BEDROCK GEOLOGY OF HERRIN QUADRANGLE
WILLIAMSON AND FRANKLIN COUNTY, ILLINOIS

Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
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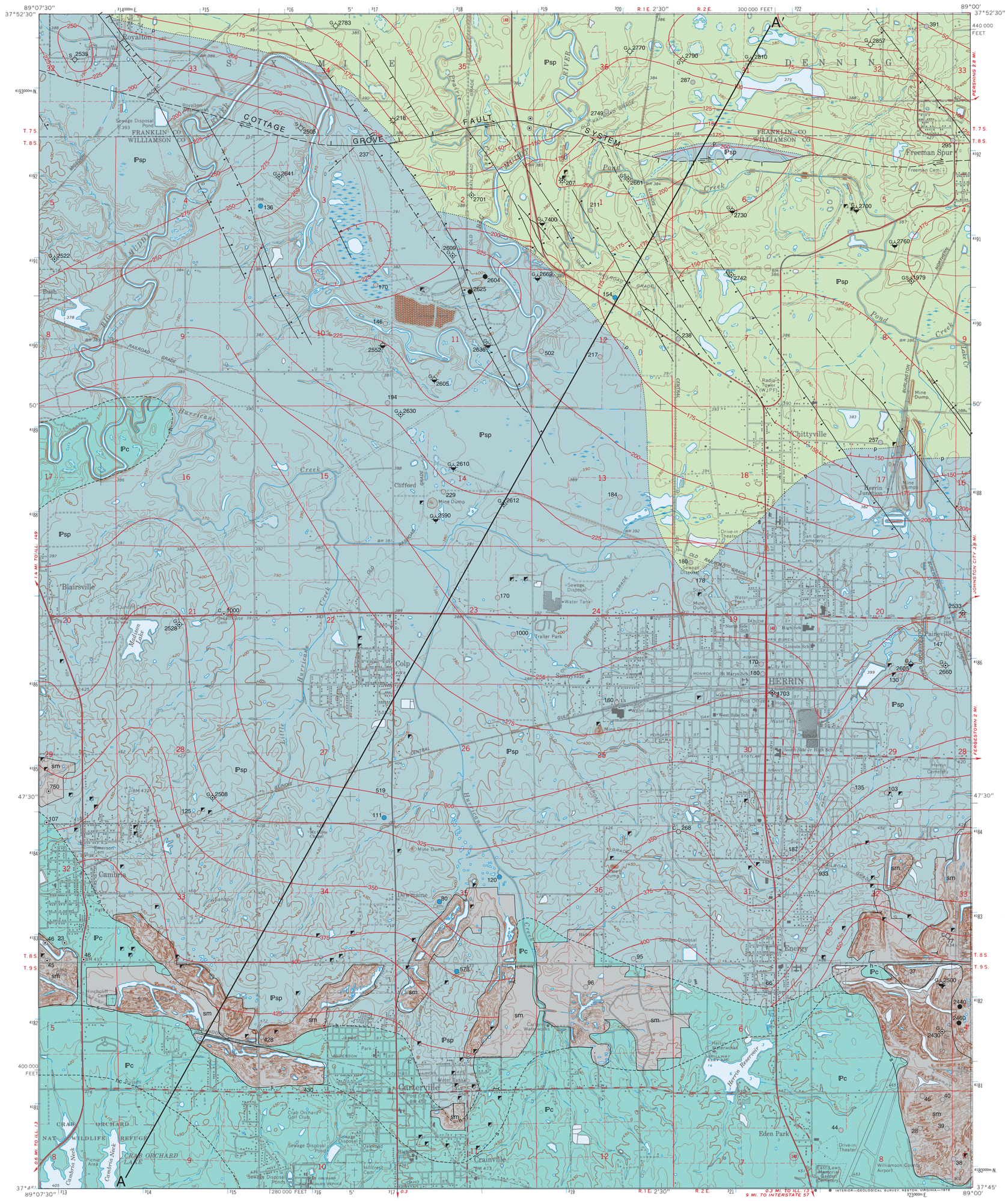
2007

Illinois Geologic Quadrangle Map
IGQ Herrin-BG



EXPLANATION

- sm — Surface mine

Pennsylvanian (Desmoinesian)

- IPsp (p) — Shelburn and Patoka Formations undivided
  - p, Piasa Limestone Member
- IPc (h, s, hc) — Carbondale Formation
  - h, Herrin Coal Member
  - s, Springfield Coal Member
  - hc, Houchin Creek Coal Member

Symbols

- Drift mine
- Shaft mine
- Slope mine

Drill Holes
from which subsurface data were obtained

- Water well
- Coal boring
- Oil well
- Dry hole
- Dry hole - show of oil
- Gas well (gas from abandoned coal mines)

CSG 210 — Numeric label indicates total depth of boring in feet. Boring with samples (s), geophysical log (g), or core (c). Dot indicates location accurate within 100 feet

Line Symbols
dashed where inferred, dotted where concealed

- Contact or coal subcrop
- Normal fault: bar and ball on downthrown side
- Fault, type unknown: ticks on downthrown side
- Strike-slip fault
- 425 — Elevation of top of Herrin Coal, contour interval 25 feet
- A—A′ — Line of cross section

Note: This is a subcrop map, showing bedrock surface with all Quaternary deposits removed. Geology shown as it was prior to surface mining. Faults are shown where they intersect the Herrin Coal. Well and boring records are on file at the ISGS Geological Records Unit and are available online from the ISGS Web site.

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Topography by photogrammetric methods from aerial photographs taken 1965. Field checked 1968. Revision from aerial photos taken 1976. Map edited 1978.

North American Datum of 1927 (NAD 27)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, east zone (Transverse Mercator)
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

Released by the authority of the State of Illinois: 2007

Geology based on field work and data analysis by W.J. Nelson, 2001–2003.

Digital cartography and graphics by J. Domier, T. Goeppinger, M. Widener, M. Jones, L. Verhelst, and S. Geegan, Illinois State Geological Survey.

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

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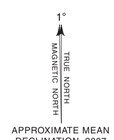
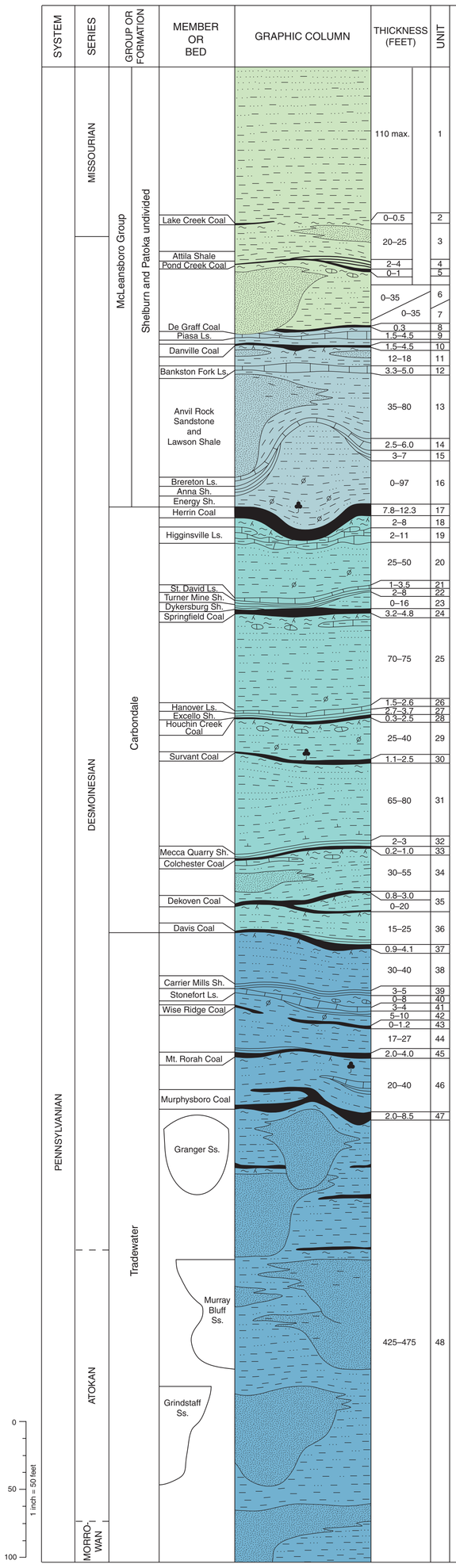
ADJOINING QUADRANGLES
1 Elkville
2 Christopher
3 West Frankfort
4 De Soto
5 Johnston City
6 Carbondale
7 Crab Orchard Lake
8 Marion



APPROXIMATE MEAN DECLINATION, 2007

ROAD CLASSIFICATION

- Primary highway, hard surface
- Secondary highway, hard surface
- Light-duty road, hard or improved surface
- Unimproved road
- State Route



McLeansboro Group

1 Shale, siltstone, and sandstone Interval coarsens upward from shale at base to sandstone at top.
2 Lake Creek Coal No definite record of coal; unit thought to be present on the basis of electric log signature.
3 Shale, siltstone, and sandstone Interval coarsens upward from shale at base to sandstone at top; probably claystone (underclay) at top.
4 Attila Shale Member Dark gray to black, thinly fissile.
5 Pond Creek Coal Member Two logs each record about 0.8 foot of coal.
6 Sandstone Coarse, soft, lower contact erosional, downcuts to Piasa Limestone.
7 Shale Medium gray to greenish gray, upper part becoming silty.
8 De Graff Coal Member Shaly coal. Thin mudstone beneath coal.
9 Piasa Limestone Member Buff, hard. Black shale underlies limestone in at least some places.
10 Danville (No. 7) Coal Member Underlain by rooted mudstone (underclay), shale, and local thin sandstone.
11 Claystone, shale, and sandstone Rooted claystone directly underlies coal; below this is gray shale and siltstone with lenticular sandstone.
12 Bankston Fork Limestone Member Light gray to buff, dense.
13 Anvil Rock Sandstone and Lawson Shale Members Lateral equivalents. The Lawson commonly coarsens upward, from dark gray clay shale at the base to the medium gray silty shale and siltstone above, in turn grading into sandstone (Anvil Rock). In the northwestern part of the map area the Anvil Rock Sandstone is coarse, friable, and water-bearing; it fills channels eroded through underlying units down to the top of the Herrin Coal. The Lawson-Anvil Rock interval tends to be thinner where the Energy Shale is thick.
14 Brereton Limestone Member Generally dark gray, micritic limestone (fossiliferous lime mudstone to wackestone) that is argillaceous and may be massive or have nodular bedding.
15 Anna Shale Member Black, highly carbonaceous, thinly fissile, pyritic. The Anna Shale is thin or absent where the Energy Shale is thicker than about 40 feet. Lower contact is erosional in many places.
16 Energy Shale Member Largely light to medium gray, silty, indistinctly bedded shale (or mudstone) that contains siderite nodules. Fossils of soft-bodied non-marine organisms similar to those of Mazon Creek reportedly occur in siderite nodules from surface mines near Carterville. The Energy Shale also contains fossil plants. Where this unit is thick, it coarsens upward, the upper part grading to siltstone or shaly sandstone. Abrupt thickness variations are usual.

Carbondale Formation

17 Herrin Coal Banded bituminous coal containing several shale and pyrite partings, of which the "blue band" is thickest and most continuous. The "blue band" is typically less than 3 inches thick and lies about 2 feet above the base of the coal, but, in the western part of the county, this gray mudstone layer thickens to nearly 1 foot. The Herrin Coal is essentially mined out in the map area.
18 Claystone Gray, massive, slickensided, rooted (underclay).
19 Higginsville Limestone Member Light brownish gray, micritic, nodular bedding with streaks of greenish gray shale; lower part contains marine fossils.
20 Sandstone, siltstone, and shale Interval generally coarsens upward from sideritic gray clay shale at the base though silty shale to siltstone or sandstone at the top.
21 St. David Limestone Member Dark gray to nearly black, fossiliferous lime mudstone and wackestone.
22 Turner Mine Shale Member Black, highly carbonaceous, thinly fissile, pyritic.
23 Dykersburg Shale Member Medium gray, silty, indistinctly bedded, contains siderite nodules and pyrite crystals. Unit is lenticular.
24 Springfield Coal Member Banded bituminous coal, containing pyrite laminae, lenses, and cleat facings, but lacking continuous mudstone partings. The Springfield has been surface-mined extensively in the map area and also was exploited in several small underground mines during the early twentieth century.
25 Clastic interval Generally a gray, rooted massive mudstone (underclay) directly underlies the Springfield Coal. This is locally underlain by nodules and lenses of silty or sandy limestone. The remainder of the interval coarsens upward from gray shale at the base to gray siltstone or fine-grained, shaly sandstone in the upper part.
26 Hanover Limestone Member Dark gray, argillaceous, fossiliferous lime mudstone to wackestone.
27 Excello Shale Member Black, highly carbonaceous, thinly fissile shale.
28 Houchin Creek Coal Member Banded bituminous coal.
29 Clastic interval Similar in lithology to Interval 25 above, but much thicker. Siderite nodules and fossil plants occur in the lower part.
30 Survant Coal Member Banded bituminous coal.
31 Clastic interval Similar in lithology to Interval 25 above, but apparently lacking limestone. Fossil plants and siderite nodules occur in the lower part; marine invertebrate fossils near the base.
32 Mecca Quarry Shale Member Black, highly carbonaceous, thinly fissile shale.
33 Colchester Coal Member Banded bituminous coal.
34 Clastic interval Either a massive, rooted gray mudstone (underclay) or a thin limestone directly underlies the Colchester Coal. The remainder of the interval generally consists of shaly sandstone in the upper part and gray siltstone or silty shale in the lower part.
35 Dekoven Coal Member Banded bituminous coal. In much of the map area, the Dekoven is split into two coal "benches" separated by as much as 20 feet of clastic strata. The upper coal bench is up to about 3 feet thick, whereas the lower is commonly less than 1 foot thick. The clastic interval between the coal benches comprises rooted claystone (underclay), a thin sandstone, and gray siltstone or shale.
36 Clastic interval A gray, massive, rooted mudstone (underclay) directly underlies the Dekoven Coal. The remainder of the interval contains varying proportions of gray shale, siltstone, and sandstone. Black shale directly overlies the Davis Coal in some boreholes.
37 Davis Coal Member Banded bituminous coal.

Tradewater Formation

38 Clastic interval A gray, massive, rooted mudstone (underclay) directly underlies the Davis Coal. The remainder of the interval includes gray sandstone, siltstone, and shale and tends to coarsen upward.
39 Carrier Mills Shale Member Black, highly carbonaceous, thinly fissile shale. A thin band of coal may occur at the base.
40 Shale and mudstone Gray to greenish gray, contains nodules or lenses of limestone.
41 Stonefort Limestone Member Gray limestone. Black shale, similar to the Carrier Mills, directly underlies the limestone in many holes. Below the black shale is gray shale or mudstone.
42 Shale and mudstone Black fissile shale, similar to the Carrier Mills, directly underlies limestone in some drill holes. Otherwise, the interval consists of medium gray shale and mudstone.
43 Wise Ridge Coal Bed A thin layer of shaly coal.
44 Clastic interval Includes massive gray mudstone immediately below the Wise Ridge Coal. The remainder of the interval is mostly shale and siltstone; black shale directly overlies the Mt. Rorah Coal in many boreholes.
45 Mt. Rorah Coal Member Banded bituminous coal 2 to 4 feet thick that commonly contains a layer of shale or mudstone up to about 1 foot thick in the lower part.
46 Clastic interval Composed largely of shale and siltstone, but contains sandstone and limestone in some boreholes. Fossil plants are present in dark gray shale a short distance below the Mt. Rorah. The limestone, which is lenticular, may represent the Creal Springs Limestone Member.
47 Murphysboro Coal Member Banded bituminous coal; few detailed descriptions available. In one borehole where the coal is reportedly 7.5 feet thick, the upper 4 feet is shaly. Thickness varies abruptly among nearby boreholes.
48 Remainder of Tradewater Formation This interval is roughly half sandstone, half shale and siltstone. The sandstone is light gray to buff, very fine- to medium-grained (rarely coarse-grained) sublitharenite to lithic arenite that contains conspicuous mica and has a clay matrix. Three categories of sandstone can be identified from cores and wireline logs: (1) Sandstones that fine upward from erosional lower contacts and crosscut underlying units. These sandstones represent fluvial, distributary, and estuarine channel fills. (2) Sandstones that occur in the upper part of upward-coarsening intervals, probably reflecting deltaic deposition. (3) Thin, lenticular bodies of relatively clean sandstone that may represent shallow marine, offshore bars. Siltstone and shale of the Tradewater are dominantly medium to dark gray and not distinguishable from older and younger Pennsylvanian lithologies. Several thin, lenticular coal beds are present within 100 feet below the Murphysboro. The Granger, Murray Bluff, and Grindstaff Sandstone Members are tentatively correlated from their outcrops south of the map area. The contact of the Tradewater to the underlying Caseyville Formation also is identified somewhat questionably. The contact is based on well-to-well correlation and the transition from impure lithic sandstones of the Tradewater to clean quartz arenite of the Caseyville.

Introduction

This map shows the distribution of bedrock formations that underlie Quaternary surficial deposits in the Herrin Quadrangle. Quaternary sediments ranging from a few inches to about 90 feet thick blanket the entire quadrangle. These deposits comprise Illinoian glacial drift, Wisconsinan lake sediments, Illinoian and Wisconsinan windblown silt or loess, and Pleistocene to Holocene stream deposits (not shown). Rock outcrops are nonexistent outside of abandoned strip mines, which are densely vegetated and difficult to access. My own field notes and sketches and those of other Illinois State Geological Survey (ISGS) geologists provide valuable information. Maps of underground coal mines are the primary source of information on faults. Some mine maps include surveyed coal elevations; these were utilized in drawing structure contours.

Logs of wells and test holes, on file at the ISGS, supplement information from outcrops. These include electric logs and sample studies from oil and gas test holes and drillers' logs and core descriptions from test borings for coal. Drillers' logs of water wells are generally less reliable.

Stratigraphy

McLeansboro Group
Pennsylvanian strata overlying the Herrin Coal on this map are assigned to the McLeansboro Group. According to the Tri-State Committee (2001), the McLeansboro constitutes the Shelburn (oldest), Patoka, Bond, and Mattoon Formations throughout the Illinois Basin (Illinois, Indiana, and western Kentucky). These formations are essentially similar in overall lithology; their boundaries are based on widely traceable limestone members. The Shelburn-Patoka contact is defined as the top of the West Franklin Limestone Member or its equivalent, the top of the Exline (Scottville) Limestone (Tri-State Committee 2001, p. 16). Neither the West Franklin nor the Exline (Scottville) Limestone exist in Williamson County. A cross section was constructed (unpublished) from the northeast corner of Williamson County into White County, where the West Franklin Limestone is well developed. The section shows that the upper bench of the West Franklin pinches out about 12 miles northeast of Williamson County. This limestone terminates within shale a short distance above the Lake Creek Coal Member. Because there is no lithologic change or mappable bed to mark the Shelburn-Patoka contact in Williamson County, these formations cannot be distinguished. The Piasa Limestone Member, however, has been mapped and serves as a color break within the McLeansboro Group.

Geologic Structure

The Herrin Quadrangle lies near the southern margin of the Illinois Basin. As shown by elevation contours on the Herrin Coal, bedrock near the surface dips northeast to north-northeast at an average rate of about 50 feet per mile, or 1 foot in 100. This amounts to a dip of 0.57°, although the dip is not uniform. Several north-trending, subtle open folds (no closure) occur in the southern half of the quadrangle.

The Cottage Grove Fault System crosses the northern half of the map area. The Herrin is near the midpoint of this 80-mile-long fracture zone that trends slightly north of west. The master fault of the system follows a sinuous course along the Franklin-Williamson County line in this quadrangle. The downthrown side changes from the north to the south, and in places there is no vertical offset, although the rocks are intensely sheared and shattered. This situation is illustrated on the cross section, just north of Pond Creek.

The Cottage Grove master fault is interpreted as a right-lateral strike-slip fault. That is to say, the rocks north of the fault moved eastward relative to rocks south of the fault. Horizontal movement apparently was accompanied by compression, which locally caused the strata to bow upward against the master fault, as depicted in the cross section (Nelson and Krausse 1981, Duchek et al. 2004).

Dozens of northwest-trending subsidiary faults accompany the master fault. These are largely high-angle normal faults, although some are reverse faults and some have components of strike-slip. Displacements range from a few inches to a maximum of 50 feet.

Economic Geology

Coal
Coal mining was a major industry in the Herrin area. The thickest seam, the Herrin Coal, is almost entirely mined out within the quadrangle. The earliest large underground mine in Williamson County opened at Carterville before 1880, and mechanized strip mining got under way near Energy in 1913. As this map goes to press, there are no active mines in the Herrin Quadrangle for the first time in more than 125 years.

The Springfield Coal was mined less extensively than the Herrin Coal. Small patches of strippable Springfield Coal remain, and almost no underground mining has taken place in this seam. The Springfield averages close to 4 feet thick throughout the quadrangle and probably has a high (3 to 5%) sulfur content.

The Houchin Creek Coal is too thin for underground mining and is off-limits for surface mining, because its outcrop passes through residential neighborhoods and the Crab Orchard National Wildlife Refuge.

Deeper coal seams that may have future potential for underground mining include the Dekoven, Davis, Mt. Rorah, and Murphysboro Coals. More drilling is needed to assess resources, thickness, and quality of these seams. The Murphysboro Coal is as thick as 7.5 feet, but this seam is highly lenticular.

Coal bed methane recovery from drilled wells into virgin coal is under way in Saline County and appears feasible in the Herrin Quadrangle. Producing wells in Saline County have been drilled into or adjacent to faults in the Cottage Grove Fault System because the intense natural fractures enhance gas flow. The net thickness of coal seams in the Herrin Quadrangle is more than 30 feet. Coal bed methane production is a good way to obtain energy from coal that cannot be mined, such as from unmined Herrin Coal in faulted areas.

Two wells in the map area are presently recovering gas from abandoned underground coal mines.

Oil and Gas
Four producing oil wells have been completed in the Herrin Quadrangle. Two of these, in Sec. 11, T8S, R1E, constitute the Clifford oil field, which was discovered in 1957 and abandoned in 1965 after producing about 15,000 barrels of oil from the Aux Vases and Ste. Genevieve Formations (Mississippian). Two oil wells near the southeast corner of the map area are in the western edge of the Energy oil field, Williamson County's third largest. These wells produce from the Aux Vases Formation. Huff (1993) analyzed petroleum reservoirs of the Energy field.

The deepest borehole in the quadrangle is the Gallagher No. 1 Old Ben Coal in SW¼ of Sec. 1, T8S, R1E, which reached a total depth of 7,400 feet in the Knox Group (Lower Ordovician).

References

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