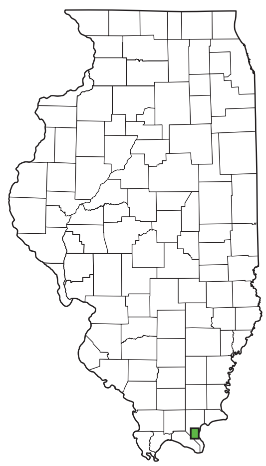
Illinois Geologic Quadrangle Map
IGQ Brownfield-BG

Bedrock Geology of Brownfield Quadrangle

Massac and Pope Counties, Illinois

W. John Nelson and F. Brett Denny

2008



Illinois 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

STRUCTURAL GEOLOGY

This quadrangle lies along the southern flank of the Illinois Basin. Mississippian bedrock dips regionally northward, so that younger formations are exposed in the northern part of the quadrangle. The erosional limit of the McNairy Formation (Cretaceous) in the southwestern part of the map area marks the northern edge of the Mississippi Embayment, a broad trough filled with largely unlithified Cretaceous and Tertiary sediments. Three fault zones, the Hobbs Creek, Barnes Creek, and Compton Mine Fault Zones, are mapped in the Brownfield Quadrangle. They are part of the Fluorspar Area Fault Complex, a family of fractures that mainly trend northeast and, in places, are mineralized with fluorite and other ore minerals.

Hobbs Creek Fault Zone

The Hobbs Creek Fault Zone crosses the northwest corner of the quadrangle. The faults are concealed by alluvium and surficial deposits, but are manifest through displacement of Mississippian rocks across the narrow, linear valley northeast of Brownfield. The rocks on the northwest side of this valley are downthrown 300 to 500 feet relative to rocks southeast of the valley. Further evidence of faulting is given by inclined bedding, slickensided fractures, zones of breccia, and wide calcite-filled veins in the core from the Abner Field borehole drilled a short distance southeast of the fault zone. The Hobbs Creek Fault Zone continues southwest and northeast of the Brownfield Quadrangle and has an overall length of at least 25 miles (Baxter et al. 1967, Weibel et al. 1991, Nelson 1995). This fault zone forms the southeast margin of a large downdropped crustal block, the Dixon Springs Graben. The Dixon Springs Graben has a long and complicated history of structural movement (Weibel et al. 1993). The last episode of movement was post-Cretaceous, as shown by a downfaulted slice of McNairy Formation in the Reevesville Quadrangle (Nelson 1996).

Barnes Creek Fault Zone

The Barnes Creek Fault Zone crosses the quadrangle from the northeast to southwest corner. Along most of its length, the zone consists of two or three parallel faults, which outline grabens a few hundred feet to 2,000 feet wide. Blocks within grabens are downdropped as much as 300 feet; however, there is little or no vertical separation from one side of the fault zone to the other. Core drilling (in Sec. 8, T14S, R6E) and outcrop data indicate that the fault zone is composed of normal faults that dip 70° to nearly vertical. The faults that outline grabens commonly split upward into two or more step faults. Drag folds are generally only a few feet wide; some faults exhibit no drag. Gouge or breccia zones typically are narrow, although a breccia zone at least 10 feet wide is exposed on the north side of Cromeenes Hollow in NW¼ NE¼, Sec. 19, T14S, R6E. Sandstone along faults commonly is silicified, whereas limestone is shattered and riddled with calcite veins. Faint vertical to steeply plunging striations were observed on fault surfaces. Joints within and close to the Barnes Creek Fault Zone strike primarily parallel with the fault zone; a secondary joint set normal to the faults is developed locally.

Quaternary sediments are deformed along the Barnes Creek Fault Zone near the southwest corner of the quadrangle. Key exposures are along a small southwest-flowing creek about 2,300 feet south of the northeast corner of Sec. 35, T14S, R5E. Here a series of north-northeast-striking high-angle normal and reverse faults juxtapose the McNairy Formation with a unit of gravel and pebbly clay. The faults outline narrow horsts and grabens. Gravel and pebbly clay also fill narrow fissures and sedimentary dikes in the McNairy. The gravel consists of rounded chert pebbles similar to those of the Mounds Gravel, except the matrix is brown silt and clay instead of red sand. Some of the pebbles bear the bronze patina typical of the Mounds, but most are pitted and bleached and have the patina partially worn away. Thus the pebbles were reworked from the Mounds and the gravel is younger—probably early Pleistocene. This material resembles the Metropolis Formation, a Pleistocene fluvial deposit found along the Ohio River (Nelson et al. 1999). Holocene alluvium overlying the reworked Mounds Gravel is not faulted.

The Barnes Creek Fault Zone also displaces reworked Mounds Gravel in exposures along Barnes Creek, about 3 miles southwest of the Brownfield Quadrangle. The Barnes Creek Fault Zone probably has undergone several episodes of movement. Most faulting apparently was dip-slip normal or gravity faulting, but the last (Quaternary) episode may have involved strike-slip motion. The direction and amount of horizontal movement, however, are unknown (Nelson et al. 1997, 1999).

Compton Mine Fault Zone

The fault zone in the southeast corner of the Brownfield Quadrangle is herein named the Compton Mine Fault Zone. The name is taken from the Compton Mine, where fluorite and lead were extracted from veins along the fault zone. The fault zone consists of two or three high-angle normal faults that outline a downdropped block 500 to 1,300 feet wide. Throw across the southeast fault is about 300 feet; throw across the northwest fault is close to 1,000 feet. The northwest fault is exposed along a small draw near the southeast corner of Sec. 27, T14S, R6E. Brecciated, recrystallized sandstone bears two fracture sets having vertical to steeply plunging slickensides and mullion (furrows on a fault surface parallel with the direction of slip). One fracture set strikes northeast, parallel to the main fault; the other fracture set strikes northwest. More fault surfaces are exposed to the south in the Paducah Northeast Quadrangle. Slickensides and other slip indicators provide evidence that movement was dip-slip and normal with little or no component of strike-slip. A cross section of the northwest side of the Compton Mine Fault Zone near the mine shows a zone 800 feet wide, containing more than a dozen high-angle normal faults having stepwise displacement down to the southeast

(Taylor 1967, p. 53). Taylor's diagram was based on core data not available in ISGS records. The Compton Mine Fault Zone here forms the northwest margin of a larger structural feature, the Rock Creek Graben. The southeast side of the Rock Creek Graben is along the Bay City Fault Zone, just beyond the southeast corner of the quadrangle.

Other Structural Features A small, gentle northwest-facing monocline was mapped in Sections 21 and 28, T13S, R6E. Bedding of sandstone on the monoclinal flank dips 5° to 12° northwest in contrast to the regional dip that generally is too slight to measure. Also near the monocline is a pronounced east-west joint set, which was not observed elsewhere in the quadrangle. This little fold may be the surface expression of a fault at greater depth.

Two small faults that run east-west project into the east edge of the mapped area from the Golconda Quadrangle (Amos 1966). We found no evidence of these faults in the Brownfield Quadrangle. If they exist, their displacements are small.

ECONOMIC GEOLOGY

Fluorspar and Lead
Fluorspar and lead ore were produced intermittently from the Compton Mine, located in the southeast part of the quadrangle in the SW 1/4, Sec. 26, T14S, R6E. Tom Compton sank the first shaft shortly after 1900 and mined a little fluorspar and galena at a depth of 60 to 70 feet. In 1904 a Mr. Kerr of Pittsburgh, Pennsylvania, deepened the shaft to about 300 feet, ran drifts and stopes, and built a small mill on the site. He operated the mine and mill intermittently until about 1930. The Illinois Fluorspar and Lead Company sank a new shaft in 1939 and mined fluorspar and lead until 1941, when they sold the property. The last known operator was S.N. Edleman, who worked the mine briefly in 1944 (Tippie 1944). The Compton Mine site is currently in a pasture. Concrete foundations, metal artifacts, small piles of waste rock, and prospect pits remain as evidence of former activity.

The Compton Mine lies at the southwest margin of the Illinois-Kentucky Fluorspar District. The mine exploited vein deposits along a fault zone, herein named the Compton Mine Fault Zone. Tippie (1944) reported that the mineralized vein in the underground mine had a strike of N45° E and a dip of 60° SE. Sandstone (probably Tar Springs or Palestine) was in the downthrown, southeast block, and the Paoli Limestone was in the upthrown, northwest block. The fault along which the ore lay outlines the northwest side of a narrow, complexly fractured graben.

The geologic setting of ore at the Compton Mine is typical of vein deposits in the Illinois-Kentucky Fluorspar District. Most ore occurs along northeast-trending faults of moderate displacement where the wall rocks are the Paoli Limestone, Aux Vases Sandstone, and upper part of the Ste. Genevieve Limestone. Fluorite and associated minerals thus may occur elsewhere along the Compton Mine, Barnes Creek, and Hobbs Creek Fault Zones. Test drilling thus far has not encountered deposits of economic value.

Gravel and Sand
Mounds Gravel is quarried on a small scale for use in surfacing local roads. Several recently active and abandoned gravel pits are in the southern part of the quadrangle, where the Mounds caps the upland plateau. Demand for gravel currently is too small to support continuous operations. Most pits, therefore, cover at most a few acres and are active for only a few days or weeks per year.

Large quantities of sand that might have commercial value are found in Quaternary alluvium in Bay Bottoms (the broad flat-bottomed valley that crosses the center of the quadrangle). The high water table might hinder sand mining in most of Bay Bottoms. The terraces that border the north side of the valley near Homberg are higher in elevation and should offer relatively dry conditions. Local residents have dug small amounts of sand from these terraces for their own use.

Stone
A small flagstone quarry operates intermittently near the center of the north half of Sec. 35, T13S, R6E. Taylor (1967) described this quarry, which was still active in February 1996. The quarry stone is sandstone near the top of the Cypress Formation. It has planar laminations and splits into layers 1 to 12 inches thick. After removing overburden using a small tractor, workers pry sandstone slabs loose with hand tools. The stone is used for sidewalks, patios, and ornamental facings. Outcrops of similar sandstone occur in the bed of Miller Creek south of the quarry.

The ruins of a cement plant and a long-abandoned limestone quarry lie in a wooded area near Miller Creek in southeast Sec. 26, T13S, R6E. The quarry, which covers less than an acre, exploited a 10-foot bench of coarsely fossiliferous limestone in the upper part of the Fraileys Member of the Golconda Formation. Taylor (1967) reported that the cement plant was destroyed by a windstorm before production began, and the operators lacked funds to rebuild.

At several sites in the quadrangle, small quantities of building stone were quarried by local residents. A pit in the Menard Limestone is alongside the road at the south end of the hill on the north side of Brownfield. A quarry in the Downeys Bluff Member of the Paoli Limestone is on the south side of Cave Creek, near the center of Sec. 27, T14S, R6E. A third pit is high on the bluff at Ropers Landing, where sandstone was taken from the lower part of the Cypress Formation.

Although limestone is abundant and the Ohio River provides cheap transportation, the Brownfield Quadrangle is not well suited for a large commercial limestone quarry. The interval of choice for large quarries in southeastern Illinois is the

Paoli Limestone and Ste. Genevieve Limestone. Only the topmost part of this interval is above drainage in the Brownfield Quadrangle, and it is immediately overlain by 100 feet or more of sandstone that forms steep bluffs. Removing this overburden and keeping water out of the pits probably would be prohibitively costly. Other limestone-bearing formations—the Menard, Glen Dean, and Golconda—are above drainage, but all contain relatively impure limestone having numerous interbeds of shale.

Oil and Gas

Records of four oil and gas exploration holes in the Brownfield Quadrangle are on file at the ISGS. All four were dry and abandoned. The Bolin and Butler No. 1 Clanahan hole, just north of Brownfield, originally was drilled to a depth of 790 feet in 1960. A second operator deepened this test to 1,100 feet in 1975 and reported a slight show of gas in oolitic Ste. Genevieve Limestone near the bottom of the hole. A sample log and geophysical logs for the Clanahan well are on file. The Vick & Waite No. 1 Trovillion oil test was drilled in 1959 on top of the bluff about 1 mile southeast of Brownfield. No show of oil or gas was reported. The only available log is a sample log by W. J. Nelson. The Trovillion hole reached a total depth of 550 feet, about 80 feet below the top of the Paoli Limestone. Also in 1959, the Vick & Waite No. 1 Chaney test was drilled in Sec. 21, T14S, R6E to a total depth of 1,065 feet. No logs, no samples, and no record of hydrocarbon shows are available for this hole. The deepest test hole drilled in the quadrangle was the Styles No. 1 Roper, drilled in 1962 to a depth of 1,375 feet. The well site is on Bay Bottoms near the center of Sec. 15, T14S, R6E. Unfortunately, the only log for this well is a driller's log that is too cursory for geologic interpretation. Total depth was reached in "limestone," most likely the Ullin Limestone or Fort Payne Formation of early Mississippian age. No show of oil or gas was mentioned.

ACKNOWLEDGMENTS

Small portions of the quadrangle were mapped by Joseph A. Devera. Some data, including positions of contacts and structural attitudes, were taken from unpublished field notes and field maps by Stuart Weller and others (ISGS files). The terrace deposits were mapped by L.R. Follmer and D. LaBrecque. Eric Livingston of the Ozark-Mahoning Company supplied core data from the Densch II tract in Sec. 8, T14S, R6E. We thank the numerous landowners in the Brownfield Quadrangle who granted access to their property for geologic study.

REFERENCES

Amos, D.H., 1966, Geologic map of the Golconda Quadrangle, Kentucky-Illinois, and the part of the Brownfield Quadrangle in Kentucky: Reston, Virginia, U.S. Geological Survey, Map GQ-546, 1:24,000.

Baxter, J.W., G.A. Desborough, and C.W. Shaw, 1967, Areal geology of the Illinois fluorspar district: Part 3, Herod and Shetlerville Quadrangles: Illinois State Geological Survey, Circular 413, 41 p. and map, 1:24,000.

Devera, J.A., 1991, Geologic map of the Glendale Quadrangle, Johnson and Pope Counties, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ-9, 1:24,000.

Nelson, W.J. 1995, Structural features in Illinois: ISGS Bulletin 100, 144 p. and 2 plates.

Nelson, W.J., 1996, Geologic map of the Reevesville Quadrangle, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ-17, 1:24,000.

Nelson, W.J., F.B. Denny, J.A. Devera, L.R. Follmer and J.M. Masters, 1997, Tertiary and Quaternary tectonic faulting in southernmost Illinois: Engineering Geology, v. 46, no. 3–4, p. 235–258.

Nelson, W.J., F.B. Denny, L.R. Follmer, and J.M. Masters, 1999, Quaternary grabens in southernmost Illinois, deformation near an active intraplate seismic zone: Tectonophysics, v. 305, p. 381–397

Taylor, R.F., 1967, Areal geology of the Brownfield Quadrangle, southeastern Illinois: M.S. thesis, Southern Illinois University, Carbondale, 103 p. and map, 1:24,000.

Tippie, F.E., 1944, The Compton Mine: Illinois State Geological Survey, J.M. Weller Manuscript 12-L.

Weibel, C.P., W.J. Nelson, and J.A. Devera, 1991, Geologic map of the Waltersburg Quadrangle, Pope County, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ-8, 1:24,000.

Weibel, C.P., W.J. Nelson, L.B. Oliver, and S.P. Esling, 1993, Geology of the Waltersburg Quadrangle, Pope County, Illinois: Illinois State Geological Survey, Bulletin 98, 41 p.

Weller, S., and F.F. Krey, 1939, Preliminary geologic map of the Mississippian formations in the Dongola, Vienna, and Brownfield Quadrangles: Illinois State Geological Survey, Report of Investigations 60, 11 p. and map, 1:62,500.