailed magnetic map by Hildenbrand and Ravat (1997) covers part of the Eldorado Quadrangle. Narrow linear bands of high magnetic intensity coincide with known dikes that were encountered in coal mines. Several dikes that extend into unmined areas have been plotted on the map on the basis of the magnetic survey. Also, Hildenbrand and Ravat identified the “Cottage magnetic anomaly” as a circular area of high magnetic intensity in the southeast corner of the Eldorado Quadrangle. The anomaly coincides with the circular Cottage dome, which has been mapped by structure contours on the Springfield Coal. The same coincidence between structure and a magnetic high is shown northeast of the Eldorado Quadrangle in the Omaha dome, where deep drilling encountered a series of igneous sills in Mississippian rocks (Bristol, 1975; Stevenson et al., 1981). For this project 2 miles of additional magnetic surveys were acquired. On this basis, we confidently predict that igneous intrusions underlie the Cottage dome.

In Willow Lake underground mine, a dike was encountered as wide as 25 feet in the Springfield Coal but does not penetrate the underclay. In shale overlying the coal, the dike narrowed and followed a series of short fractures in a relay or en echelon pattern. These observations suggest that magma was highly fluid and capable of moving laterally through the coal.

A sill replacing the Herrin Coal was encountered in a surface mine (in 1986), in NW¼ NE¼, Sec. 10, T9S, R7E. The sill lay within a horst outlined by two high-angle normal faults trending N 20° W and having the center block upthrown 15 feet. Drilling showed the intrusion to be about 30 feet thick, with Anna Shale above and Herrin underclay below. Thus, the magma apparently assimilated the coal (normal 4 to 5 feet thick) and filled its space to a height of 30 feet, raising overburden in the manner of a hydraulic jack. Faults clearly served as pathways for magma. However, little or no vertical offset was observed in the mines.

Economic Geology

Coal

Coal mining was an important industry in Saline County throughout the 20th century, and several mines continue active as of 2016. Mining has taken place chiefly in the Springfield (No. 5) Coal, and to a lesser extent in the Herrin (No. 6) Coal. The Springfield seam has been largely mined out in the southern 2/3 of the Eldorado Quadrangle. Deep reserves remain in the northeastern part of the map area. In the northwestern corner of the quadrangle, the Springfield Coal is absent within the Galatia channel, a paleochannel that is shown on the geologic map. Adjacent to the channel, the coal contains multiple layers of shale and claystone that may render mining uneconomic.

The Herrin Coal has been extracted only in the southeast quarter of the Eldorado Quadrangle, both by surface mining and in the active Wildcat Hills underground mine. Elsewhere in the map area, the Herrin ranges from 4.5 to 6.5 feet thick, which is ample for deep mining. Potential subsidence of older underground works in the Springfield Coal, below the Herrin, is probably the main deterrent to mining the latter. Faults and igneous dikes represent obstacles, but the locations of many are accurately known through encounters while mining the Springfield. Magnetic surveys are the best tool for locating igneous intrusions in unmined areas.

Deeper coal resources have been mapped in the Dekoven and Davis Coal Members. The Dekoven is 2½ to 3½ feet thick in most of the Eldorado Quadrangle, locally reaching 4 feet, whereas the older Davis Coal is 3½ to 4½ feet thick, locally exceeding 5 feet (Jacobson, 1993).

Methane from Coal

At least five boreholes have been drilled to extract methane from abandoned underground coal mines in the south-central part of the Quadrangle. These holes tapped three different mines: Wasson No. 1 and O’Gara Nos. 8 and 11. Initial production of 950,000 cubic feet of gas per day was reported from one hole. This compares to methane emission ranging from 0.1 to 2.4 million cubic feet per day from 19 Illinois mines, as reported by the U.S. Bureau of Mines (Irani et al., 1972). It is likely that the numerous faults and associated fractures enhance the output of gas from coal mines in the Eldorado Quadrangle.

To date the only commercial extraction of methane from virgin coal in Illinois took place in the Delta project of western Saline County (Nelson and Denny, 2015b). Undertaken in 2004, the Delta project has been suspended because of depressed gas prices and the current boom in producing natural gas from deep shale deposits elsewhere in the United States.

Oil and Gas

Five oil fields have been developed within the map area. By far the largest among these is the Eldorado Consolidated field, which extends in a northeasterly direction across the north-central part of the Quadrangle (see inset map, Plate 1). Discovered in 1941, the field has yielded nearly 15 million barrels of oil through the end of 2015. A total of 335 wells have been completed, of which 69 are still producing. Eldorado Consolidated comprises a series of pools and reservoirs that are disconnected geologically but close together geographically. The bulk of production comes from a sandstone body in the Upper Mississippian Waltersburg Formation. Less than a mile wide, the sand body extends southwest from Section 2 to Section 20, T8S, R7E, through the city of Eldorado. Hawn (1968, p. 98) wrote, “Waltersburg Sandstone has a maximum thickness of 80 feet with an average of over 30 feet. It is a relatively clean, well-sorted, fine quartz sand with moderately angular to moderately rounded grains.” Although structural closure is present, the primary trap is stratigraphic in sandstone (average porosity 17.27%, average permeability 235 md) encased in impermeable shale.

Potter (1962, 1963) investigated and mapped the Waltersburg Formation on outcrop and in subsurface of southern Illinois. His 1963 publication included maps and cross sections of the Eldorado Consolidated oil field. Potter mapped the Waltersburg forming a series of southwest-trending, elongate, arcuate to slightly sinuous sand bodies. Potter (1962, p. 80) suggested that these represent “pro-delta marine deposits”, while Potter (1963) revised his opinion partly in light of data from Eldorado Consolidated. “Although origin as a beach deposit seems remote, it is difficult to distinguish definitely between either a fluvial or an off-shore marine bar origin (Potter, 1963, p. 15). Mapping the outcrop of a large Waltersburg sand body south of the Eldorado Quadrangle, Nelson (1993) observed large-scale planar and trough crossbedding with foreset beds consistently dipping west, southwest, and south. These observations agree with Potter (1962). Nelson further noted that the thick crossbedded sandstone graded laterally to much thinner, laminated sandstone having impure coal and well preserved fossil land plants near the top. These features rule out offshore sedimentation. In view of these findings, the Waltersburg reservoir at Eldorado Consolidated is probably of fluvial origin. It may represent a deltaic distributary channel of the fill of a valley that was incised during eustatic lowstand.

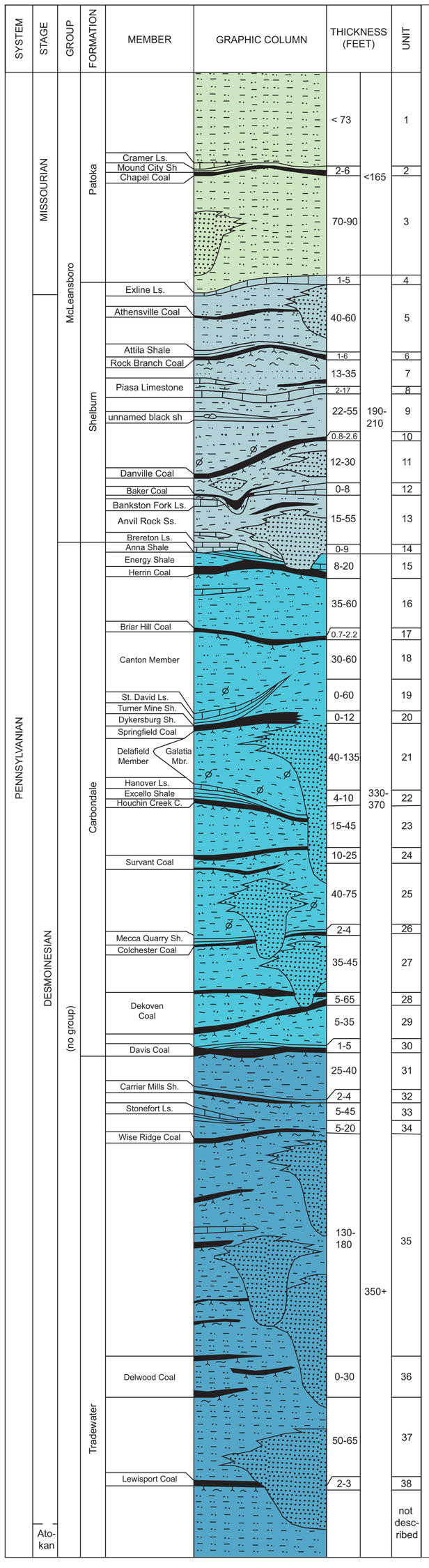
Production in the northwestern part of the Eldorado Consolidated field is achieved from several different Upper Mississippian sandstone and limestone formations. The Aux Vases is most prolific, followed by Palestine, Tar Springs, Hardinsburg, Cypress, Ste. Genevieve Limestone, and several others. Trapping is a combination of stratigraphic and structural factors and has not been analyzed systematically in print. Returning to the primary Waltersburg reservoir, Hawn (1968) reported evidence that the northwest-striking faults and igneous dikes act as barriers to fluid migration. This became apparent when water flooding was introduced in 1962.

The Eldorado East field was discovered in 1953 and comprises 49 wells, of which 17 were still pumping in 2015. Cumulative production is 590,400 barrels. Most production is achieved from sandstone reservoirs in the Upper Mississippian Cypress and Aux Vases Formations. The small Grayson field, discovered in 1957, contains 8 wells, of which 3 are still operating. Cumulative production is 62,000 barrels. Tar Springs, Cypress, Aux Vases, and Ste. Genevieve production is reported. The contiguous Omaha South and Omaha West fields lie partly within the northeast corner of the Eldorado Quadrangle. Together, they contain 58 wells, 41 still active, and report cumulative output of 1,262,700 barrels. These fields are working combined stratigraphic and structural traps chiefly in Cypress and Aux Vases Formations, with lesser production from Tar Springs, Sample, and Ste. Genevieve Formations (all Mississippian), and a little production from Pennsylvanian sandstone (Huff, 1988).

Acknowledgements

We thank Mike Shetley of Peabody Energy Company for supplying a structure map on the Springfield Coal, and Bryan Huff of the ISGS for current oil-field statistics. Tim Larson of the ISGS digitally superimposed the Eldorado Quadrangle map onto the magnetic map of Hildenbrand and Ravat (1997), enabling igneous dikes inferred from magnetic data to be mapped accurately. Tim Larson also conducted new magnetic surveys to help accurately locate the igneous dikes.

The research was funded in part by the U.S. Geological Survey (USGS) National Cooperative Geologic Mapping Program under USGS-STATEMAP award number G15AC00505. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government. Digital cartography was completed by Jennifer Carrell and Tim Kropp.



Quaternary deposits – Loess overlies bedrock to the south, in Cottage Grove hills as seen in the surface mine. Peoria Silt light brown, about 3 feet thick; Roxana Silt is slightly darker brown with reddish cast, clay-rich, 5 feet thick; Loveland Silt with Sangamon soil, orange and gray mottled, harder and blockier than above, 5 feet. Till is patchy at southern edge of quadrangle near Cottage Grove, composed of up to 10 feet clay with cobbles and boulders of Pennsylvanian rocks. Water well logs indicate that unconsolidated material of clay, gravel, and sand is over 100 feet thick in the northwestern part of the quadrangle (see drift thickness map). The Equality Formation is also present in the southern portion of the quadrangle. The Equality is dominantly gray silty clay with occasional sandy lenses. These Quaternary units are not depicted on the geologic map.

1. Clastic interval – This unit is less than 73 feet thick and is composed of shale and siltstone, generally coarsens upward; medium to dark gray, darker and finer downward, planar and wavy lamination, gutter-stacked burrows, calcareous interval 10-17 feet above base contains gastropods and pelecypods

2. Cramer Limestone, Mound City Shale, and Chapel Coal – The Cramer Limestone is 0.5 foot or thinner and does not register on most electric logs. The limestone is medium to dark gray, argillaceous, and fossiliferous. The Mound City Shale is 2 to 5 feet thick and dark gray to black. This unit is partly highly fissile, low-density black shale and partly dark gray shale that is less fissile and contains crinoids and brachiopods. The persistent Chapel Coal is 0.4 to 1.5 feet thick. The Chapel Hill Coal is a bright-banded coal that has laminae of shale and fusain.

3. Clastic interval – This unit ranges in thickness from 70 to 90 feet and is composed of shale, siltstone, and sandstone. A carbonaceous shale with plant fossils and thin coal occurs 20-30 feet below the Chapel Coal in some boreholes, which separates two upward-coarsening cycles. In other places the lower part of interval is upward-fining from an erosive lower contact.

4. Exline Limestone – The Exline Limestone is 1 to 5 feet and thickens eastward. The Exline is composed of medium to dark gray and brownish gray lime mudstone to wackestone with brachiopods and crinoids. It is commonly shaly with a sharp contact with underlying units.

5. Clastic interval – This unit ranges in thickness from 40 to 60 feet and varies from nearly all sandstone (with an erosive lower contact) to shale and siltstone that coarsens upward. Some logs indicate two or three upward-coarsening sequences. The thin Athensville Coal is commonly present 10 to 25 feet below the Exline and rests on rooted underclay. The Athensville is patchy and not laterally continuous across the quadrangle.

6. Attila Shale and Rock Branch Coal – The Attila Shale is dark gray to black shale 0.5 to 5.5 feet thick. Much of it is hard, fissile and low-density, but portions are dark gray, calcareous and fossiliferous shale, especially near the top of the unit. Medium gray, less fissile shale containing pectenoid bivalves was noted near base. The Rock Branch Coal is a laterally persistent, 0.5 to 1.4 feet thick, bright-banded coal having fusain and pyrite laminae.

7. Clastic interval – This diverse unit is 13 to 35 feet thick. It is typically composed of a thick underclay, as thick as 11 feet, greenish and olive-gray claystone, partly calcareous, with limestone nodules in lower part. One core showed shale with coal stringers in the same stratigraphic position as the underclay. The remainder of the interval is shale, siltstone, and minor sandstone, generally coarsening upward. Some logs indicate multicolored shale or claystone in the lower part of the interval. Surface mine exposures in the southern part of the map area and a few drilling logs elsewhere reveal the DeGraff Coal. This coal is normally a few inches thick but reaches 1 foot thick, and is separated from the Piasa Limestone by dark olive-gray, slickensided underclay about 2 to 3.5 feet thick.

8. Piasa Limestone – The Piasa Limestone is absent to 17 feet and commonly 2 to 6 feet. The unit consists of one to three beds of limestone separated by calcareous shale and siltstone. The limestone is greenish to olive-gray, sublithographic, and massive to nodular. The lowest limestone bed appears to be most persistent and is the only bed present in the southern part of the quadrangle. This bed is medium to light gray, dolomitic lime mudstone to wackestone that contains crinoid columnals and productid brachiopods. The unit is thick bedded to nodular and somewhat argillaceous.

9. Clastic interval – This unit is 22 to 55 feet thick. A black, fissile, low-density shale up to about 6 feet thick commonly occurs in the upper part of the interval. The black shale contains large, ovoid to spheroidal concretions of dolomite. The remainder of interval is shale and siltstone, generally coarsening upward. Medium gray siltstone in the upper part grades downward to dark gray shale that contains siltstone laminae. Siderite bands 0.1 to 0.3 foot thick are widely continuous and spaced about one foot apart. Pectenoid pelecypods, small gastropods, the brachiopods *Lingula* and *Mesolobus*, and fossil plants occur in the lower part. A band of pyritized shell debris commonly occurs at the base.

10. Danville Coal – The Danville Coal is a bright-banded coal 0.8 to 2.6 feet thick, having discontinuous fusain and shale laminae.

11. Clastic interval – This unit is a 12 to 30 feet, rooted, slickensided underclay below the Danville Coal. It ranges in thickness from 3 to 10 feet. The remainder of section consists variably of mudstone, siltstone, and sandstone, with no consistent profile. The lenticular “sub-Bankston coal”, which locally exceeds 2 feet thick, occurs in the upper part of the interval. The coal is commonly dull and shaly, and may represent transported plant material. Abundant fossil plants, including tree stumps in growth position, occur in the roof of the Baker Coal. One or two thin but laterally widespread coal layers occur a short distance above the Baker in the southern part of the quadrangle. The Baker Coal generally is a few inches thick, and is locally present. In the Cottage Grove surface mine in the southern part of the map area, the Baker locally thickened to 4 feet where it fills channels eroded into the Bankston Fork Limestone. Between the Baker and Bankston Fork a grayish-green underclay with limestone nodules is normally present.

12. Bankston Fork Limestone – The Bankston Fork Limestone is 0 to 8 feet thick. The limestone is light to medium gray, weathering brownish orange. The rock is largely microgranular and dolomitic, containing scattered brachiopods and other fossils. Bedding can be thick to nodular. In places, calcareous shale or mudstone divides the limestone into two benches. The lower contact is sharp and undulating.

13. Clastic interval – This unit is 15 to 55 feet thick. More commonly, an upward-coarsening interval of sandstone, siltstone, and shale is present. Less commonly, upward-fining interval of Anvil Rock Sandstone with erosive base; may cut into Herrin Coal. As many as three erosion surfaces have been observed in mine exposures. Sandstone is light gray, fine-grained, thin- to thick-bedded, crossbedded in lower part. Rhythmic lamination with laminated tidal bundles was observed in mine highwalls in the upper part of an upward-fining sequence. Underlying shale medium-dark gray, upper part has planar, ripple, and cross-lamination, rhythmic siltstone laminae, lower part silt-free with siderite nodules. The informally named sub-bankston coal occurs sporadically near the top of the interval and reaches about 2 feet thick. Conant Limestone, locally present, is dark gray, argillaceous limestone to calcareous shale less than 1 foot thick. Productid brachiopods and echinoderm fragments are plentiful. The Jamestown Member, below the Conant Limestone, is a 1 to 2 feet of dark gray, calcareous, carbonaceous shale.

14. Brereton Limestone – The Brereton Limestone is 0 to 9 feet thick, medium-dark gray, lime mudstone to wackestone with crinoids, brachiopods, and fusulinids; argillaceous with wavy shale laminae. As observed in coal mines, the Brereton is lenticular. Limestone distribution shows no observable pattern, and absence is likely due to non-deposition rather than erosion.

15. Anna Shale, Energy Shale, and Herrin Coal – The Anna Shale is 0 to 4 feet thick and consists of black, hard, highly fissile shale that contains large ovoid limestone or dolomite concretions and exhibits large, planar joints that consistently strike ENE. The Energy Shale occurs as isolated lenses up to about 10 feet thick. The Energy Shale is medium-dark gray, carbonaceous, weakly fissile, slightly silty, pyritic, with plant fragments. The Herrin Coal is 4.5 to 6.5 feet thick and consists of bright-banded coal having many fusain laminae and several claystone laminae, the most prominent of which is the “blue band” 0.1 to 0.25 foot thick at 1.0 to 1.8 feet above base. A thinner band of dark gray, pyritic shale commonly occurs 0.5 to 0.9 feet below top of coal. Pyrite lenses and cleat facings are plentiful.

16. Clastic interval – This unit is 35 to 60 feet thick and is composed of underclay 3 to 5 feet thick and rooted, grading to siltstone. The remainder of the unit is composed of sandstone, siltstone, and shale in upward-coarsening cycles. The lower part may be a dark gray silty to silt-free shale with siderite nodules, siltstone laminae with ripple lamination, and horizontal burrows. Calcareous shale with brachiopods was noted 24 feet above base in one core. The Percy Limestone is locally present about 10 feet below the Herrin Coal. Drillers logs indicate that limestone reaches 4.5 feet thick but they provide few lithologic details or descriptions.

17. Briar Hill Coal – This coal is 0.7 to 2.2 feet thick and is composed of a bright banded coal with a thin shale layer near top. In a surface mine just south of the map area, the Briar Hill contained a “split” of siltstone or silty mudstone as thick as 2.5 feet. Large fossil logs and stems were abundant in the split, suggesting an ancient log jam. Underclay is weakly developed and the floor under the coal is generally laminated shale or siltstone having root traces.

18. Canton Member, St. David Limestone, and Turner Mine Shale – The Canton is a clastic unit 25 to 55 feet thick that generally coarsens upward from shale in the lower part to siltstone or sandstone in the upper part. Gutter-stacked burrows, slumped lamination, and siderite nodules are recorded in core descriptions along with upward-fining sandstone with erosive base. Distinguishing the Canton from Dykersburg Member is difficult where St. David Limestone and Turner Mine Shale are absent. The combined thickness of Canton and Dykersburg reaches 115 feet near the Galatia channel. The St. David Limestone is 0 to 2 feet thick and consists of medium-dark gray wackestone with the brachiopods *Chonetes* and *Mesolobus*. The limestone grades laterally to fossiliferous shale. The Turner Mine Shale is 0 to 7 feet thick, is a black shale that is hard, highly fissile, and contains large spheroidal limestone or dolomite concretions. The shale is commonly burrowed near upper contact. Large parallel joints seen in underground mines consistently strike ENE. The St. David Limestone and the Turner Mine Shale are absent where the Dykersburg Shale is thicker than about 20 feet, and within the Galatia channel.

19. Dykersburg Shale – The Dykersburg Shale is 0 to at least 60 feet thick. It is composed of gray shale with siltstone and sandstone laminae. Pectenoid pelecypods and abundant fossil plants occur near base. Away from the Galatia channel, the Dykersburg is reduced to isolated pods several feet thick and tens to hundreds of feet across. This shale is medium to dark gray, finely silty, and shows faint planar lamination. Lenses are evidently the product of erosion prior to deposition of Turner Mine Shale as shown by a sharp contact that truncates lamination in the Dykersburg.

20. Springfield Coal – The Springfield Coal is 0 to 12 feet thick and averages 4 to 6 feet in much of quadrangle. Bright-banded coal is fairly clean and lacks persistent clastic layers except in close proximity to Galatia channel. The Springfield Coal contains little visible pyrite and cleat is weakly developed. Coal thickness is fairly uniform in the southern part of the quadrangle, becoming more variable near the Galatia channel, where the coal is commonly “split” with layers of shale and siltstone. Some of the “splitting” consists of laminae of dark shale that probably represent brief clastic incursions into the peat swamp. More dramatic disruptions divide the coal into two or more “benches” through intervals as thick as 60 feet and likely involve rafting of peat near the channel margins. Within the tract labeled “Galatia channel” on the map, clastic rocks entirely replace the coal.

21. Delafield and Galatia Members – The Delafield Member is 40 to 75 feet thick and is an upward-coarsening succession. The lower part is medium to dark gray shale with common siderite nodules and scattered marine bioclasts including brachiopods and crinoid stems. Planar, wavy, rippled, and slumped siltstone laminae increase upward through the unit. Shale gives way to siltstone or fine-grained sandstone in the upper part of the member. Rooted underclay occurs at the top (beneath the Springfield Coal). The Galatia Member ranges from 0 to 135 feet thick and is a succession of silty shale or mudstone, siltstone, and sandstone that fills a large paleochannel. The lower part of the channel succession is composed largely of sandstone deposited prior to development of the Springfield peat. The channel truncates strata as old as the Survant Coal. The upper part of the Galatia Member is largely siltstone that was deposited contemporaneous with Springfield peat formation. The tract where the Springfield Coal is absent because of channel activity is shown on the geologic map as the “Galatia Channel”.

22. Hanover Limestone, Excello Shale, and Houchin Creek Coal – The Hanover Limestone is only locally present, ranging to about 2 feet thick, and normally less than 1 foot thick. The limestone is medium to dark gray, argillaceous lime mudstone to wackestone with crinoid and brachiopod fragments. In some boreholes, the unit is fossiliferous shale containing lenses of limestone. The Excello Shale is 3 to 7 feet of hard, black, thinly fissile shale containing pyrite nodules and concretions of dense, dark gray limestone or dolomite. The Houchin Creek Coal is bright-banded, pyritic coal 1 to 2.5 feet thick.

23. Clastic interval – This unit is15 to 45 feet thick composed of medium to dark gray silty shale and siltstone that tends to coarsen upward. Underclay at the top contains small limestone nodules.

24. Survant Coal – Two distinct layers of bright-banded coals are separated by gray silty shale and siltstone that is commonly less than 10 feet thick but locally reaches 25 feet. Coal layers range from a streak to about 2.5 feet thick, but the lower coal is thinner and less persistent than the upper.

25. Clastic interval – This unit is 40 to 75 feet thick and generally is an upward-coarsening cycle. Shale in the lower part is mostly dark gray, slightly silty to silt-free, and contains numerous siderite nodules. Thin interbeds and lenses of limestone containing marine fossils occur in the lower part. The upper part of the unit consists of gray siltstone to light gray, fine to medium-grained, shaly sandstone, topped with underclay of the Colchester Coal. In places the interval includes thick upward-fining sandstone that fills valleys or channels, truncating the Colchester Coal.

26. Mecca Quarry Shale and Colchester Coal – The Mecca Quarry Shale is about 2 to 4 feet thick and is black, hard, and thinly fissile, producing very high gamma-ray log readings on electric logs. Thin limestone or calcareous shale containing marine fossils occurs at the top. As shown by core data, the Colchester Coal is a few inches thick, too thin to register on most wireline electric logs.

27. Clastic interval – This interval is 35 to 45 feet thick and consists largely of siltstone and sandstone. The unit normally coarsens upward and has a well-developed underclay at the top. In places the interval is largely sandstone that displays an upward fining profile and erosive lower contact, truncating the Dekoven Coal.

28. Dekoven Coal – In most of the quadrangle the Dekoven consists of two discrete coal beds or “benches” separated by clastic strata that thicken from zero near the southeast corner to as much as 60 feet near the northwest corner of the quadrangle. The lower coal ranges from a few inches to about 3 feet thick, whereas the upper coal is 1 to 3 feet, locally as thick as 5 feet (Jacobson, 1993). The clastic unit between the two coal benches generally coarsens upward from silty shale in the lower part to sandstone in the upper part. However, locally logs indicate upward-fining sandstone with erosive lower contact that truncates the lower bench of the Dekoven. It is likely that the upper and lower Dekoven coals represent two distinct cycles of sedimentation.

29. Clastic interval – This unit is 5 to 35 feet thick, containing variable proportions of gray shale, siltstone, and sandstone, topped by underclay of Dekoven Coal. Directly overlying the Davis Coal is persistent black, hard, highly fissile shale 2 to 5 feet thick, registering high readings on gamma-ray logs.

30. Davis Coal – The thickness of this unit ranges from less than 1 to nearly 5 feet thick, but is 3 to 4 feet thick in most of the map area (Jacobson, 1993). The coal is bright-banded, moderately pyritic, and lacks persistent clastic layers.

31. Clastic interval – This unit is 25 to 40 feet thick and is composed of gray shale, siltstone, and sandstone that tends to coarsen upward. Underclay occurs at the top.

32. Carrier Mills Shale – The Carrier Mills Shale is 2 to 4 feet thick, and is composed of fissile indurated black shale. The black shale registers very high readings on gamma-ray logs. Thin coal commonly occurs at the base.

33. Clastic interval – This unit is 5 to 45 feet thick and is composed of shale and siltstone that tends to coarsen upward and is capped by an underclay.

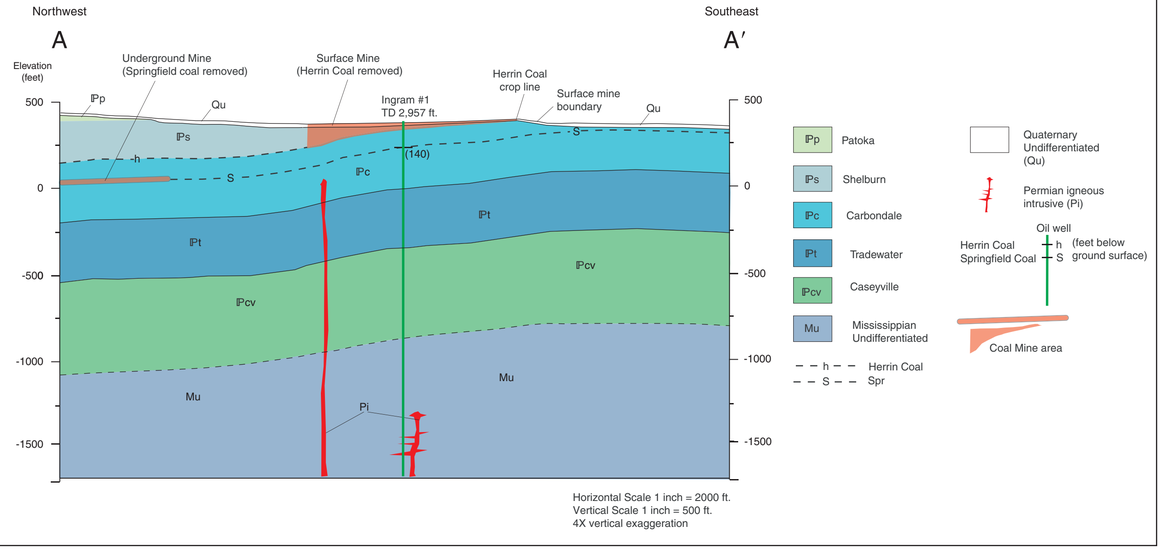
34. Stonefort Limestone, black shale, and Wise Ridge Coal – The Stonefort Limestone and underlying black shale are absent in most of the map area. Where present, the limestone is less than 2 feet thick and overlies less than 3 feet of black shale that yields very high readings on gamma-ray logs. Shale or siltstone 15 feet thick may separate these units from the Wise Ridge Coal, which is persistent and varies from a few inches to about 2 feet thick.

35. Clastic interval – Between the Wise Ridge and the Delwood Coals a 130 to 180 feet thick clastic interval is present. In places 130 to 150 feet of this section is sandstone. The interval is normally a fine to medium-grained, relatively “clean” sandstone. Portions of the interval have thin shale laminae and coal rip-up clasts. Sandstone is thick bedded and crossbedded with a lower erosive contact. The interval likely represents more than one sandstone unit stacking on each other. In places, the upper 50 to 150 feet of the interval consists of shale, mudstone, siltstone, and thin lenticular sandstone, along with as many as 4 coal beds, which probably include the Mt. Rorah and Murphysboro Coals. Well-to-well correlations of these beds are challenging. A limestone bed (Creal Springs or Mitchellsville?) 1 to 2 feet thick occurs 55 to 70 feet below the Wise Ridge Coal on several logs from the northern part of the map area. Sandstone generally predominates below the coal-bearing interval.

36. Delwood Coal – This is a discontinuous zone of coal, carbonaceous shale, underclay, and coarser clastics that reaches 30 feet thick. Coal layers are up to about 2 feet thick; some are shaly, grading to carbonaceous shale. Plant fossils were noted in core. Peppers (1993) identified Delwood Coal on basis of fossil spores at 896-898 feet depth in Bransford Mining Company #178 boring, Sec. 1, T8S, R7E.

37. Clastic interval – Variable gray shale, siltstone, lesser sandstone and conglomerate, at least one thin coal bed with underclay. Thickness is about 50 to 65 feet.

38. Lewisport Coal – Peppers (1993) correlated coal at 951-953 feet depth in Bransford Mining Company #178 boring, Sec. 1, T8S, R7E with the Lewisport coal bed of western Kentucky, on the basis of palynology. The coal is approximately 2.3 feet thick and grades upward and downward to carbonaceous, dark gray shale containing abundant fossil plants. The Lewisport can be identified in only a few logs close to the Bransford boring.



Horizontal Scale 1 inch = 2000 ft.
Vertical Scale 1 inch = 500 ft.
4X vertical exaggeration

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