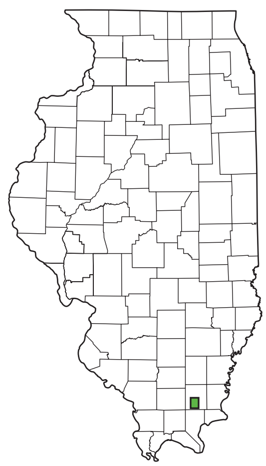
Illinois Preliminary Geologic Map
IPGM Harrisburg-BG

Bedrock Geology of Harrisburg Quadrangle

Saline County, Illinois

F. Brett Denny, Russel J. Jacobson, and W. John Nelson
2007



Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief
Natural Resources Building
615 East Peabody Drive
Champaign, IL 61820-6964

http://www.isgs.uiuc.edu

Introduction

This report accompanies the bedrock geologic map of the Harrisburg 7.5-minute Quadrangle in Saline County in southeastern Illinois (fig. 1). The area is agricultural with row crops in the northern and middle portions of the quadrangle and livestock and poultry ranching in the rural southern portions. The surface water drainage in the northern portion of the quadrangle is northerly into the tributaries of Bankston Fork which then drains into the Middle Fork of the Saline River. Drainage in the middle and southern portions of the quadrangle flows into the South Fork which flows easterly into the Saline River which then flows into the Ohio River.

The bedrock consists of Pennsylvanian sedimentary rocks which outcrop in areas of moderate topographic relief in the southern portion of the quadrangle. Pennsylvanian units are also present in the northern portion of the quadrangle but are blanketed and concealed by Pleistocene glacial sediments. The Equality Formation is composed of fine-grained sediment including slack water clay which formed in a lacustrine setting (lake bed) during the melting of the glaciers at the end of the Wisconsin Episode. The extremely flat geomorphic surface is diagnostic of this formation. The Equality is well developed in the southeastern portions of the quadrangle but probably is not present above elevations of 380 feet. The paleogeography of this region some 10,000 years ago would include an upland surface at the southern edge of the quadrangle and to the north isolated islands surrounded by a relatively shallow lake. Glacially derived windblown silt (loess) blankets the majority of the quadrangle and typically is less than 5 feet thick. This windblown silt is not depicted on the accompanying geologic map.

Stratigraphy

Bedrock exposed in the Harrisburg Quadrangle is Pennsylvanian and composed of sandstone, shale, limestone, and coal. The Lower Pennsylvanian unconformably overlies the Mississippian Kinkaid Limestone and marks the base of the Absaroka Sequence (Willman, et al. 1975). The Lower Mississippian rocks (Valmeyeran) are dominated by carbonate rock (limestone and dolomite) that generally formed in an epeiric sea. The Upper Mississippian (Chesterian) is composed of limestone, shale, and sandstone that reflect fluctuations of the eustatic sea-level. Toward the end of Mississippian, the northeastern U.S. and parts of Canada

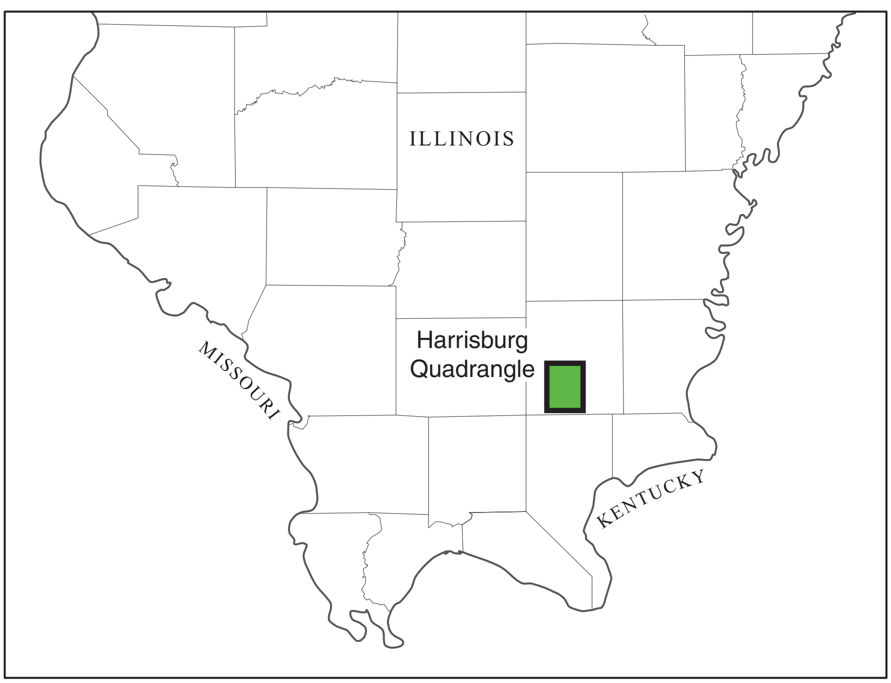


Figure 1 Location of the Harrisburg 7.5 minute quadrangle, Saline County Illinois.

were being uplifted, and sea-level was dropping. This created a major unconformity as the Mississippian units were exposed above sea-level. As the eastern U.S. and parts of Canada continued to rise, erosion took place on this exposed area and the sediment was transported in a southwesterly direction (Howard 1979). This early Pennsylvanian sediment was fairly clean quartz sand and quartz pebble conglomerate. As the region continued to receive sediment, finer grained shale and siltstone become more prominent, and coals began to form in swamp environments. Sea-level fluctuations, related to glacial cycles, were common and coupled with the tectonic activity, have created a complex stratigraphic sequence.

The stratigraphic nomenclature used for this report and map sheets adheres to the formation boundaries suggested by the Tri-State Committee on correlation of the Pennsylvanian System in the Illinois Basin (2001).

Morrowan
Caseyville Formation

The Caseyville Formation is composed of sandstone, siltstone, quartz-pebble conglomerate, and shale. The sandstones are composed of coarse to fine-grained quartz, relatively devoid of mica and clay. Sandstone conglomerates with rounded quartz granules and pebbles up to ½ inch (12 mm) diameter are common and diagnostic for the unit. These conglomerate beds may be over 100 feet thick and are commonly cross bedded. The silt-

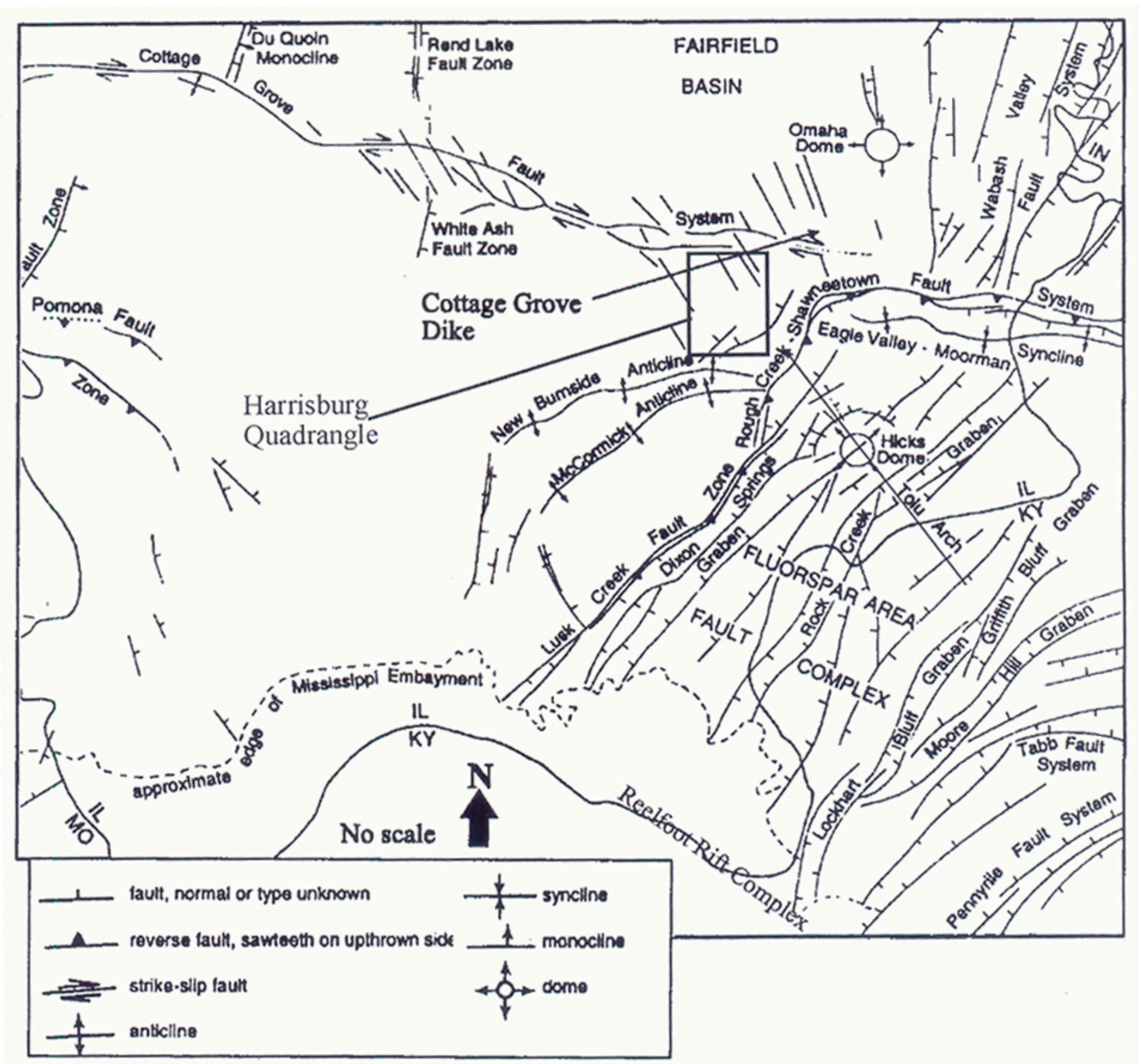


Figure 2 Structural features near the Harrisburg Quadrangle. Adapted from Denny (2005) originally adapted from Nelson (1995).

stone and shale are medium to dark gray and usually thinly bedded and may contain carbonaceous debris. This unit is believed to be deposited in a fluvial system.

Atokan and Desmoinesian Series
Tradewater Formation
The Tradewater is composed of silty gray shale, fine to coarse-grained sandstone, and minor amounts of coal. The lower part of the Tradewater Formation is transitional between the pure quartz sandstones (quartz arenite) of the Caseyville and the sublitharenites of the Upper Tradewater (Potter and Glass 1958). The base of this formation consists of fine-grained sandstone and siltstone with lesser amounts of coal. The middle and upper portions of this unit contain sandstone, siltstone, and minor amounts of limestone and coal. The coals of the lower Tradewater lack lateral continuity, but the upper Tradewater coals have more lateral continuity. The sandstones of the upper Tradewater contain abundant mica and carbonaceous debris.

Desmoinesian Series
Carbondale Formation
The Carbondale contains siltstone, sandstone, claystone, coal, and limestone. This formation contains significant amounts of coals that are economically mineable which are laterally continuous. These coal are sometimes cut out by sandstone channels, but otherwise are much more persistent than the Tradewater coals.

Shelburn Formation
The Shelburn contains siltstone, sandstone, claystone, coal, and limestone. The lithologies of the Shelburn are very similar to the underlying Carbondale. Illinois stratigraphy formerly classified the formation, above the Carbondale Formation, as the Modesto Formation. A multi-state consortium between Illinois, Indiana, and Kentucky (Illinois Basin Consortium) formalized the stratigraphic nomenclature of the Pennsylvanian in 2001. Utilizing the IBC nomenclature the strata above the Herrin Coal is now called the Shelburn Formation.

Structure

The regional dip of the bedrock in the Harrisburg Quadrangle is generally to the north-northwest at 1 to 2 degrees. Several tectonic structures occur within or close to the Harrisburg Quadrangle which influence regional dip. The region is further complicated by Permian igneous activity. The Hicks Dome crypto-volcanic structure is located approximately 10 miles southeast of the Harrisburg Quadrangle, and the Tolu Arch (Bradbury and Baxter 1992) probably extends northwest into the region (fig. 2). The igneous features are a result of ascending ultramafic magma at the intersection of the Reelfoot Rift and the Rough Creek Graben (Bradbury and Baxter 1992). The fracture pattern in the Precambrian rocks of the Midwest is northwesterly (Marshak and Paulsen 1997). Permian intrusions ascending very rapidly from the upper mantle along the northwest boundary of the Reelfoot Rift were funneled upward along the northwesterly trending joints and fractures within the Precambrian basement rock. This igneous activity complicates the tectonic history of the structures discussed below.

The master fault for the Cottage Grove Fault Zone is located approximately 1000 feet north of the Harrisburg Quadrangle. Clark and Royds (1948) were the first to propose the Cottage Grove is a strike-slip fault zone. Heyl and Brock (1961) specified dextral (right-lateral) displacement for this feature. The fault zone is an east-west trending right-lateral strike-slip fault zone with many subsidiary (northwest trending) high-angle normal faults. The en echelon arrangement of northwest-trending faults fits extension along an east-west dextral master fault. Most of these faults (as observed in coal mines) are high-angle normal faults, but some have undergone oblique slip (Nelson and Krausse 1981; Duchek et al. 2004). The structure is also thought to be located over a Precambrian plate boundary (Heigold and Kolata 1993). If the Cottage Grove Fault Zone is located over a Precambrian plate boundary, as Heigold and Kolata (1993) reported, then it would follow that a portion of the up-welling Permian magma would be

Figure 3 Alnöite dike from the Will Scarlett (Peabody surface coal mine) Harrisburg Quadrangle. The Dike is named after the coal mine.

funneled along the Cottage Grove Fault. Denny (2005) attributes a portion of the vertical offset of strata along the Cottage Grove to the regional Permian igneous activity. Several north-northwest trending faults at the northern portion of the map sheet are thought to be related to the Cottage Grove Fault Zone. Some northwesterly trending faults are occupied by mafic igneous dikes.

Several northeasterly trending faults are mapped in the southern half of the quadrangle. As exposed in surface coal mines, these are high-angle normal faults having slickenside striations in dip direction. Maximum throw is about 65 feet. The faults outline horsts and grabens which trend roughly parallel with the southern portion of the Rough Creek-Shawneetown Fault Zone (RCS). The McCormick Fault (Nelson and Lumm 1987) is a normal fault that strikes N 40° E. The northwest side is downthrown less than 100 feet and the fault dies out to the northeast.

The origin and timing of movement along the Rough Creek-Shawneetown Fault Zone (RCS) have been debated. Weller (1940) suggested that horizontal compression from the southeast associated with the Appalachian Orogeny caused the south block to be uplifted. He cited the New Burnside and McCormick Anticlines as further evidence of this regional compressional event. Heyl (1972) envisioned the RCS as part of a continental-scale fracture zone, the 38th Parallel Lineament, which underwent many miles of strike-slip motion. Nelson and Lumm (1987) argued that there is no evidence for horizontal compression because no parallel folds or thrust faults are recognized in the vicinity of the RCS and that the New Burnside and McCormick Anticlines are actually zones of high-angle reverse faulting. They also ruled out strike-slip on the basis of Pennsylvanian paleochannels (in Kentucky) that cross the RCS without offset. Nelson and Lumm favored a scenario in which the southern block was first uplifted along a high-angle reverse fault, then dropped back down (under extension) to nearly its original position.

Although compressional features near the fault zone are unknown, approximately 60 kilometers to the north there are a series of anticlines and synclines trending generally north-south along the general trend of the north-south leg of the RCS. The deformation on the Clay City Anticline and most of the smaller anticlines in this area took place in early Pennsylvanian time (Nelson 1995), the same interval proposed by Weller (1940) for a regional compressional event. Nelson currently interprets the Clay City Anticline, Salem, Louden,

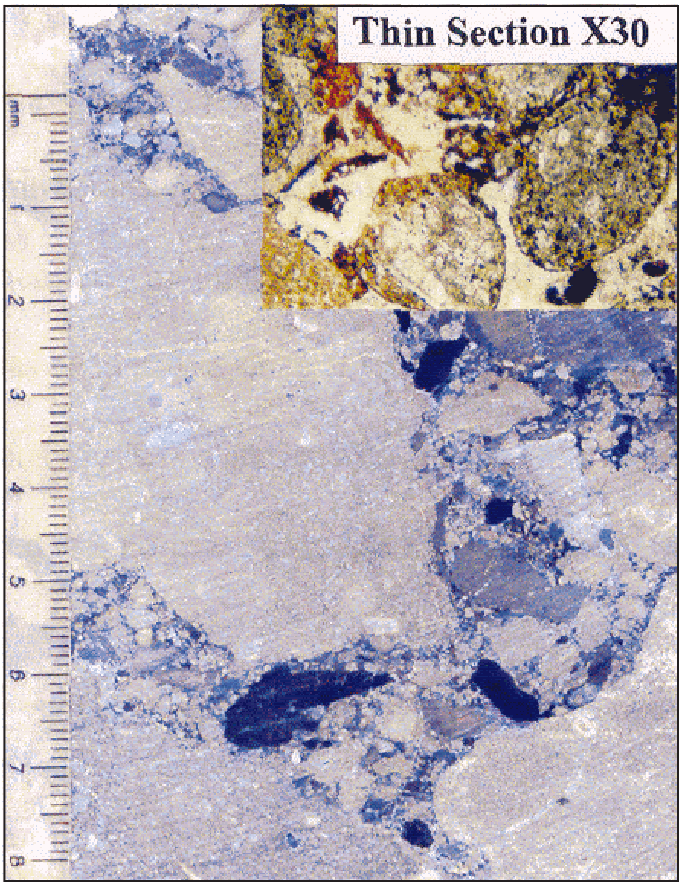


Figure 4 Diatreme intrusion from Saline county. The inset (thin section) shows the pelletal lapilli which is indicative of high velocities. Clasts are limestone (gray), black (shale) and white (quartz). (Modified from Denny, 2005)

Du Quoin, La Salle, and many other structures of south-central Illinois, as products of the Ancestral Rocky Mountain event in which principal deformation took place from latest Mississippian through Early Permian time. Nelson believes this deformation is slightly older than the Alleghenian orogeny, has a different driving mechanism, and a different structural style. Thus, the scientific debate concerning the structural framework for this region continues.

Igneous Activity

Igneous rocks have been encountered at several underground mines in the quadrangle and have an adverse impact on coal mining activities. The early reports of these ultramafic rocks described the composition as mica peridotite. Underground mine working maps typically show irregular mining patterns along these linear igneous intrusions. Where observed in coal mines, these dikes trend north-northwest and dips are nearly vertical. The igneous rocks usually intrude through the coal without noticeable vertical offset across strata on either side of the dike. The dikes have also been encountered while drilling oil wells in this region. The oil well data indicates that at least a portion of the igneous bodies are horizontal sills and the drilling may go in and out of igneous rock at several depths. The largest dike recorded in the Harrisburg quadrangle was observed to be over 100 feet wide and sills have been reported to be over 75 feet thick.

Nelson et al. (1991) reported that ultramafic igneous dikes were uncovered at the Will Scarlet Peabody Mine. At this location there were several igneous dikes, the largest was 23 feet wide trending 30 degrees with a nearly vertical dip. A dark-green to black porphyritic igneous rock was described along with a gray rock that was primar-

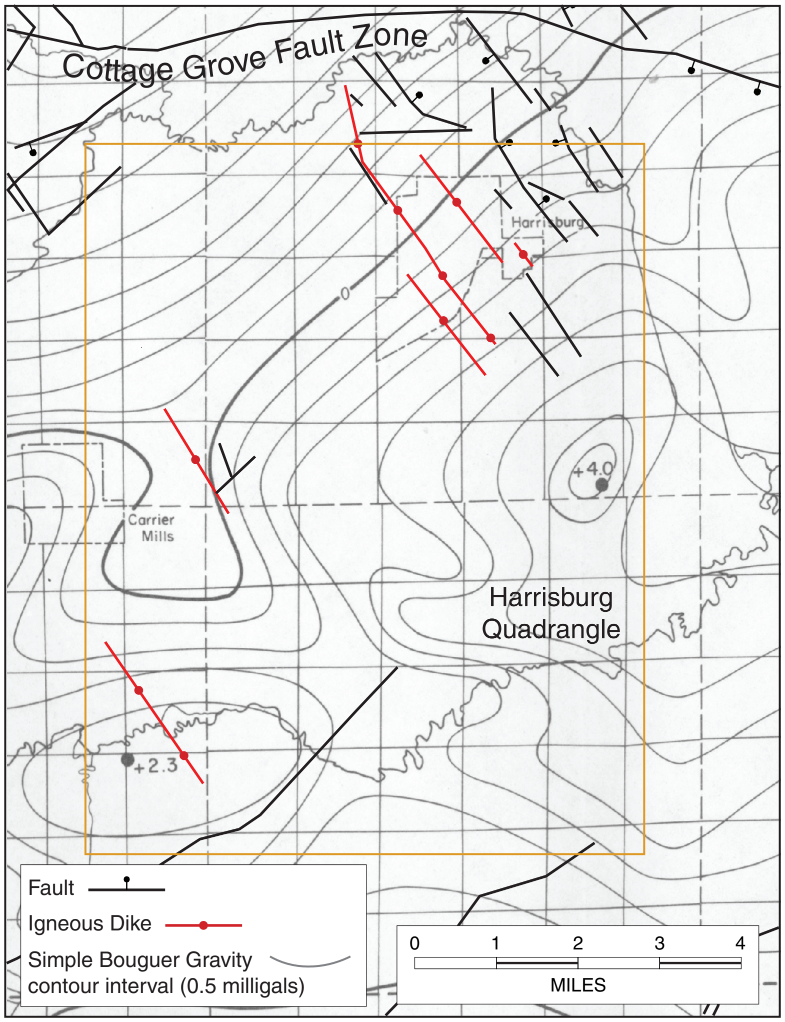


Figure 5 Simple Bouguer Gravity map of the Harrisburg Quadrangle. Faults and ignoeus features have been overlain. Modified from Heigold, 1970.

ily carbonate. The dark-green rock was submitted to Exmin Corporation for pertographic analysis. D.G. Fullerton performed the petrographic analysis and reported that altered olivine phenocrysts in a ground mass of melilite, spinel, mica, perovskite, and carbonate were present. Mr. Fullerton described the rock as an alnöite (fig. 3), which is in agreement with recent electron microprobe research on rocks of similar composition at Cottage Grove, Illinois. The rocks at Cottage Grove were severely altered to the extent that the olivine was almost completely replaced by serpentine. Also, all of the minerals identified by Fullerton at the Will Scarlett Dike were present in the Cottage Grove Dike. The recent microprobe analysis also identified titanium-rich andradite garnet, chlorite, and apatite in the groundmass or mesostasis (Denny et al. 2002).

The gray rocks observed at the Will Scarlet Mine are dominantly carbonate, and have been described as lamprophyres. These enigmatic igneous carbonates are probably related to the segregation of phases of the ultramafic igneous complex. These gray rocks are usually associated with diatremes which may represent an explosive release of energy of the ultramafic complex. Bradbury and Baxter (1992) described the diatremes as breccias and related these pipe-shaped bodies to a CO_2 rich fluid that entrained lithic fragments during ascent. The lapilli that surrounds the autolithic clasts indicate that these pipes were vented to the surface or near surface at high velocities, and may be classified as either a nucleated autolithic texture or pelletal lapilli (fig. 4). The pelletal lapilli texture is characteristic of diatremes and may be considered characteristic. Additionally, all rocks containing

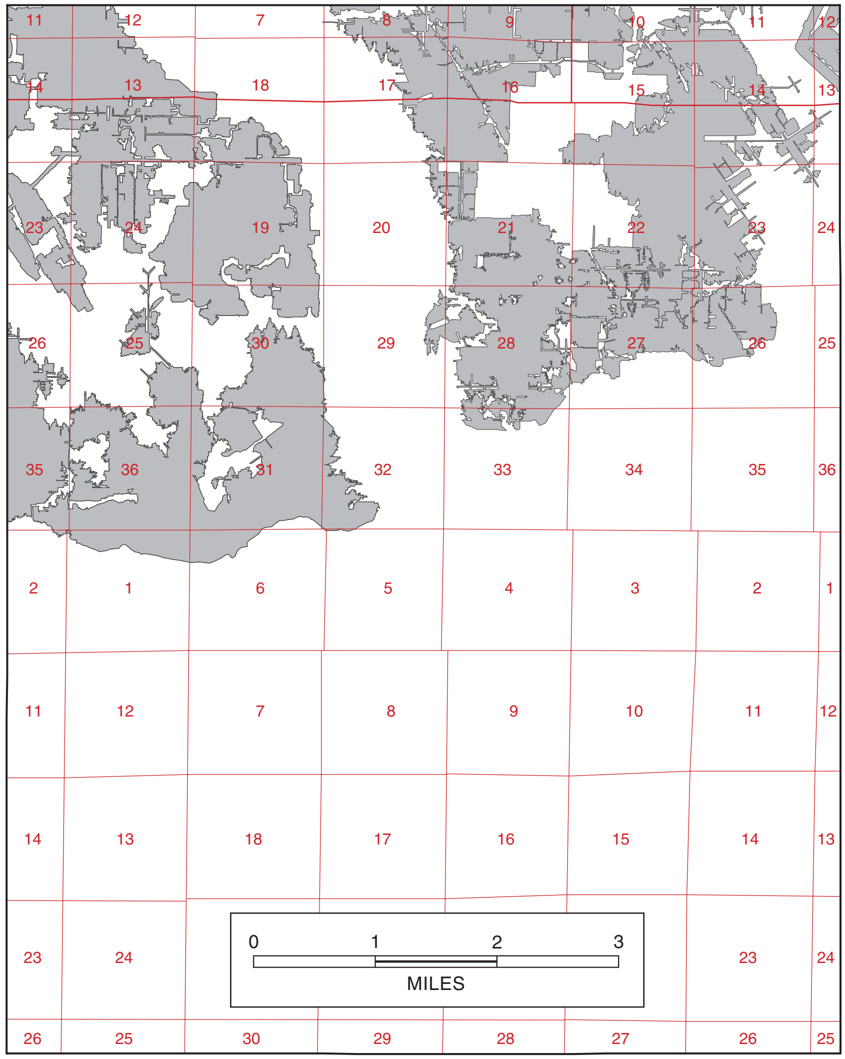


Figure 6 Underground mined out areas of the Springfield Coal. (Modified from Obrad and Chenoweth, 2005)

pelletal lapilli are CO_2 rich relative to common magma types (Mitchell 1995).

Permian intrusions ascending very rapidly from the upper mantle along the Reelfoot Rift were funneled upward along the northwesterly trending joints and fractures within the Precambrian basement. This regional igneous activity was responsible for creating the northwesterly trending Tolu Arch, Hicks Dome, and the igneous dikes observed in the Harrisburg Quadrangle (fig. 2). Ascending igneous magma would also be funneled upward through zones of weakness i.e., faults in the Precambrian basement. Sills into the Paleozoic units should occur as the velocities of the ascending igneous body slows. The diatremes may have formed as the initial ultramafic magma was vented due to rapid expulsion of volatiles potentially accelerated by the interaction of groundwater into the system.

Geophysical Surveys

Two gravity anomalies are present in the Harrisburg Quadrangle (fig. 5). These gravity anomalies measure lateral density differences and may reflect several geologic features; 1) lithologic changes in the stratigraphy, 2) relief or topographic expression on the Precambrian basement, or 3) lateral density differences between the upper crust and the mantle (Heigold 1970). Given the setting, it is likely that these gravity highs represent igneous bodies, most likely sills. Magnetic surveys in this region would augment the gravity data and prove useful to identify the location of the igneous sills and dikes. The depths to the tops of these igneous sills may be modeled by analyzing magnetic intensities utilizing Euler's differential equation (Ravat et al. 2002). Coal mine planning in regions close to the gravity anomalies or igneous dikes would benefit from additional geophysical surveys of this region. High-resolution aeromagnetic surveys have proven highly accurate in locating igneous bodies in southeastern Illinois (Hildenbrand and Ravat 1997).

Economic Geology

Oil and Gas

Petroleum has been produced from several wells within the quadrangle. The Pankeyville Field (Sec. 25, T9S, R6E) has a cumulative production of 6,100 barrels of oil from the Cypress Sandstone at about 2200 to 2300 feet below the ground surface. Also, several wells produced oil from the Tar Springs Sandstone in Sec. 8, T9S, R6E. Structure contours drawn on the top of the Beech Creek Limestone (Barlow Lime) for this project identified approximately 50 feet of closure in this area. The structure contour on the top of the Springfield Coal also shows a small structure which probably terminates northerly into the Cottage Grove Fault Zone (north of the Harrisburg Quadrangle). The Mitchellsville Field (Secs. 2, 3, 10, 11, 14, and 15, T10S, R6E) has produced gas or oil from the Degonia, Palestine, Cypress, and Tar Springs Formations. A few other wells have been completed with shows of oil or gas in this region. Most exploration activity has drilled to the Mississippian rocks (Upper Valmeyeran or Lower Chesterian units). A gas well was being drilled (Sec. 34, T9S, R6E) at the time of this publication by Bravo Natural Gas, LLC. It was reportedly being drilled to explore for natural gas in the New Albany Shale. This well will be one of the deepest exploration tests in the Harrisburg Quadrangle.

Coal

Coal was first mined in this quadrangle at a small underground drift in 1856 near Ingram Hill Church (Sec. 26, T9S, R6E). The Herrin, Springfield, Dekoven, and Davis Coals have been mined extensively throughout the region with the Houchin Creek, New Burnside, and Delwood Coals being mined locally. Historical accounts of coal mining in this quadrangle were published in 2003 and revised in 2005 (Obrad and Chenoweth 2003). This mining directory contains detailed information concerning the history of coal mines, coal production, and maps depicting the coal mine boundaries (fig. 6).

The Herrin Coal has been mined by surface methods along the northern portion of the quadrangle. The Herrin Coal should be present at about 100 feet below the surface along the northwest edge of the quadrangle. There are a few wells in this area that show the Herrin Coal in this region is at about and elevation of 300 feet. The Cottage Grove Fault Zone in this area will impact mining. The Herrin should also be present along the northeastern portion of the map sheet, but will also be impacted by a set of northwesterly trending faults (see geologic map).

The Springfield Coal has been mined very extensively in the northern portion of the quadrangle. A small area of Springfield Coal remains west of the Big Ridge Mine underground workings and east of the Sahara No. 3 underground workings. The depth to the Springfield Coal in this area is approximately 150 to 300 feet below the surface. Several faults are projected in this region and the Middle Fork of the Saline River flows above this area which may complicate mining efforts. The Springfield Coal is replaced by a sandstone channel called the Galatia Channel (see geologic map). This fluvial sandstone body perhaps drained surface water contemporaneously with the deposition of the Springfield Coal. Near the channel the coal is split by sandstone and siltstone (see cross section). Underground coal mine roof conditions deteriorated near the splits and mining stopped well short of the channel.

The Davis and Dekoven Coals have been surface mined at several sites in the southern half of the quadrangle. The Kent borehole located in the southeast 1/4 of Sec. 2, T10S, R6E contained 3.5 feet of Dekoven Coal at about 110 feet below the surface and 4.5 feet of Davis Coal at about 135 feet below the surface (Appendix 1).

Lower Tradewater coals have been mined at several places in the southern portion of the map sheet. Little information is available concerning these small local mining operations. For specific information concerning individual mines the reader is referred to Obrad and Chenoweth (2005).

Acknowledgments

The field work for this project was completed by F. Brett Denny and Russell J. Jacobson of the Illinois State Geological Survey (ISGS) during the winter of 2005 and spring of 2006. Nelson's field work, along the southern edge of the quadrangle, was conducted during the early 1980s. Jane Domier provided graphic and cartographic assistance and Zak Lasemi, Chris York, and Joseph A. Devera provided constructive reviews of the text.

One borehole was conducted for this research. This core can be examined at the Illinois State Geological Survey core storage facility in Champaign, Illinois. The authors would like to thank Irene Kent who gave access to her property for this research. Bravo Natural Gas also supplied cuttings from the upper 300 feet of their current gas exploration well to the ISGS for analysis. We appreciate the corporation of all who helped to complete this research and to all landowners who granted the ISGS access to their property.

This research was supported in part by the U.S. Geological Survey, National Cooperative Geologic Mapping Program (STATEMAP) under USGS award number INT 05HQAG0079. 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.

References

Bradbury, J.C., and J.W. Baxter, 1992, Intrusive breccias at Hicks Dome: Illinois State Geological Survey, Circular 550, 23 p.

Clark, S.K. and J.S. Royds, 1948, Structural trends and fault systems in Eastern Interior Basin: American Association of Petroleum Geologists Bulletin, v. 32, no. 9, p. 1728–1749.

Denny, F.B., R.H. Fifarek, R.N. Guillemette, and P.L. Padgett, 2002, Petrographic and microprobe analysis of the Cottage Grove Dike (Saline County, Illinois), Geol. Soc. Am. Abstracts with programs, 34(2): A92–93.

Denny, F.B., 2005, The Cottage Grove Dike and mafic igneous intrusions in southeastern Illinois and their relation to regional tectonics and economic resources, M.S. Thesis, Southern Illinois University at Carbondale, 6 tables, 28 figures., 83 p.

Duchek, A.B., J.H. McBride, W.J. Nelson, and H.E. Leetaru, 2004, The Cottage Grove fault system (Illinois Basin): Late Paleozoic transpression along a Precambrian crustal boundary, GSA Bulletin; November/December 2004; v. 116; no. 11/12, p. 1465–1484.

Heyl, A.V. and M.R. Brock, 1961, Structural framework of the Illinois-Kentucky fluorspar district and its relation to mineral deposits: U.S. Geological Survey, Professional Paper 424-D, p. 3–6.

Heyl, A.V., Jr., 1972, The 38th Parallel Lineament and its relationship to ore deposits: Economic Geology, v. 67, p. 879–894.

Heigold, P.C., and D.R. Kolata, 1993, Proterozoic crustal boundary in the southern part of the Illinois Basin: Tectonophysics, V. 217, p. 307–319.

Heigold, P.C., 1970, A gravity survey of extreme Southeastern Illinois, Illinois State Geological Survey, Circular 450, 12 p., 1 pl., 4 figs.

Hildenbrand, T.G. and D. Ravat, 1997, Geophysical setting of the Wabash Valley Fault System: Seismological Research Letters, v. 68, no. 4, p. 567–585.

Howard, R.H., 1979, The Mississippi-Pennsylvanian unconformity in the Illinois Basin- Old and new thinking, in Depositional and structural history of the Pennsylvanian System of the Illinois Basin (Part 2: invited papers), editors James E. Palmer ad Russell R. Dutcher, Field Trip 9/Ninth International Congress of Carboniferous Stratigraphy, p. 34–43.

Mitchell, R.H., 1995, Kimberlites, Orangeites, and related rocks, Plenum Press, New York, 410 p.

Marshak, S., and T. Paulsen, 1997, Structural style, regional distribution, and seismic implications of the midcontinent fault and-fold zones, United States: Seismological Research Letters, v. 68, no. 4, p. 511–520.

Nelson, W.J. and Krausse, 1981, The Cottage Grove Fault System in southern Illinois: Illinois State Geological Survey, Circular 522, 65p.

Nelson, W.J. and D.K. Lumm, 1987, Structural geology of southeastern Illinois and vicinity: Illinois State Geological Survey, Circular 538, 70 p.

Nelson W.J., J.A. Devera, R.J. Jacobson, D.K. Lumm, R.A. Peppers, B. Trask, C.P. Weibel, L.R. Follmer, M.H. Riggs, S.P. Esling, E.D. Henderson, and M.S. Lannon, 1991, Geology of the Eddyville, Stonefort, and Creal Springs Quadrangles Southern Illinois, Illinois State Geological Survey, Bulletin 96, 58 figures, 7 tables, 1 plate, 85 p.

Nelson, W.J., 1995, Structural features in Illinois: Illinois State Geological Survey, Bulletin 100, 144 p.

Obrad J.M., and C. Chenoweth, 2003, revised 2005, Directory of coal mines in Illinois, 7.5 minute quadrangle series, Harrisburg Quadrangle, Saline County, Illinois State Geological Survey, 3 map sheets, and 75 p. report.

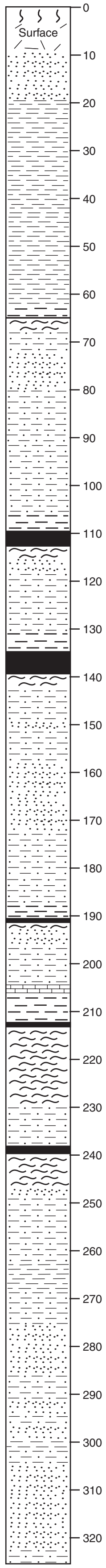
Potter, P.E., and H.D. Glass, 1958, Petrology and sedimentation of Pennsylvanian sediments in southern Illinois-A vertical profile: Illinois State Geological Survey, Report of Investigations 204, 60p.

Ravat, D.N., K. Kirkham, and T.G. Hildenbrand, 2002, A source-depth separation filter: Using the Euler method on the derivatives of total intensity magnetic anomaly data: Society of Exploration Geophysicists, The Leading Edge-The Meter Reader, v. 21, issue 4, p. 360–365.

Tri-State Committee on correlation of the Pennsylvanian System in the Illinois Basin, (R.J. Jacobson, W.J. Nelson, H.H. Damberger, C.P. Weibel and R.A. Peppers of the Illinois State Geological Survey; W.A. Hasenmueller, N.R. Hasenmueller, D.L. Eggert, and C.H. Ault of the Indiana Geological Survey; S.F. Greb and D.A. Williams of the Kentucky Geological Survey; M.E. Hopkins, H. Lamkin, Jr. and R.L Langenheim of the University of Illinois), 2001, Toward A More Uniform Stratigraphic Nomenclature For Rock Units (Formations and Groups) of The Pennsylvanian System in The Illinois Basin, Illinois Basin Consortium Study 5, Joint publication of the Illinois State Geological Survey, Indiana Geological Survey and Kentucky Geological Survey, 26 p., 1 plate.

Weller, J.M., 1940, Geology and oil possibilities of extreme southern Illinois, Union, Johnson, Pope, Hardin, Alexander, Pulaski, and Massac Counties: Illinois State Geological Survey, Report of Investigations 71, 71 p.

Willman, H.B., E. Atherton, T.C. Buschbach, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975, Handbook of Illinois Stratigraphy, Illinois State Geological Survey, Bulletin 95, 261 p.



Kent Hole
API 12-165-2682300
2-10S-6E
(1300 ft. EL, 50 ft. SL)
Elevation 362 ft.

Colchester (65 feet)

Dekoven Coal, black bituminous, high in vitrinite and fusinite and pyrite. The coal is .3.5 feet thick overlying a sandy underclay. The Mecca Quarry Shale above the DeKoven is 3.3 feet thick.

Davis Coal, black bituminous, high in vitrinite with some fusinite. The coal is 4.5 feet thick. A black shale above the coal is 3.9 feet thick and the underclay is gray and silty containing plant fossils.

Wise Ridge Coal (212 feet), black bituminous, high in vitrinite and clarinite with some fusinite. The coal is 1.0 feet thick. A black calcareous shale above the coal is 5.3 feet thick which grades into a 2.3 feet thick limestone. The underclay gray and sandy.

Mt. Rorah Coal (238 feet), black bituminous, high in vitrinite and fusinite. The coal is 1.7 feet thick. A gray carbonaceous siltstone above the coal is 8.6 feet thick.

Appendix 1 Graphic log for the Irene Kent Borehole located in section 2 T10S R6E (1300ft. EL, 50 ft. SL). All depths are feet below the ground surface.