Illinois Preliminary Geologic Map
IPGM Murphysboro-BG

Bedrock Geology of Murphysboro Quadrangle

Jackson County, Illinois

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Stratigraphy

Pennsylvanian System
Atokan and Desmoinesian Series
Tradewater Formation

The lower part of the Tradewater Formation is transitional between the pure quartz sandstones (quartz arenite) of the Caseyville Formation and the sublitharenites of the Upper Tradewater Formation (Potter and Glass 1958). The Tradewater is composed of silty gray shale, fine-grained sandstone, coal, and minor amounts of quartz pebble conglomerate.

The coals are highly variable, from less than one inch to several feet thick. The Murphysboro Coal (fig. 1) has been mined by surface and underground methods at numerous sites in the Ava Quadrangle to the northwest. It is currently being mined at the Creek Paum Mine in the Ava Quadrangle.

Above the Murphysboro Coal, an unnamed gray, silty-shale, commonly showing tidal rhythmites has been observed. Joe Devera (personal communication) observed a *Conosticus sp.* (sea anemone trace fossil) in the northeast corner of the Raddle Quadrangle above a two-foot carbonaceous zone that may correlate with the Murphysboro Coal. Above the silty gray shale, a thin coal is present in places that correlates with the Mt. Rorah Coal Member. This coal is typically only a few inches to 3 to 4 feet thick and is overlain by a fine-grained sandstone or silty shale.

Utilizing primarily electrical logs, Jacobson (1983) mapped a linear sandstone in the region and placed this sandstone at the same stratigraphic level as the Murphysboro Coal and attached the name Oraville Channel to this feature. This sandstone is present along the western edge of the Murphysboro Quadrangle and the eastern edge of the Oraville Quadrangle to the west. Jacobson (1983) considered the Oraville Channel to be lateral to the Murphysboro Coal in what he interpreted as a fluvial-dominated environment. The thicker coals that he mapped appeared to be aligned parallel to this "sandstone paleochannel" and the coal splits were interpreted as a result of crevasse splays along the margins of the channel.

Cores drilled by the ISGS during the spring of 2005 on the Ava Quadrangle to the north and west of the Murphysboro Quadrangle, suggest some slight differences in the interpretations by Jacobson in 1983. The stratigraphic relationship of the sandstone observed in these borings suggests that the sandstone found in Jacobson's "Oraville Channel" unit may be younger than the Murphysboro Coal possibly equivalent in time to the Mt. Rorah Coal, found about 30 to 50 feet above the Murphysboro Coal. The clastic sediments found at the Murphysboro horizon appear instead to be part of an eustarine-dominated system rather than a fluvially-dominated one as originally inferred by Jacobson. The splits within the upper portion of the Murphysboro may represent fluctuations in sea level or be the result of slow subsidence in the area along the sag formed to the east of the Bodenschatz-Lick Fault (BLF) (fig. 2). There are limestone and green and red shale beds several feet above the Murphysboro Coal in one of the ISGS borings from the Ava Quadrangle which fits well with the proposed eustarine model.

Above the Mt. Rorah, a thin coal may be present that we correlate with the Wise Ridge Coal. This coal is overlain by a claystone with abundant plant debris which grades into a calcareous shale and in places a thin limestone. The limestone unit has been identified in our mapping in adjacent quadrangles as the Seahorne Limestone. The Mt. Rorah, Seahorne, and Wise Ridge are not laterally continuous. Above the Seahorne is the Davis Coal which marks the base of the Carbondale Formation.

Carbondale Formation

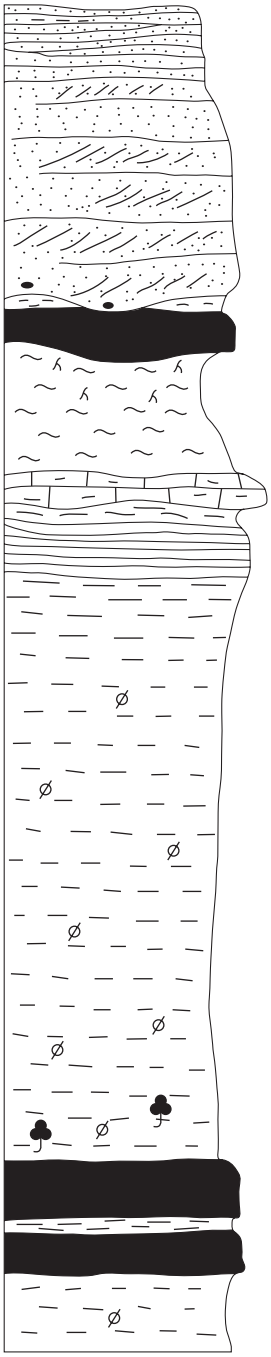
The Davis Coal averages about 3 to 4 feet thick throughout much of southern Illinois (Jacobson 1993). The Davis Coal appears to be relatively free of pyrite and probably is a high quality bituminous coal.

The Dekoven Coal is located above the Davis Coal, but is thin and discontinuous ranging from less than a foot to about 2 feet thick. In a few areas directly above the Davis we have noted a 3-foot shale bed with 0.8 feet of coal resting above it. This upper coal bed may be a lower split of the Dekoven Coal Member similar to that seen in southeastern Illinois, or may be a split within the Davis Coal. Typically the Dekoven lies 20 to 30 feet above the Davis.

Above the Dekoven, a coarsening upward sequence is normally present with a sandstone at the top. The Colchester Coal lies atop the sandstone, which is between 40 to over 60 feet above the Dekoven Coal. There usually is a thin sandy underclay at the base. The Colchester in this region is generally less than 1.0 foot thick and overlain by a black shale and limestone. The limestone is several feet thick and is known as the Oak Grove Limestone.

The Houchin Creek Coal is present approximately 40 to 50 feet above the Oak Grove Limestone. The Houchin Creek is usually less than 0.5 foot thick and overlain by thin black shale and then by a brown micaeous sandstone or limestone.

The Springfield Coal lies 70 to 80 feet above the Houchin Creek. The Springfield has been mined extensively throughout southern Illinois. This coal was mined along with the overlying Herrin Coal in most of the northeastern portion of the quadrangle. The Springfield Coal ranges from around 3 to 5 feet thick and the interval between the Springfield and Herrin Coal is 20 to 40 feet composed of sandstone, limestone, and shale. The Herrin Coal is 3 to 7 feet thick and is overlain by shale and limestone. The limestone unit is called the Brereton, the black shale is named the Anna Shale, while the silty-gray shale is called the Energy Shale. In a small



15 ft. Vergennes Sandstone Member, coarse, friable, micaceous, lower part cross-bedded, plant casts, erosional lower contact.

1.5 to 3 ft. Mt. Rorah Coal Member

4 to 8 ft. Claystone, stigmarian roots; formerly mined for making bricks

1 to 2 ft. Creal Springs Limestone Member, argillaceous, upper part nodular to conglomeratic; contains fusulinids, brachiopods, corals, echinoderm frements

3 ft. Shale, black, fissile, “slaty”, contains Lingula, Orbiculoidea

30 ft. Shale, upper part dark gray, remainder medium gray, weakly fissile, siderite concretions common, fossil plants in basal 3 ft.

5.9 ft. Murphysboro Coal Member, comprising upper 3.0 ft. Coal, middle 0.7 ft. Shale, lower 2.3 ft. Coal.

15 ft. Shale, gray, siderite concretions, poorly exposed, base at Big Muddy River.

Figure 1 Type section of the Murphysboro Coal in ravine, NW 1/4 SE 1/4, Sec. 9, T9S, R2W, Jackson County. From field notes by H.R. Wanless, 1932; H.E. Culver, 1922-1924; G.H. Cady, 1921; (drafted by J. Nelson 2007).

area in the NE corner of the Murphysboro Quadrangle additional strata (consisting of limestones, shales and sandstones and 3 feet of Danville Coal) are noted in at least one drill hole record. The Danville Coal in this drill hole was found about 70 feet above the Herrin Coal. The Energy Shale here is locally up to 25 to 30 feet thick, with the Anna and Brereton overlying this gray silty Energy Shale.

Structure

Regional Picture

The Murphysboro Quadrangle is situated near the southwestern margin of the Illinois Basin. Across the Mississippi River in Missouri lies the Ozark Dome, a persistently high area that was uplifted repeatedly through geologic time

while the Illinois Basin was warped downward. The Illinois Basin subsided intermittently throughout the Pennsylvanian Period. In consequence, Pennsylvanian and older rock strata of Jackson, Perry, and Randolph Counties have been tilted gently toward the northeast. Faults and folds greatly modify regional dip in the Murphysboro Quadrangle.

Several tectonic features (figs. 2 and 3) have effected the Murphysboro Quadrangle; 1) the Ste. Genevieve Fault Zone, and 2) Bodenschatz-Lick Fault Zone. The timing of each feature has implications for the economic geology of the region. Stratigraphic information implies at least a portion of the faulting occurred after the deposition of the Caseyville, but prior to the deposition of the Tradewater, producing an unconformity on the Caseyville surface.

Ste. Genevieve Fault Zone

The Ste. Genevieve Fault Zone, located approximately 10 miles southwest of the Murphysboro Quadrangle, trends northwest. Structural offset on the Ste. Genevieve in this region exceeds 3,000 feet (Nelson 1995). The Ste. Genevieve was active during Ordovician, Devonian, and late Mississippian into the Pennsylvanian, with the latest period being reverse movement with the southwest block being uplifted. Several workers have proposed strike-slip movement along this structure (Heyl 1972, Clendenin et al. 1989, Schultz et al. 1992). The Bodenschatz-Lick Fault crosses the Ste. Genevieve at 90 degrees and the relationship between these two faults is not well documented.

Bodenschatz-Lick Fault

The steeply dipping eastern limb of the Bodenschatz-Lick Fault (BLF) (figs. 2 and 3) can be observed at the surface to the west in the Oraville Quadrangle where a prominent topographic ridge is present. This topographic high was recognized by Root (1928) who related this feature to a structure which he named the Levan Anticline. Shaw and Savage (1912) depict this structure plunging 150 feet per mile down to the east and diminishing northward. Nelson (1995) suggested the Levan Anticline was actually a monocline related to the Bodenschatz-Lick Fault and therefore discarded the term 'Levan'. Nelson and Lumm (1985) traced the BLF using subsurface data and determined that the fault extends northeast from south of the Ste. Genevieve Fault Zone in Missouri and merges with the Cottage Grove Fault Zone in

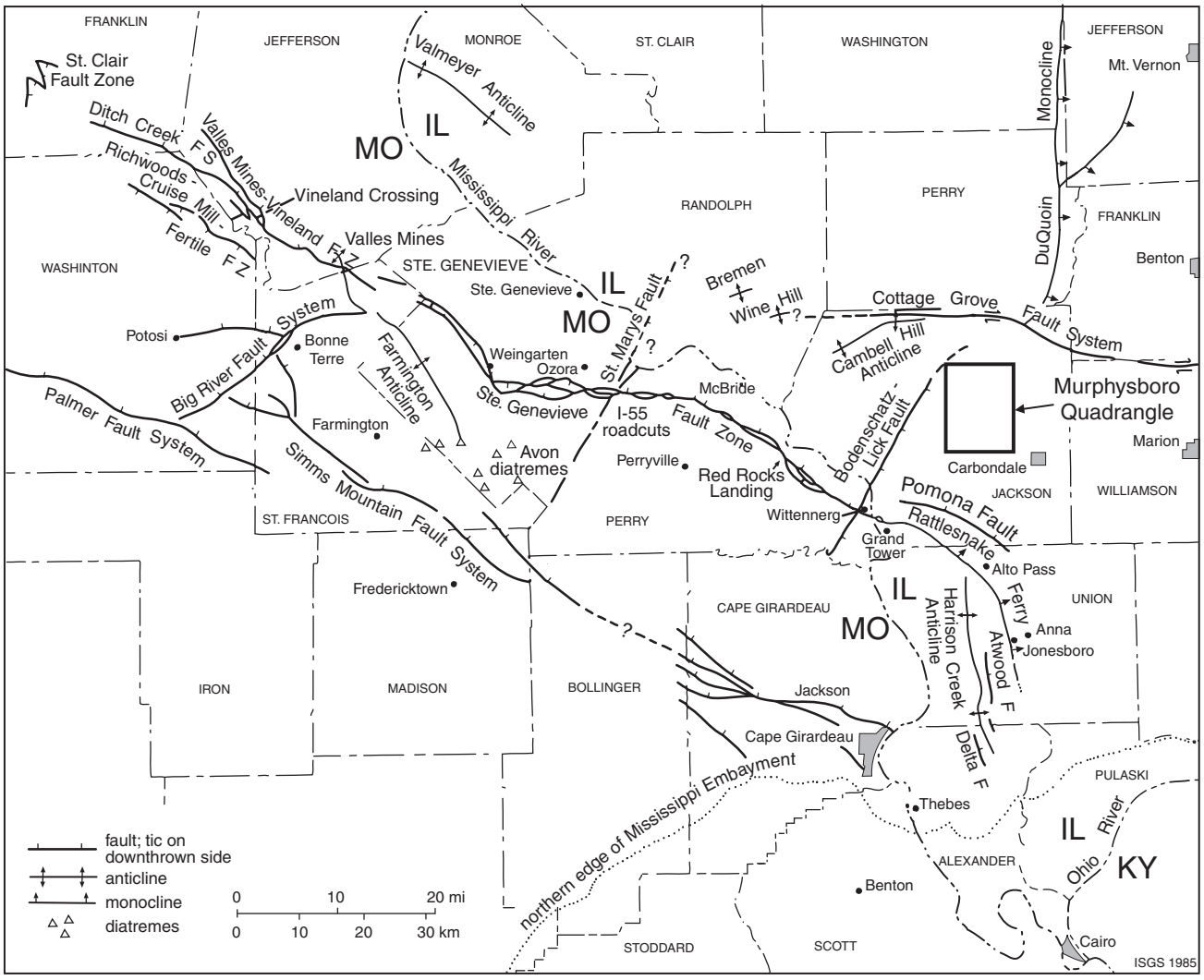


Figure 2 Regional structural geology of southwestern Illinois and southeastern Missouri (adapted from Nelson and Lumm 1985).

Jackson County, Illinois. Nelson and Lumm suggested that there was an increase in vertical offset on units lower in the section and that the Pennsylvanian was folded into a monocline at the surface. Bristol (1968) mapped several hundred feet of vertical offset on the base of the Barlow Limestone (Mississippian Beech Creek Limestone) along this feature (fig. 3). There are indications that the sag produced to the east/southeast of this fault controlled Pennsylvanian sedimentation and the development of the estuarine environment noted at the Murphysboro-Mt Rorah interval of the Tradewater Formation.

Summary

At least three and probably four periods of movement are needed to explain the tectonic activity within this area. The seismic lines published by Duchek et al. (2005) depicts these movements. The first period of movement is extensional and rifted the Precambrian Basement which was then filled with Knox Group sedimentation. The second period of movement is probably related to the regional uplift of the Sparta Shelf northeast of the Ste. Genevieve Fault Zone during the Devonian. The Sparta Shelf is defined as the southern portion of the Western Shelf that defines the western flank of the Illinois Basin (Nelson 1995). This Western Shelf exhibits a slower rate of subsidence than the area to the east of the Du Quoin Monocline, which marks its eastern boundary. The unconformity near the top of the Knox Group probably relates to this regional uplift.

The third period of movement effectively raised the southern portion of the region along the Cotage Grove Fault (seen to the north on the Vergennes Quadrangle). It is also likely that movement on the Bodenschatz-Lick Fault occurred simultaneously with this Early Pennsylvanian (Atokan) event. The unconformity along the flanks of the Campbell Hill Anticline (to the north and west) between the Caseyville Sandstone and the Tradewater Formation supports this tectonic event (Denny 2005a). The stratigraphic correlation of the early Desmoinesian Murphysboro strata indicate that along the down-thrown side of the Bodenschatz-Lick Fault, marine limestones are present while on the up-thrown side fine-grained intertidal and eustarine deposits were being deposited. This also indicates that movement may have been active during early Desmoinesian. During middle to late Desmoinesian the region was apparently fairly stable and widespread coal formation was prolific.

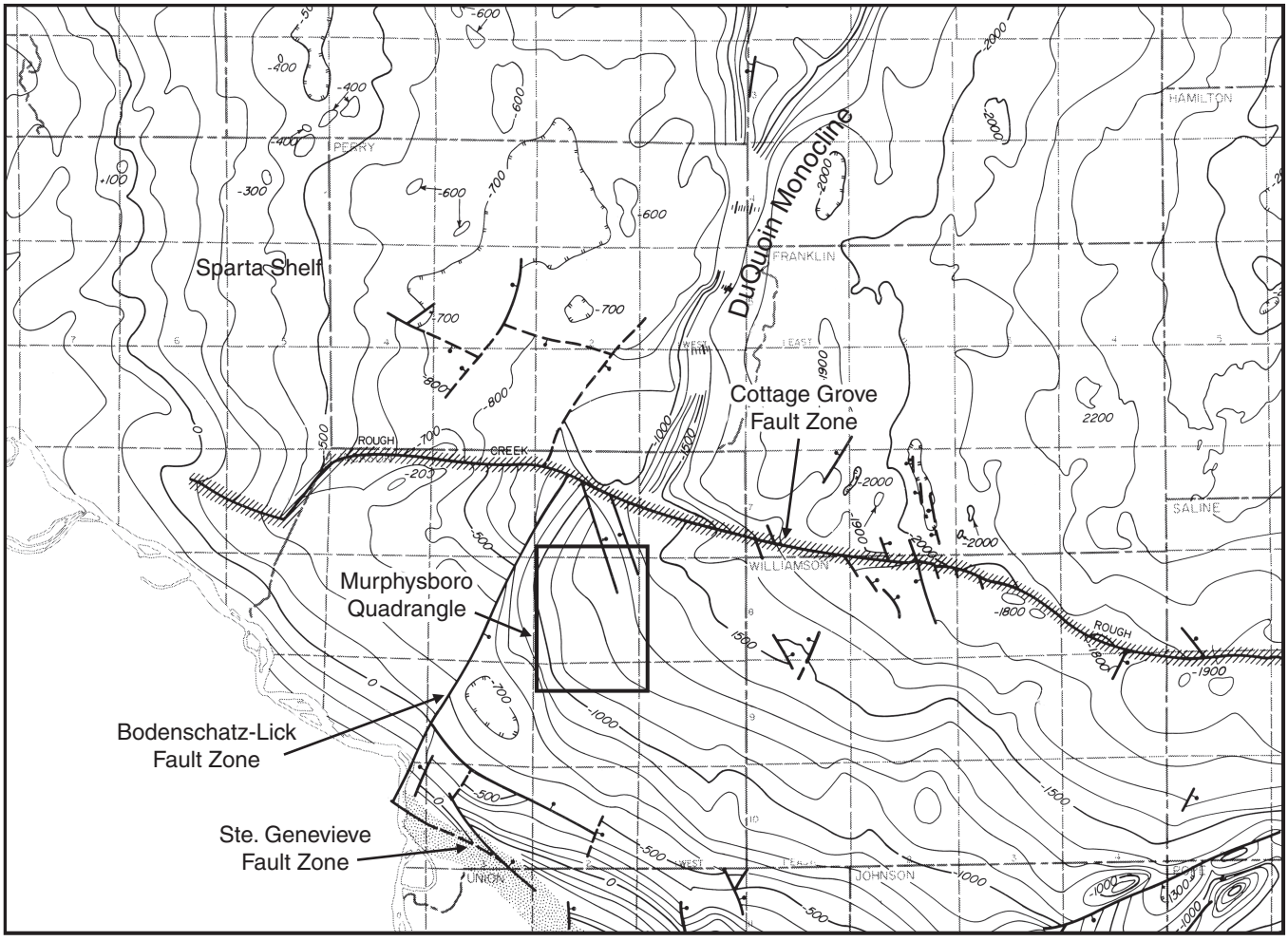


Figure 3 Structure contour on the base of the Barlow Limestone (Mississippian, Golgonda Formation). Note that the Cottage Grove Fault has been labeled the Rough Creek Fault Zone (modified from Bristol 1968).

The fourth period of movement (post-Desmoinesian) occured as reverse movement along the south side of the Cottage Grove Fault Zone to the north of the Murphysboro Quadrangle (on the Ava and Vergennes Quadrangles). Anticlines along the Cottage Grove Fault Zone have been described by Nelson and Lumm (1985). With the exception of the Cottage Anticline in Saline County, which is related to a Permian igneous intrusion (Denny 2005b), they are confined to the southern portion of the Cottage Grove Fault Zone. This leads to the speculation that reverse movement along the western end of the Cottage Grove Fault Zone is related to deep-seated, northerly directed post-Desmoinesian compressional force. This movement may be related to continental compression from the Ouachita region. Alternatively, the final period of movement may be a result of east-west transpression along a Precambrian crustal boundary during Permian (Nelson and Krausse 1981, Duchek et al. 2005). The horizontal striations along small northwesterly trending faults observed in the Creek Paum Mine tend to support the transpressional theory (Denny 2005a).

Economic Geology

Coal

Coal has been mined extensively within the Murphysboro Quadrangle. While no mining is currently active on the quadrangle, a single mine currently extracts the Murphysboro Coal to the north and west of this quadrangle on the Ava Quadrangle. The Murphysboro Coal is a high quality, low sulfur bituminous coal (Jacobson 1983). Murphysboro Coal in excess of 3.5 feet thick should be present at depths less than 200 feet in much of the western portion of the Murphysboro Quadrangle, except in the area in and around Murphysboro where most of the coal has already been mined out utilizing underground methods in the late 19th and early 20th centuries. Borings in the area have encountered up to 5 feet of Murphysboro Coal. More of the northwestern half of the quadrangle should be drilled to determine the quality and thickness of the Murphysboro Coal north of the area already mined out.

The Davis Coal was observed in borings in this quadrangle as well as the Ava and Vergennes Quadrangles to the northwest and north. It was observed to be bright banded with few partings and little pyrite, ranging from less than 1 foot to over 3 feet thick. Above the Davis a coal up to 2 feet thick is seen in some drill holes which may be the Dekoven Coal. The Dekoven Coal appears to be shaley and probably would be of marginal quality.

The Herrin and Springfield Coals have been mined along the north and eastern half of the Murphysboro Quadrangle and are mostly mined-out. The Houchin Creek and Colchester Coals have been identified in this area but are found to be less than 2 feet thick in most borings.

Oil and Gas

Only a few wells have been drill on the Murphysboro Quadrangle in search of oil and gas. Little or no production has resulted from this exploratory drilling to date.

Acknowledgments

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