STATEMAP
Coal Valley-BG

Bedrock Geology of Coal Valley Quadrangle

Rock Island and Henry Counties, Illinois

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Introduction

Geographic location and geomorphological framework

The Coal Valley 7.5-minute Quadrangle is located in the Quad Cities area, Rock Island and Henry Counties, in northwestern Illinois. The study area is about 73 miles southeast of Cedar Rapids (Linn County, Iowa), 91 miles southwest of Rockford (Winnebago County), 89 miles northeast of Illinois-Iowa-Missouri border, and 68 miles northwest of Peoria (Peoria County). Map coverage extends to the east from the Davenport East and Milan Quadrangles, to the west from Green Rock Quadrangle, to the north from Orion Quadrangle and south of the Silvis Quadrangle. The quadrangle covers approximately a 55 square mile area that is bounded by 41°22'30" and 41°30'00" North latitude and 90°22'30" and 90°30'30" West longitude. The Coal Valley Quadrangle is mostly residential, in which the village of Coal Valley, Sunny Hill Estates and Warner township are located in the central and southern parts, while the cities of Moline, East Moline, Silvis and the village of Carbon Cliff are located in the north part of the quadrangle. The commercial development is centered north of the Coal Valley area. The principal industry is manufacturing and agriculture (e.g., corn and soybean) with the minor livestock (e.g., cow) south of the quadrangle. The manufacture of farm implements is of primary importance. Forestry and lumbering is limited to small portions of the Coal Valley area. No current coal mining operations are withing the quadrangle, however over 3,846,000 tons of coal were mined between 1847 and 1948. Old mines are mainly located in the area around the village of Coal Valley and in the southeastern and eastern portions of the Moline Upland (Obrad and Chenoweth 2009). As of the 2019 U.S. Decennial census, the population covered by the quadrangle was estimated less than 70,000.

The topography of the Coal Valley Quadrangle mainly consists of upland plains, highly dissected valley sides, terraces and flood plains (Figure 1). The upland plains are at elevations up to 700 feet in extreme northern (e.g., Moline Upland) and southern areas of the quadrangle. They form a gently rolling glacial moraine deposits, mainly composed of loess and silt of the Roxana Silt that is bordered by dissected valley sides. The dissected valley sides and terraces are at elevations between 600 and 700 feet and are the most topographic surface morphologies in the Coal Valley area. They consist of till and clay of the Kellervillle Till Member of the Glasford Formation, in which erosion by tributaries (e.g., Coal, Shaffer and Mosquito Creeks) of the Rock River has produced highly dissected topography. A flood plain is located along the Rock River in the central part of the quadrangle. Its elevation ranges between 550 and 600 feet. Silt, sand and gravel of the Cahokia Formation are the main lithology. The surface units are part of the Illinois and Iowa Deep Loess and Drift ecoregion that was formed during the Illinoisian Glacial Episode. Glacial deposits were not mapped in this study. Bedrock surface is largely concealed beneath these sediments that range in thickness from less than 5 to 135 feet following the degree of the differential erosion. Thinner Quaternary sediments are located along Rock River. Bedrock exposures occur in the Coal Valley Quadrangle in a few outcrops mainly located south and north of the Rock River, and its south-oriented tributaries.

The geologic map lies near the northern margin of the Illinois Basin and is located in a structurally complex area along the eastern side of the Mississippi River Arch (Howell 1935). This structural feature has a north by northeast trend affecting northeastern Missouri, northwestern Illinois and southeastern Iowa (Devera and Krienert 2020). Strata in the Coal Valley Quadrangle are structurally tilted (Culver 1923). Erosive surfaces related to the unconformity between Devonian and Pennsylvanian strata have been identified along Shaffer Creek. The oldest bedrock exposure in the Coal Valley area is the Cedar Valley Limestone (Middle Devonian). Most bedrock outcrops in the quadrangle, are the Tradewater Formation (Upper Carboniferous, Middle Pennsylvanian). The oldest subsurface stratigraphic unit, identified in water well data, is the Mount Simon Sandstone (Middle-Upper Cambrian).

Previous work and Conditions of establishment of the geologic map

The geology of Rock Island County was firstly described by A.H. Worthen and J. Shaw (1873). Early statewide geologic maps at scale 1/500,000 have illustrated previous geological features of Rock Island and Henry Counties (Worthen et al. 1875; Weller 1906). Norton (1889) mapped Silurian, Devonian and Pennsylvanian strata in Scott County, Iowa, which is adjacent to Rock Island County. The first geologic investigations and descriptions in the Coal Valley Quadrangle were conducted by J.A. Udden (1912), then later by H.E. Culver (1921-1924). Geology and mineral resources of the Edgington and Milan Quadrangles in Rock Island County were published by T.E. Savage and J.A. Udden (1921). Other geologists (Ekblaw 1930; Wanless and Ekblaw 1930; Wanless 1930; Workman 1931; Benson 1935; Moody 1958: Parham 1959; Searight 1964) also identified and described outcrops in the area. W. Parham (1961) described the clay resources of Rock Island County. The bedrock geology was reinterpreted by T.C. Buschbach (1965). J.E. Brueckmann and R.E. Bergstrom (1968) published the ground-water geology of the area. One year later, a statewide geologic map of Iowa showed the distribution of geologic units at the bedrock surface in Scott County (Hershey 1969). The geology, mineral resources and hydrogeology of Rock Island County has been reported for land use and regional planning (Anderson 1980). Silurian stratigraphy in the Quad Cities area, Iowa and Illinois, was revisited by B.J. Witzke (1994). The bedrock geologic map of northeast Iowa has delimited the stratigraphic contours of Scott County (Witzke 1998). A series of surficial and bedrock geologic maps from Scott County also show the stratigraphic contours of the area (Witzke et al. 1998; McKay et al. 2009; Tassier-Surine et al. 2009a,b; McKay et al. 2011). In Illinois, the geology of the Rock

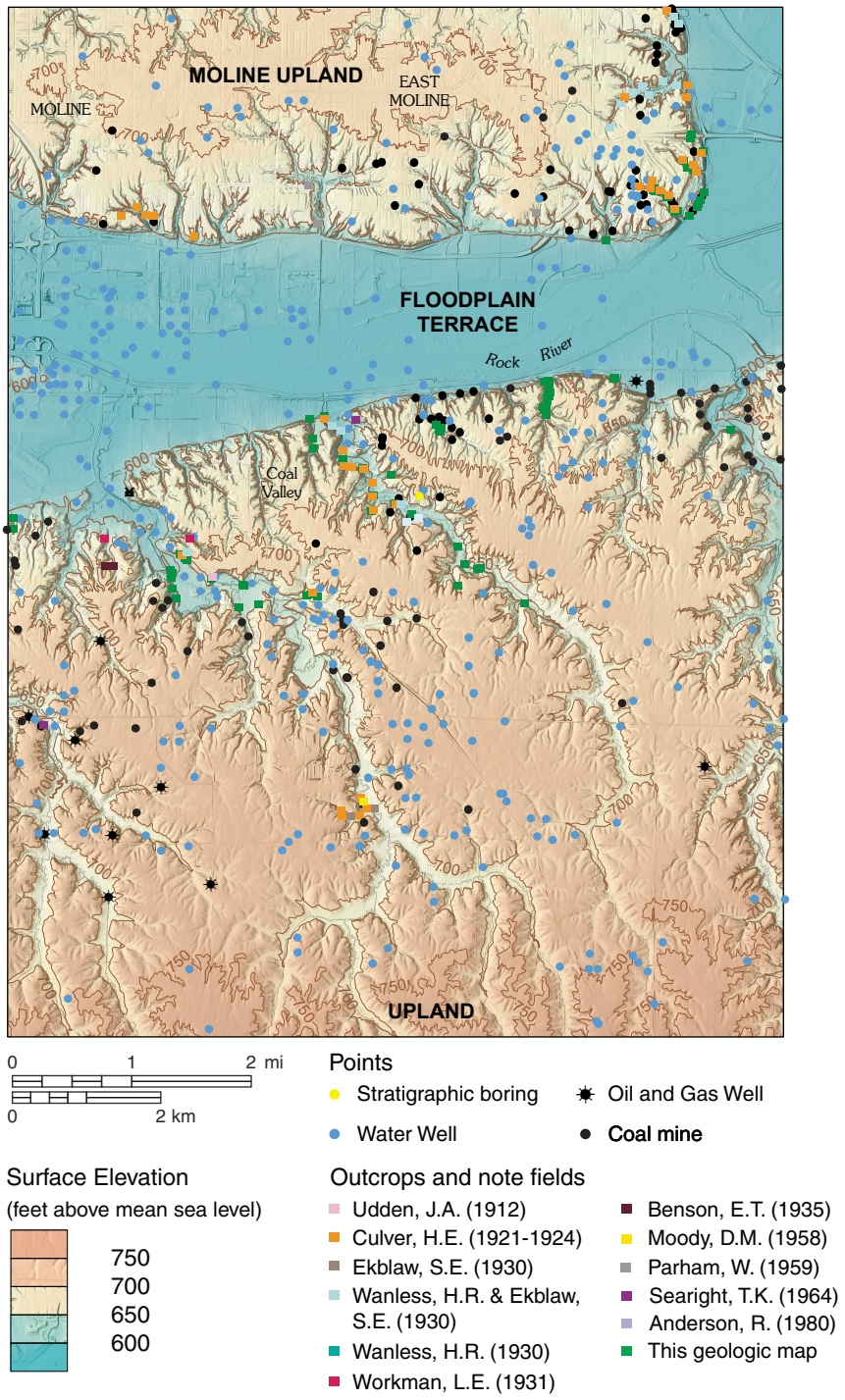

Figure 1 Index map of Coal Valley Quadrangle and location of data points. Data density does not allow all individual points to be shown at this scale.

Island-Milan areas was generalized in the fieldtrip guidebook 1999B (Anderson et al. 1999). New understandings of the Middle Devonian depositional system in Rock Island County were interpreted by J. Day (2006) and B.J. Witzke and B.J. Bunker (2006a,b). The bedrock geology of Rock Island and Henry Counties has been reinterpreted in the statewide geologic map of Illinois (Kolata 2005). Detailed surficial geology of Rock Island and Henry Counties, showing exposures of bedrock geology, was mapped by R.C. Anderson and X. Miao (2011, 2016). Structural geology in the Coal Valley area has been described by H.E. Culver (1923) and J.V. Howell (1935). The stratigraphic nomenclature system of Rock Island County was recently revised by Devera and Krienert (2020), because the nomenclature of the stratigraphy in the Illinois Quad Cities area has been long overdue. The authors have reassigned the Racine Formation to the Gower Forma-

tion, in which the lithology was previously attributed as this stratigraphic unit in the Quad Cities area by Norton (1899). Such nomenclature change has been already proposed by Witzke (1992, 1994), in which the Illinois nomenclature of Racine Formation along the Mississippi River area has been reassigned to, from the base to the top, the upper Hopkinton, Scotch Grove and Gower Formations. Underlying Silurian strata have been identified in the Quad Cities area in Iowa, and consist, from the oldest to the youngest, into Mosalem, Tête des Morts, Blanding, and lower Hopkinton Formations (Witzke 1994). The Mosalem and Tête des Morts Formations have been only recognized north of the Quad Cities area, Iowa, in which these strata overstep by the Blanding Formation to the south and west (Witzke 1992). The Sweeney and Marcus Formations in Illinois are reassigned as Members of the Scotch Grove Formation in Iowa. Such adoption of change for an identical stratigraphic terminology and rank should be applied for the Quad Cities area. However, due to the lack of exposures and widely scattered and not detailed water wells, the Silurian System is mapped in a single stratigraphic unit. Another nomenclature change in the Quad Cities area in Illinois is the reassignment of the lower Pennsylvanian Caseyville Formation to the Muscatine Formation (Nelson et al. in progress). The lower Ordovician Oneota Dolomite, New Richmond, Shakopee Formation and Gunter Sandstone are grouped into Prairie du Chien Group due to the difficulty of differentiation in the water wells.

The geologic map of the Coal Valley Quadrangle is based on the compilation of data from bedrock exposures in natural bluffs along the Rock River and its tributaries, and from the examination of 632 plat verified water wells and 9 oil and gas well records from the Illinois State Geological Survey's water well database (ILWATER), 79 drill cuttings stored at the ISGS core library, and 126 coal mine records from the Illinois State Geological Survey's coal mine database (ILMINES) (Figure 1). All sample sets of rock cuttings were examined at the ISGS Geological Samples Library by F. Delpomdor. Archived field notes from previous geologists are used as reference sections. A Two hundred sixty feet stratigraphic test boring was drilled through the Quaternary to the Middle Devonian Wapsipinicon Limestone for stratigraphic investigations on the Niabi Zoo's property located 886 feet south of the Niabi Zoo Rd bend to the border between Rock Island and Henry Counties (API 121612475400; total depth: 260 feet; 150 feet and 860 feet respectively from the east and north lines sec 25, T 17 N, R 1 W; GPS coordinate: N41.439722°, W090.433301°). The core and stratigraphic descriptions are archived at the ISGS Geological Samples Library and at the ISGS Geologic Records Unit, respectively. Five samples of coal and carbonaceous shale were analyzed by Prof. Cortland F. Elbe of the Kentucky Geological Survey for palynologic and petrographic analysis. Field work for this study was completed during the 2020-2021 field season by the author.

Stratigraphy

Eighteen stratigraphic units are identified on bedrock exposures, water-wells, oil and gas wells records, and a stratigraphic test boring. They range in age from Middle-Upper Cambrian to Quaternary. Four of these units crop out in the study area, ranging in age from Middle Devonian to Quaternary. Only the Muscatine (Caseyville) and Tradewater Formations are known to contain coal beds, most of which are Middle Pennsylvanian. All boreholes used in this investigation are represented in diagrams showing the distribution of borings in graphic columns that have sample studies (Figures 2 and 3). A brief description of each unit is presented to aid in unit recognition and to provide a stratigraphic picture of formations shown on the geologic map.

Cambrian System

The oldest stratigraphic units known in the subsurface in the quadrangle is from the Christianson Brothers's water well (API 121610021000, total depth: 2,890 feet), located 0.2 miles east Friendship Farm Rd in SE¼ SE¼ NE¼ sec. 8, T 17 N, R 1 E. From oldest to the youngest, those of the Middle-Upper Mount Simon Sandstone and the Upper Cambrian Eau Claire Formation, undifferentiated Galesville-Ironton Sandstone, Franconia Formation, Potosi Dolomite and Eminence Formation. These six units within the Cambrian succession are grouped together, because surface exposure is missing, and well records are widely scattered and not detailed. The description of the Cambrian System in the Coal Valley area is based on cutting rocks that have been collected between 1,720 and 2,890 feet in depth (Figure 2).

Mount Simon Sandstone The Mount Simon Sandstone takes its name from Mount Simon, an escarpment near Eau Claire, Wisconsin, where the type section displays coarse-grained, partly conglomeratic, sandstone over a Precambrian granite (Ulrich 1914). The formation consists of red to red-orange, clear gray to yellow when leached, fine- to coarse-grained, mainly moderately, quartz arenite with a few partings of greenish-grey to brick red-maroon silty mudstone. Its maximum thickness is 976 feet thick in the vicinity of southeast East Moline, but undoubtedly it thickens eastward from this location. The boundary with the crystalline Precambrian basement is not encountered in the well. The contact between the Mount Simon Sandstone and Eau Claire Formation is not observed, however, the distinct change of lithology shows a sharp contact. T.C. Buschbach (1975) has indicated that this contact is conformable.

Eau Claire Formation The Eau Claire Formation is named for Eau Claire, Wisconsin, where the type section is mainly thin-bedded, partly shaly, fossiliferous sandstone (Ulrich 1914). In the Coal Valley area, the formation consists of three different kinds of lithologic assemblages described, from the oldest to the youngest, as follow:

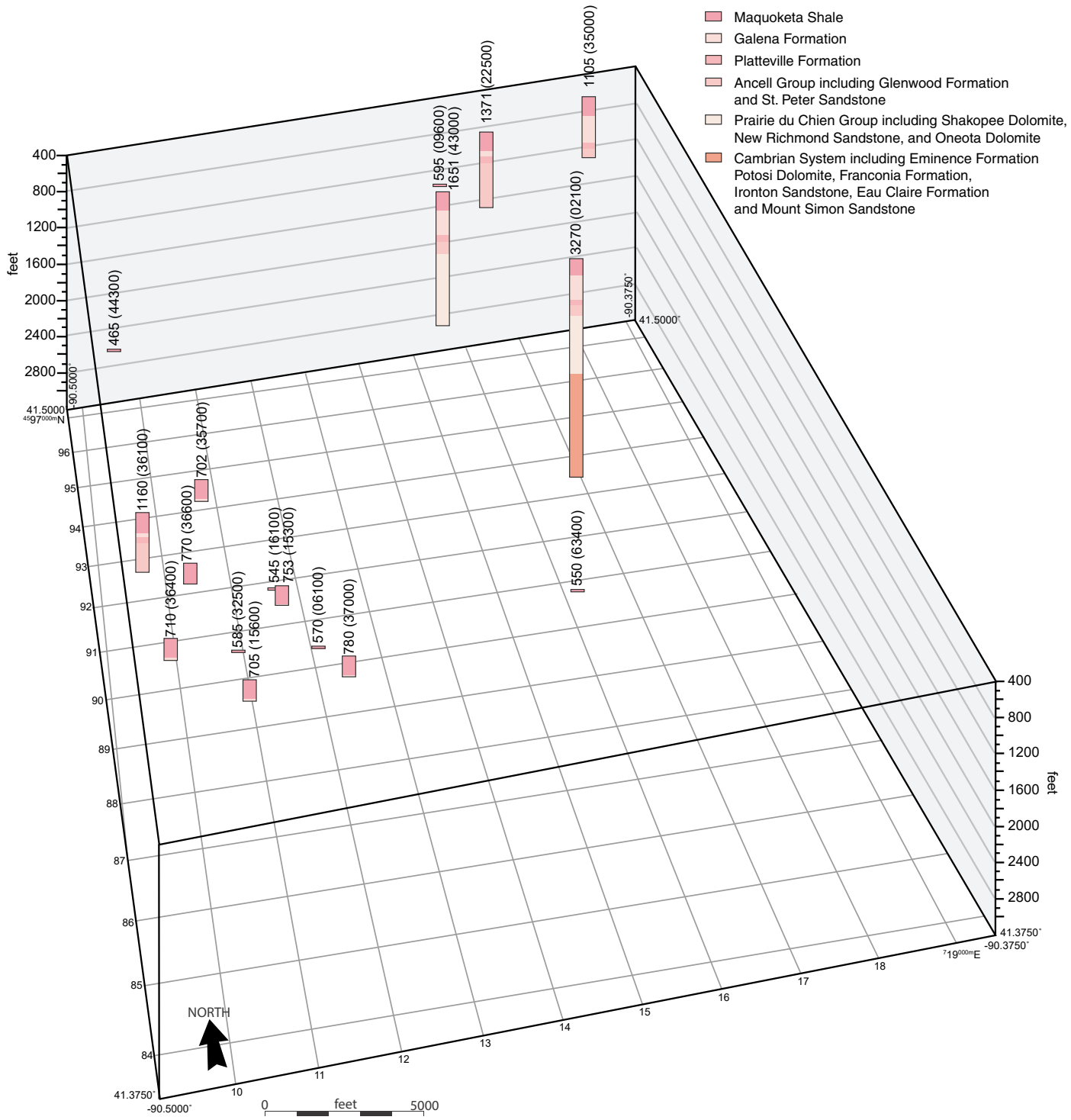

Figure 2 Projected lithologic logs of water wells, oil and gas wells and stratigraphic test boring crossing the Middle-Upper Cambrian to Upper Ordovician within the Coal Valley Quadrangle, Rock Island and Henry Counties. Vertical scale is exaggerated.

(1) As much as 15 feet thick light gray, fine- to medium-grained, moderately sorted, sandstone with thin gray shale partings, that is attributed to the Elmhurst Sandstone Member. A "sooty" sandstone, that has been formerly described by Workman and Bell (1948), is observed near the contact with the Mount Simon Sandstone. It consists of dark gray, medium-grained, moderately sorted, pyritous sandstone;

(2) Approximately 53 feet thick light gray to greenish-gray, medium-grained, moderately sorted, glauconitic sandstone containing a few greenish-gray shale partings. This unit corresponds to the Lombard Dolomite Member, which has been defined by T.C. Buschbach (1964), and northeastward to glauconitic sandy dolomite and southward to shaly materials;

(3) As much as 60 feet thick red, fine-grained, well sorted, dolomitic sandstone with greenish shale partings, which is overlain by ~105 feet of thick light gray sandy siltstone. This unit is attributed to the Proviso Siltstone Member, where it is sandy in northern Illinois, and becomes more shaly to the south.

The maximum thickness of the Eau Claire Formation is estimated around 223 feet in the Coal Valley area. The contact with the undifferentiated Galesville-Ironton Sandstone is not observed in the Christianson Brothers's water well, but it is regionally considered as gradational (Buschbach 1975).

Undifferentiated Galesville-Ironton Sandstone The Galesville and Ironton Sandstones are grouped together because the Galesville Sandstone is not easily recognized with the overlying Ironton Sandstone in the well. The Galesville Sandstone takes its name for Galesville, Wisconsin, where the type section is exposed along Beaver Creek (Trowbridge and Atwater 1934). The Ironton Sandstone is named for Ironton, Wisconsin, where it consists of a few feet of calcareous, coarse-grained sandstone beds (Thwaites 1923). In the Coal Valley area, these units consist of 139 feet of gray, light buff to yellow-orange when weathered, fine- to medium-grained, poorly to moderately sorted, friable sandstone that becomes coarser and dolomitic at the top (e.g., Mooseheart Member). A pinkish to red-colored sandstone occurs at the base between 2,065 and 2,075 feet in depth. In north Illinois, their maximum cumulated thickness ranges between 90 feet and 200 feet (Buschbach 1975). The subdivisions of these units (e.g., the Bueller, Fox Valley, Marywood and Mooseheart Members) are not identified due to the poorly detailed lithological descriptions of wells. The Ironton Sandstone is conformable with the overlying Franconia Formation (Buschbach 1975).

Franconia Formation The formation is named for Franconia, Minnesota, where the type section consists of shale and sandstone (Berkey 1897). In Illinois, the Franconia Formation was first recognized by L.E. Workman (1935), where the type section near Oregon exposes a gray to pink, glauconitic, dolomitic sandstone. In the quadrangle, the unit consists of undifferentiated gray fine-grained, glauconitic, dolomitic sandstone with green shale partings. The Davis and Derby-Doerum Members are not identified in the Christianson Brothers's water well. Its maximum thickness is around 96 feet, but its maximum thickness is regionally estimated around 150 feet (Buschbach 1975). The Franconia Formation thickens southward from about 50 feet near the border between Wisconsin and Illinois to 500-700 feet thick in the southern part of the state. The Franconia Formation is usually overlain conformably by the Potosi Dolomite (Buschbach 1975).

Potosi Dolomite The Potosi Dolomite takes its name for Potosi, Missouri, where the type section shows a relatively pure dolomite (Winslow 1894). In the Coal Valley area, the formation consists of pinkish gray to buff when weathered, finely crystalline, relatively pure, glauconitic, dolomite with sandy dolomite in the lower part locally. Drusy quartz filling small cavities are observed in cutting rocks. Its maximum thickness is around 120 feet, but it is estimated between 100 and 200 feet thick in northwest Illinois (Buschbach 1975). The Potosi Dolomite is conformable with the overlying undifferentiated Prairie du Chien Group.

Eminence Formation The Eminence Formation is difficult to recognize due to the similarity of lithology with the overlying Lower Ordovician Gunter Sandstone in the Christianson Brothers's water well. The Eminence Formation takes its name for Eminence, Missouri, and was extended in Illinois by L.E. Workman and A.H. Bell (1948), then T.C. Buschbach (1964). In northwest Illinois, the maximum thickness of the Eminence Formation is estimated between 50 and 100 feet. The Christianson Brothers's water well contains as much as 80 feet thick of light gray, medium-grained, sandy dolomite and fine- to medium-grained, mainly well sorted, sandstone. The contact with the overlying Gunter Sandstone is not observed.

Ordovician System

The Ordovician System occurs throughout northwestern Illinois, but is not exposed. Its maximum thickness ranges between 1,000 and 1,200 feet, and increases to about 5,000 feet at the southern border of Illinois. In the Coal Valley area, the Ordovician System is observed in the subsurface in 17 water, oil and gas well records and cuttings, which are mainly located in the west-central and northeast sides of the quadrangle (Figure 2). They range in age from Ibexian to Cincinnatian of the Lower to Upper Ordovician in North America (Tremadocia-Floian? to Katian Stages of the Lower to Upper Ordovician). This system comprises, from the oldest to the youngest:

1) the undifferentiated Prairie du Chien that includes the Gunter Sandstone, Oneota Dolomite, New Richmond Sandstone, Shakopee Dolomite;

2) the Ancell Group that includes the St. Peter Sandstone and Glenwood Formation;

3) the Sinnipee Group, that includes the Platteville and Galena Formations; and
4) the Upper Ordovician Maquoketa Shale Group (Willman and Buschbach 1975).

Undifferentiated Prairie du Chien Group This group is observed in the subsurface in the Christianson Brothers's water well (API 121610021000, total depth: 2,890 feet), located 0.2 miles east Friendship Farm Rd in SE¼ SE¼ NE¼ sec. 8, T 17 N, R 1 E, and the John Deere Co's water well (API 121610043000, total depth: 1,651 feet), located 0.5 miles north-northeast of the intersection between the John Deere Pl. and John Deere Pkwy. in SW¼ NE¼ SW¼ sec 7, T 17 N, R 1 E, where respectively 535 and 491 feet thick mainly dolomite crop. The Prairie du Chien Group is named for exposures near Prairie du Chien, Wisconsin (Bain 1906). In the wells, the Prairie du Chien Group consists from the oldest to the youngest:

1) 20-30 feet thick light gray, fine-to medium-grained, moderately sorted, dolomitic sandstone;
2) 351 feet thick light gray, fine- to medium-grained, slightly pure to sandy, cherty dolomite;
3) 150 feet thick light gray to buff when weathered, fine-grained to crystalline, slightly pure to argillaceous, sandy dolomite and light, medium-grained, poorly to moderately sorted, sandstone.

The contact with the overlying St. Peter Sandstone is unconformable and is attributed to the Sauk Sequence (below) from the Tippecanoe Sequence (above) (Willman et al. 1975).

Ancell Group The Ancell Group is named for several sections in the bluffs north of Ancell, Missouri, where the type section consists of sandstone, argillaceous and sandy limestone and dolomite that overlie the Everton Dolomite and underlie the Platteville Formation (Templeton and Willman 1963). The basal unit is the St. Peter Sandstone that underlies the Glenwood Formation. The range in age of the Ancell Group is Upper Whiterockian to Lower Mohawkian of the Middle-Upper Ordovician in North America (Sandbian Stage of the Upper Ordovician). The Ancell Group is not exposed in the quadrangle, but it was observed in 5 subsurface rock cuttings from wells bored for groundwater and petroleum resources (Figure 2).

St. Peter Sandstone The name of St. Peter Sandstone is taken for St. Peter River, Minnesota, that is now called the Minnesota River (Owen 1847). In the Coal Valley area, the St. Peter Sandstone consists largely of fine- to medium-grained, well sorted, well rounded, friable and weakly cemented, sandstone. In the Christianson Brother's and John Deere Co's water wells, respectively 5 and 15 feet thick greenish shale and light greenish fine-grained, argillaceous sandstone occur at the base (respectively 1,180-1,185 feet and 1,125-1150 feet). This fine-grained material is attributed to the Kress Member, while the coarser sandstone corresponds to the Tonti Sandstone Member. Bentonite, which occurs near the base of the Kress Member, is not identified due the difficulty to identify such material in cutting rocks. The maximum thicknesses of the Kress and Tonti Sandstone Members range respectively between 0 and 15 feet, and between 43 and 164 feet. The contact with the Glenwood Formation is sharp and conformable.

Glenwood Formation This formation is named for Glenwood Township, Iowa, where the type section consists of highly varied beds of sandstone, dolomite and shale (Calvin 1906). In the Coal Valley area, the Glenwood Formation is not exposed, but was observed in subsurface rock cuttings from 3 water and 1 oil and gas wells, all located in the upper half part of the quadrangle. The formation consists of four members, from the oldest to the youngest, the Kindgom Sandstone, Daysville Dolomite, undifferentiated Loughridge Sandstone and Nokomis. The youngest member of the Glenwood Formation, the Harmony Hill Shale Member, is absent in the wells. Its best representation in the subsurface are in the City of Silvis's water well (API 121612122500, total depth: 1,371 feet), located 712 feet southwest of the intersection between 17th Av. And 14th Av. in SW¼ NE¼ NE¼ sec. 5, T 17 N, R 1 E, and Wadsworth's oil and gas well (API 121610036100, total depth: 1,160 feet), located 725 feet west of the intersection between the Case Creek and 106th in SE¼ SW¼ SW¼ sec. 33, T 17 N, R 1 W; where the Glenwood Formation is respectively between 1,050 and 1,100 feet, and between 1,050 and 1,100 feet in depth. The formation comprises from the oldest to the youngest:

1) 12-20 feet thick greenish gray argillaceous and silty sandstone of the Kingdom Sandstone Member;
2) 4-8 feet thick greenish gray, light gray when weathered, argillaceous and silty dolomitic limestone and dolomite of the Daysville Dolomite Member;
3) 11-30 feet thick greenish gray argillaceous and silty sandstone of the undifferentiated Loughridge Sandstone and Nokomis Sandstone Members.

Its maximum thickness ranges between 25 and 50 feet. The Glenwood Formation is eroded or unconformable with the overlying Platteville Formation.

Sinnipee Group In Illinois, the name of the Sinnipee Group is reassigned for the former Ottawa Group by F. Delpomdor and J. Devera (2020). Its name is derived from Sinnipee, Wisconsin (Mudrey et al. 1982). The Sinnipee Group is composed, from the oldest to the youngest, the Platteville and Galena Formations. The range in age of this group is Upper Whiterockian to Lower Cincinnatian of the Middle-Upper to Upper Ordovician in North America (Sandbian Stage of the Upper Ordovician). The Sinnipee Group is only observed in rock cuttings from wells bored for groundwater and petroleum resources (Figure 2).

Platteville Formation The Platteville Formation takes its name for Platteville, Wisconsin, where the type section consists largely of limestone. In the Coal Valley area, the formation is divided into five members that are identified in rock cuttings from City of Silvis and Wadsworth's (API 121610036100; total depth: 1,160 feet; sec 33, T 17 N, R 1 W) water, oil and gas wells. They are the Pecatonica (oldest), Mifflin, and Grand Detour, Nachusa and Quimbys Mill Members. The stratigraphy of the Platteville Formation comprises from the oldest to the youngest:

1) 20-25 feet thick light gray, slightly argillaceous to pure, sandy, dolomite and light gray, fine- to medium-grained, mainly moderately sorted, sandstone of the Pecatonica Member;
2) 10-15 feet thick light gray, fine-grained, argillaceous dolomite with thin greenish gray shale partings of the Mifflin Member;
3) 30-40 feet thick light gray, locally cherty, slightly argillaceous to pure, dolomite with thin dark gray to brown-red shale partings of the Grand Detour Member;
4) 5-15 feet thick light gray, fine- to medium-grained, locally argillaceous, dolomite of the Nachusa Member;
5) 10-15 feet thick light gray, largely pure, dolomite of the Quimbys Mill Member.

Light buff or yellow-gray dolomite is common when the rocks are weathered. Its maximum thickness ranges between 75 and 100 feet. The contact with the Galena Formation is conformable.

Galena Formation The name Galena Formation is taken for Galena, Jo Daviess County, where the type section consists of limestone and dolomite beds overlying the Platteville Formation and underlying the Maquoketa Shale (Hall 1851). In the Coal Valley area, the Galena Formation is not exposed, but it was observed in subsurface rock cuttings in 4 water and 6 oil and gas wells, all located in the upper half part of the quadrangle (Figure 2). The formation is stratigraphically divided into the Decorah and Kimmswick Members, respectively at the base and the top. The Decorah Member consists, from the oldest to the youngest, of 35 feet thick gray to yellow-brown, locally red speckled, fine- to coarse-grained to crystalline, dolomite, then 10 feet thick brownish, fine- to medium-grained, dolomite. The Kimmswick Member is composed, from the oldest to the youngest, by 75 feet thick pale yellowish brown, fine- to medium-grained, largely cherty, dolomite, 45 feet thick yellowish brown, cherty dolomite, and 115 feet thick pale yellowish brown, fine- to coarse-grained, vuggy, dolomite. Its maximum thickness ranges between 250 and 360 feet, but it is estimated around 250 feet in the Coal Valley Quadrangle (Willman and Buschbach 1975).

Maquoketa Shale Group The Maquoketa Shale Group is named for exposures along the Little Maquoketa River in Dubuque County, Iowa (White 1870). It largely consists of shale and limestone in its middle part. The group unconformably overlies and underlies respectively the Galena Formation and the Silurian System. In the Coal Valley area, the Maquoketa Shale Group is only observed in subsurface rock cuttings from 19 wells bored for groundwater and petroleum resources (Figure 2). The base of this group is the Scales Shale that underlies the Fort Atkinson Limestone and Brainard Shale. The range in age of the Maquoketa Shale Group is Cincinnatian of the Upper Ordovician (Katian Stage of the Upper Ordovician). Its maximum thickness is estimated between 195 and 230 feet.

Scales Shale The formation takes its name for Scales Mound in Jo Daviess County, where only 30 feet thick of dark gray to dark brown shale is exposed (Templeton and Willman 1963). In the Coal Valley area, two members are identified in the Scales Shale. They consist, from the oldest to the youngest, of the Elgin Shale Member that is composed of 60 feet thick brownish, compact, shale with thin beds of brown dolomite near the base and in the uppermost part, which can correspond with the Lower Depauperate beds; and the Clermont Shale Member that includes 50 feet thick, grayish, friable, shale with thin beds of dolomite. As much as 5-10 feet of red shale is observed in the Christianson Brother's water well near the contact with the Galena Formation. Its maximum thickness ranges between 120 and 130 feet.

Fort Atkinson Limestone The name of the Fort Atkinson Limestone is taken for exposures at Fort Atkinson, Iowa (Calvin 1906). In the Coal Valley area, the formation is largely composed of grayish, fine-grained, slightly argillaceous, dolomite with minor shale and sandstone. Its maximum thickness is around 15 feet.

Brainard Shale An exposure near Brainard, Iowa, is the type section for this formation (Calvin 1906). In the Coal Valley area, as much as 80 feet thick, greenish gray, partly sandy to dolomitic, shale that contains locally beds of yellow to greenish, fine-grained, party sandy, dolomite is observed in wells. Fossils including brachiopods and bryozoans are commonly observed in the City of Silvis's water well. Its maximum thickness ranges between 80 and 82 feet.

Silurian System

The Silurian System was observed in 45 rock cuttings samples from wells bored for groundwater and petroleum resources (Figure 3). Two of these cuttings from the City of Silvis's water well and the Wilson's oil and gas well (API 121610037000, total depth: 780 feet) that is located 0.37 miles south of the intersection between the 120th Av. and 104th Av. in NW¼ SE¼ NE¼ sec 11, T 16 N, R 1 W, are used as referenced sections for the stratigraphy of the Silurian System. It comprises, from the oldest to the youngest, the Blanding, Hopkington, Scotch Grove and Gower Formations. The Blanding and Hopkington Formations are grouped together because well records are widely scattered. The range

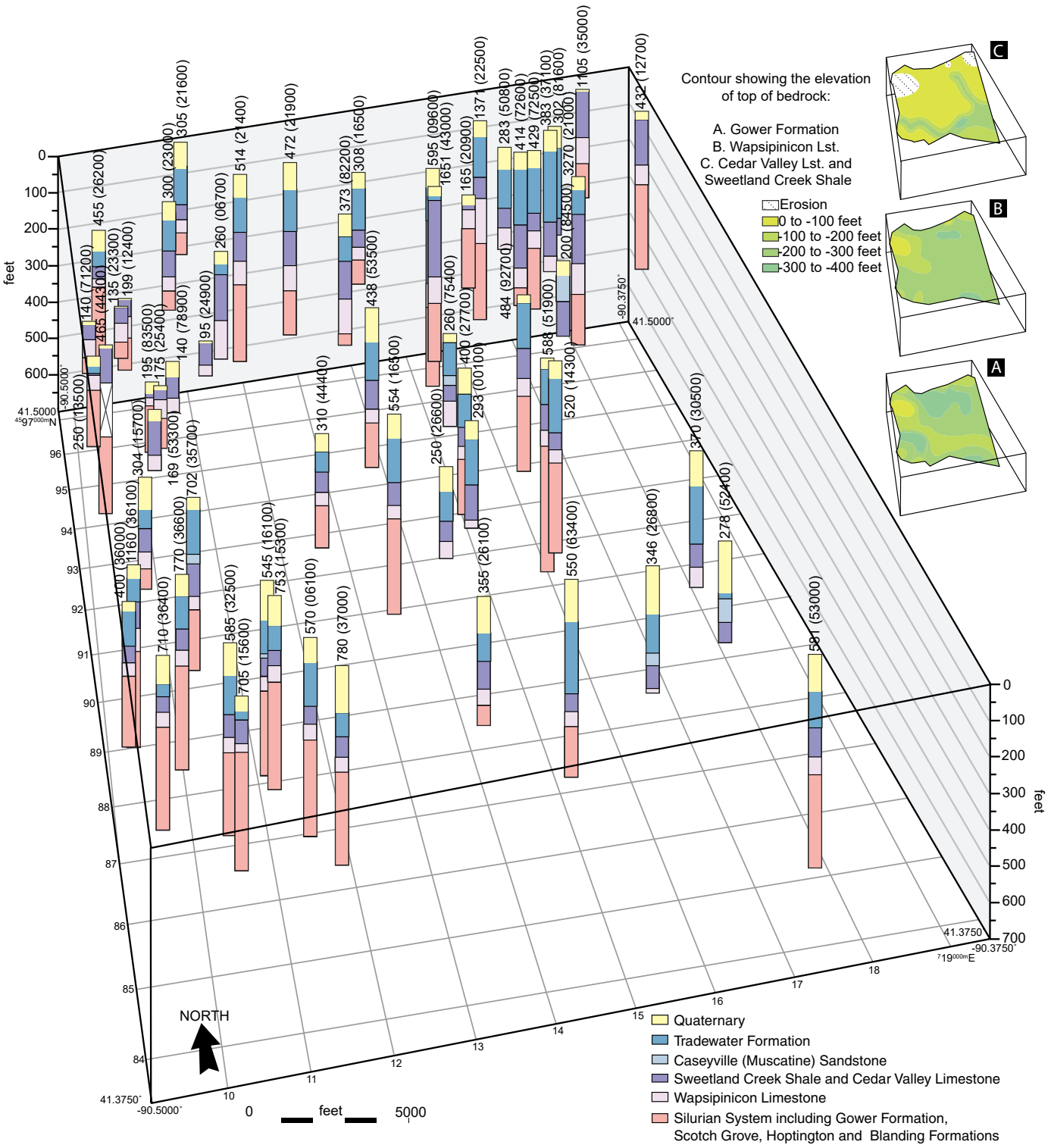

Figure 3 Projected lithologic logs of water wells, oil and gas wells and stratigraphic test boring crossing the Lower Silurian to Middle Pennsylvanian within the Coal Valley Quadrangle, Rock Island and Henry Counties. Vertical scale is exaggerated.

in age of this system is Lower to Lower-Upper (?) Silurian. Its maximum thickness is estimated between 165 and 280 feet.

Blanding and Hopkington Formations The name of the Blanding Formation is taken for the upper part of the Mississippi River bluffs near Blanding, Jo Daviess County (Willman 1973), while The Hopkington Formation was defined for Hopkinton, Iowa (Wilson 1895). The formations are composed of light gray, fine- to coarse-grained, dense to porous, locally pyritous, dolomite, which chert occurs in the Blanding Formation. The contact with the Maquoketa Shale Group is locally marked by 5 feet light gray, very coarse-grained, sandy dolomite. Its maximum thickness varies between 55 and 95 feet.

Scotch Grove Formation The formation derives its name for Scotch Grove Township, Iowa. Rock cuttings from Coal Valley's wells consist of light gray to pinkish gray, fine- to coarse-grained, pure dolomite with thin pale greenish shale partings. Its maximum thickness is much as 70 feet.

Gower Formation The Gower Formation takes its name for Gower Township, Iowa, where exposures in the Anamosa Quarry show laminated dolomite (Norton 1899). The formation includes the Anamosa and Le Claire Members, where they are exposed in the Mill Creek and Allied Quarries in the Milan and Davenport East Quadrangles (Devera and Krienert 2020). In the Coal Valley area, these members are composed from the oldest to the youngest by a light gray to yellowish-gray, slightly argillaceous to pure, dolomite, and light gray, largely coarse-grained to crystalline, vugular porous to dense, dolomite. The maximum thickness of the Gower Formation varies between 55 and 85 feet. The sub-Kaskaskia unconformity occurs in the area with the erosion or non-deposition of the upper Silurian and lower Devonian units (Devera and Krienert 2020).

Devonian System

In the Coal Valley Quadrangle, the Devonian System comprises, from the oldest to the youngest, the Wapsipinicon Limestone, Cedar Valley Limestone, and Sweetland Creek Shale. The range in age of this system is Middle to Upper Devonian in North America (Eifelian to Famenian Stages of the Middle and Upper Devonian). The Devonian strata unconformably overly the strata of Silurian age. This unconformity represents the boundary between the Tippecanoe and Kaskaskia sequences. In the Coal Valley area, the Upper Devonian Sweetland Creek Shale is locally removed by erosion prior to Pennsylvanian time, in which Pennsylvanian strata rest directly upon the Cedar Valley Limestone. In the western part of the Rock River's floodplain, erosion has removed much of the Pennsylvanian strata, where Devonian strata directly subcrops Quaternary sediments. The Devonian System was observed in rare exposures in the dissected valley side of the Coal Creek (Plate 1A) and terraces of Rock River (Plate 1C). The best observations are in subsurface rock cuttings from water, oil and gas wells contain the Devonian System (Figure 3). In the Rock Island area, the thickness of this system is estimated around 150 feet.

Wapsipinicon Limestone The name of the Wapsipinicon Limestone is taken for exposures along Wapsipinicon River, Iowa (Norton 1895). The formation is classically divided into the Bertram (oldest), Otis and Pinicon Ridge (youngest) Members, where the Bertram Member is locally observed in channel fillings and fissures on the Silurian erosional surface. In the Coal Valley area, this member is not identified in wells. The Wapsipinicon Limestone is only observed in subsurface geology in the quadrangle. However, a few quarried exposures outcrop in the adjacent Davenport East and Milan Quadrangles west of the Coal Valley Quadrangle. In the Niabi Zoo well (API 121612475400, total depth: 260 feet), the Otis Member consists of light gray to greenish gray, fine- to coarse-grained to crystalline, slightly argillaceous to pure, peloidal, vuggy, poorly fossiliferous, limestone (Figure 4a). Near the base, a 10-20 feet thick light gray, fine- to medium-grained, sandy limestone is locally present. The Pinicon Ridge Member is largely composed of pinkish gray to light gray, argillaceous to pure, partly silty-sandy, unfossiliferous, dolomite and collapse breccias (Figures 4b,c). The contact with the Cedar Valley Limestone is conformable with the Cedar Valley Limestone. The maximum thickness of this formation ranges between 35 and 120 feet.

Cedar Valley Limestone The Cedar Valley Limestone derives its name from the Cedar River valley, Iowa (McGee 1891). This formation is exposed along the flood plains and terraces of the Mississippi River and its tributaries in the Rock Island area. In this area, three members are identified from the oldest to the youngest as follow: Solon, Rapid and Coralville Members (Collinson and Atherton 1975). The Solon and Rapid Members are only observed in wells in the quadrangle, while the Coralville Member crops in a small creek south side of 78th Ave. near the intersection with Shaffer Creek (sec 24, T 17 N, R 1 W, GPS coordinate: N41.45055°, W090.44938°) (Plate 1A). Based on cores and rock cuttings from water, oil and gas wells, the Solon Member consists of grayish brown, fine- to coarse-grained, sandy, argillaceous to dolomitic, fossiliferous, limestone. Brachiopods are abundant, but fossils such as disarticulated crinoids, trilobites and bryozoans are common. Its maximum thickness ranges from 6 to 8 feet. The overlying Rapid Member is largely composed of gray to buff, fine-grained, argillaceous, locally dolomitic, limestone. Its maximum thickness was estimated around 60 feet in the Rock Island area (Collinson and Atherton 1975). The Coralville Member consists, from the oldest to the youngest, of (1) 0.1 to 1.5 feet thick beds, massive to slabby, of light gray, brown to buff when weathered, fine- to medium-grained, very fossiliferous limestone with very thin greenish gray shale partings (Plate 1B; Figure 4d), and (2) a few inches thick beds of light to gray red stained, argillaceous, fossiliferous limestone becoming shaly in its upper part. Its maximum thickness is estimated be-

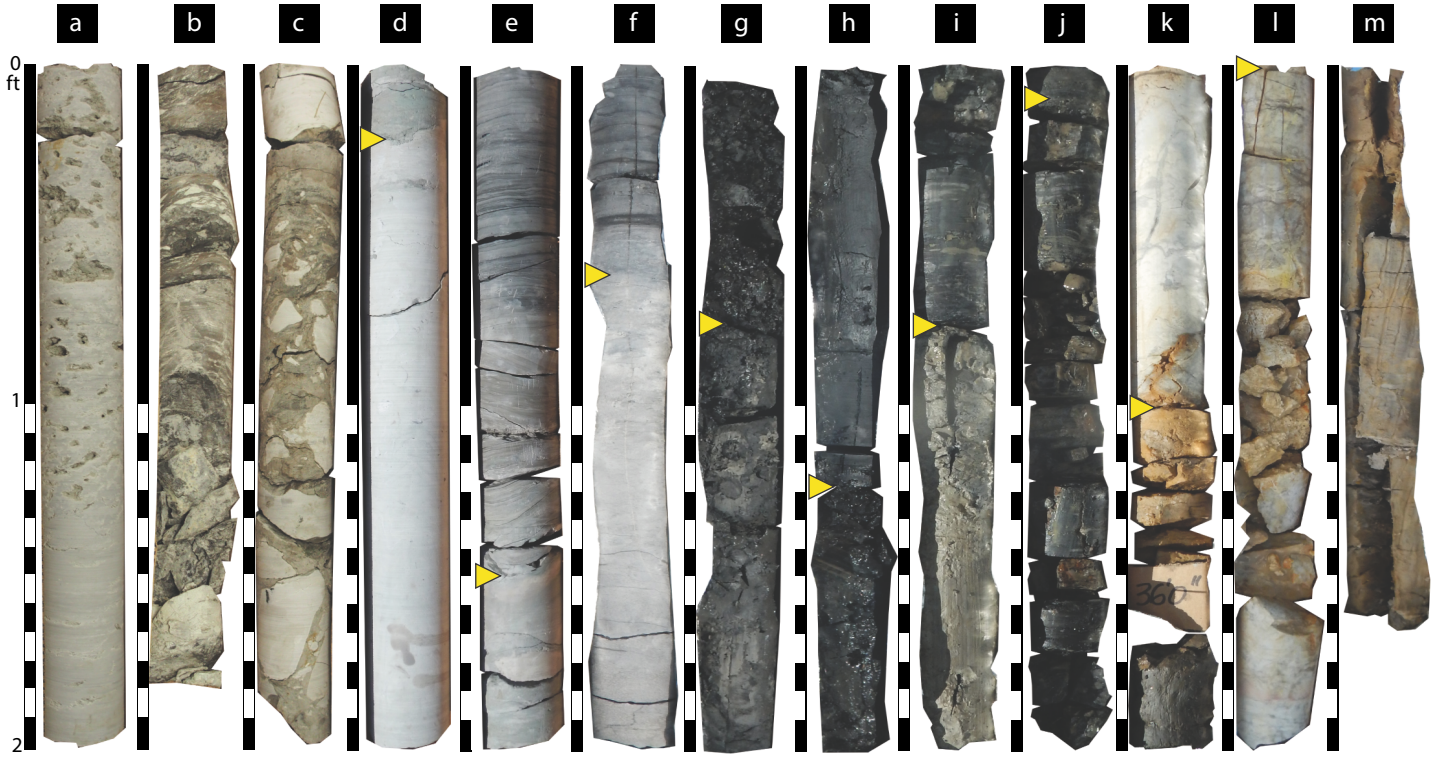

Figure 4 Photographs of the Niabi Zoo's cores (API 121612475400; total depth: 260 feet; sec 25, T 17 N, R 1 W; N41.439722°, W090.433301°). (a) Light gray, pure, vuggy, unfossiliferous, limestone of the Otis Member of the Middle Devonian Wapsipinicon Limestone. (b-c) Collapse breccia composed of light to dark gray subangular to subrounded fragments of argillaceous to pure limestone within dark greenish-gray to beige calcareous shaly matrix of the Pinicon Ridge Member of the Middle Devonian Wapsipinicon Limestone. (d) Light gray, fine- to medium-grained, very fossiliferous limestone of the Coralville Member of the Middle Devonian Cedar Valley Limestone. (d-e) Greenish gray, fissile, slightly calcareous, shale with small lenses of light gray to dark gray, massive to finely laminated, slightly calcareous, siltstone of the Upper Devonian Sweetland Creek Shale. The lower and upper contacts (arrows) are erosive. (e-f) Medium to dark gray laminar to low angle cross-bedded sandy siltstone with thin dark gray shale partings of the lower Pennsylvanian Muscatine Formation (former Caseyville Formation). The top of the unit is marked by light gray, fine- to medium-grained, moderately sorted, sandstone. The contact (arrow) with the overlying Tradewater Formation is conformable. (g-h) Dark, fissile, coal within dark gray, fissile to non-fissile, shale and siltstone of the Middle Pennsylvanian Tradewater Formation. (i-j) Dark, fissile, coal of the Rock Island (No. 1) Coal bed of the Middle Pennsylvanian Tradewater Formation. (k-l) White silicified limestone, named "Moline Chert" by archeologists, of the Seville Limestone Member of the Middle Pennsylvanian Tradewater Formation. The member is bounded (arrows) by orange iron staining siltstone and fine-grained sandstone. (m) Dark gray silty shale of the Middle Pennsylvanian Tradewater Formation.

tween a few feet and 25 feet. This formation is unconformably overlain by the Sweetland Creek Shale (Figure 4d), or when this formation is missing, by the Middle Pennsylvanian Muscatine (Caseyville) Sandstone or Tradewater Formation.

New Albany Shale Group In the Coal Valley area, the Sweetland Creek Shale is the only formation that occurs in the Upper Devonian New Albany shale Group. This group is 0-50 feet thick in the area.

Sweetland Creek Shale The Sweetland Creek Shale is taken is name for Sweetland Creek, Iowa, where the type section exposes 14 feet thick gray and green shale that underlies the black shales of Grassy Creek Shale (Udden 1899; Collinson et al. 1967). In the Coal Valley area, the Sweetland Creek Shale outcrops in a 120 feet-long and 15 feet-thick stream bank that is located on the left bank of Coal Creek, north of the village of Coal Valley (sec 27, T 17 N, R 1 W; GPS coordinate: N41.213090°, W090.47379°) (Plate 1C). Only 9 inches of Sweetland Creek Shale was drilled in the Niabi Zoo well (API 121612475400) (Figures 4d,e). It consists largely of greenish gray to dark gray, fissile, slightly calcareous, silty shale with 1-4 feet-long lenses of light gray to dark gray, massive to finely laminated, slightly calcareous, siltstone (Plate 1D). Sphalerite and galena occur in calcite veins of this siltstone (Plate 1E). The Sweetland Creek Shale is maximum 50 feet, but it is discontinuous in some areas of the quadrangle, in which it is missing. Its contact with the Middle Pennsylvanian strata is unconformable (Figure 4e).

Pennsylvanian System

In the Rock Island area, the Pennsylvanian System unconformably overlie Devonian strata. Mississippian strata was removed by erosion prior to Pennsylvanian time. Such a contact can be observed in a natural exposure, located 0.4 miles south-southeast of the intersection between 78th Ave. and Niabi Zoo Rd. in SW¼ SE¼ NW¼ sec 24, T 17 N, R 1 W (N41.859774°, W89.354248°), where the Sweetland Creek

Shale is unconformably overlain by the Morrowan Muscatine (Caseyville) Formation (Lower Pennsylvanian) (Plate 2A). A regional unconformity occurs in the area, and it marks the boundary between the Kaskaskia and Absaroka sequences. This system comprises, from the oldest to the youngest, the Muscatine (Caseyville) and the Tradewater Formations. The range in age of this system is Morrowan of the Lower Pennsylvanian to Atokan-Desmoinesian of the Middle Pennsylvanian in North America (respectively Bashkirian and Moscovian Stages of the Lower and Middle Pennsylvanian). The Muscatine (Caseyville) and Tradewater Formations largely outcrop in steep valley sides and bluffs south and north of the Rock River, and its south-oriented tributaries (e.g., Coal, Shaffer and Mosquito Creeks). The spatial distribution of the Muscatine and Tradewater Formations is based on the description and geometry from rock cuttings from wells bored for groundwater and petroleum resources and Niabi Zoo's core from the stratigraphic boring (Figure 3). The Tradewater Formation covers an area of 4/5 of the quadrangle, while the Muscatine Formation is restricted to a small area located north-central in the quadrangle. Its maximum thickness is estimated around 0 to 125 feet.

Raccoon Creek Group The name Raccoon Creek Group is derived for Raccoon Creek, Indiana (Wier 1961). It is the basal group for Pennsylvanian strata in Illinois. It is comprised of the Morrowan Muscatine Formation and the overlying Atokan-Desmoinesian Tradewater Formation. The Raccoon Creek Group occurs on the northern and southern sides of the Rock River, where the Devonian System does not subcrop. The group is uncomfortably overlain by Quaternary sediments.

Muscatine Formation (Caseyville) The formation only crops 0.33 miles northeast from the north line of sec 20, T 17 N, R 1 E (GPS coordinate: N40.45486°, W090.40227°), in which a 50 feet-long exposure shows 4-5 feet thick, yellow to buff, fine- to medium-grained, well sorted, slightly micaceous, massive to cross-bedded quartz arenite with 1-2 inches thick interbeds of greenish gray siltstone (Plates 2B-D). Along Case Creek west-central of the quadrangle (sec 4, T 16 N, R 1 W), T.K. Searight (1964) has described 18 feet thick strata of the Muscatine Formation that consists of 15 feet of largely gray shale (base) and 3 feet of light gray sandstone (e.g., the Bernadette Sandstone Member). Two coal beds occur in the shale, and they are attributed to the Iowan coal beds named Wildcat Den Coal bed and the younger Wyoming Hill Coal bed. The formation subcrops in many places, all located in the eastern edge of the quadrangle (Figure 3). In rock cuttings from McGraw (API 120730052400, total depth: 278 feet) and Orion School District 223 (API 120730026800, total depth: 346 feet) water wells (respectively located sec 5, T 16 N, R 1 E and sec 5, T 16 N, R 1 E) near Sunny Hill Estates, the base of the Muscatine Formation contains coarser and very micaceous sandstone, which is therefore attributed to the Babylon Sandstone Member. In the Niabi Zoo well, this sandstone laterally varies for light gray laminar to low angle cross-bedded sandy siltstone with thin dark gray shale partings (Figure 4e). A thin limonite crust is described at the contact with the Devonian strata (Devera and Krienert 2020). The contact with the overlying Tradewater Formation is conformable, where light gray fine- to medium-grained sandstone is in sharp contact with light to dark gray siltstone and shale (Figure 4f). This unit appears to be confined to north-south trending paleo-channels or random paleo-karst features over the Devonian limestones. Its maximum thickness ranges between 0 and 80 feet.

Tradewater Formation The former Abbott and Spoon Formations have been formally changed in Illinois to the Tradewater Formation (Jacobson 1992). However, the names of members are preserved. In the Rock Island area, the Rock Island (No.1) Coal bed is the basal member of the Tradewater Formation. The upper part of the formation does not outcrop in the Coal Valley Quadrangle. The formation largely outcrops in steep valley sides and bluffs south and north of the Rock River, its south-oriented tributaries, and in natural exposures near the village of Carbon Cliff (Figure 5). Approximately 100 feet of Tradewater Formation is drilled in the Niabi Zoo well (API 121612475400), where it is a section of reference in the Coal Valley area. Its lithology appears discontinuous, because horizontal and vertical lateral variations of facies occur in the area. A composite lithologic log of reference is proposed in Figure 6. Its maximum thickness is estimated between 0 and 120 feet. The Tradewater Formation consists, from the oldest to the youngest, of:

(1) Gray to dark gray, red to orange iron staining when weathered, fissile to non-fissile, carbonaceous near coal seams and beds, shales with thin layers, slightly undulated, of medium to dark gray siltstone (Figure 4f) that becomes locally dominant near the contact with the overlying Rock Island (No.1) Coal bed (Plates 3A and E). One to two feet thick lenses of light gray to yellow, brown orange when weathered, medium- to coarse-grained, generally well sorted, sandstone may occur a few feet below the Rock Island (No.1) Coal bed. Local coal beds occur near the Rock Island (No. 1) Coal bed, where the maximum thickness can reach 1.5 feet (Figures 4g,h). The maximum thickness of this unit varies between 11 and 40 feet.

(2) A dark, fissile, coal of the Rock Island (No.1) Coal bed (Plate 3C; Figures 4 i,j). The best exposures for this coal bed are encountered in a dissected valley side 0.34 miles south southeast of the intersection between 132nd Ave. and the US. highway 6 (sec 19, T 17 N, R 1 E, GPS coordinate N41.44851°, W090.43070°) located northeast the village of Coal Valley (Plate 3B), and in a deep ravine in the TPC Deere Run golf club 0.42 miles southeast of the intersection between Heather Knl and Colona Rd (sec 9, T 17 N, R 1 E, GPS coordinate N41.48059°, W090.30060°) located south of the village of Carbon Cliff (Plate 3D). Its thickness locally varies between 1.7 and 6 feet.

(3) A 0 to 3.5 feet thick dark gray, red to orange iron staining when weathered, non-fissile to fissile, locally carbonaceous and pyritic, shale and siltstone that vary locally from dark gray, red to orange iron staining when weathered, siltstone and fine-grained sandstone in the Niabi Zoo well (API 121612475400) (Plate 3A; Figure 4k). Some of siltstone beds contain trace fossils such as *Teichichnus* (Figure 6A), *Asterosoma* and *Conostichus* (Figure 6B).

(4) A dark gray, locally red to orange iron staining when weathered, argillaceous limestone of the Seville Limestone Member (Plate 3F). A few brachiopods, gastropods and crinoids have been described by T.K. Searight (1964) in natural exposures in Case Creek (sec 4 ,T 16 N, R 1 W) just off the study area in the Milan Quadrangle (Figure 4). In an area covering the central part of the quadrangle, the member relatively thickens and it contains thin beds of bluish-gray to white chert that has been named "Moline Chert" by archeologists (Plates 3A, B and G; Figures 4k,l). To the northeast of the quadrangle the Seville Limestone Member appears to be missing at the village of Carbon Cliff (sec 5, T 17 N, R 1 E) or reduced to a few lenses of argillaceous limestone in a calcareous shale (sec 9, T 17 N, R 1 E) (Figure 4). The thickness of the Seville Limestone Member varies between 0 and 13 feet.

(5) A 4 to 6 feet thick thin undulated beds of medium to dark siltstone and gray shale, locally ferruginous, that are overlain by 1 to 5 feet thick tan, medium- to coarse-grained, poorly sorted, argillaceous and micaceous, sublitharenite and quartz arenite (Figures 4m and 6). A few feet thick shale overlies this sandstone, then occurs a thin coal bed (0.5 to 4 feet thick) that is not identified. Ferruginous shale, locally overlain by a sandstone that directly occurs above the coal bed. The top of this unit largely comprises a dark gray, non-fissile to fissile, shale. Its maximum thickness is estimated around 60 feet on the base of Culver's description in 1923 from the Rural Mine southwest of the quadrangle (sec 3, T 16 N, R 1 W).

(6) A 2 feet thick light gray, limestone containing gastropods and ostracods has been described by H.E. Culver (1923) in the Rural Mine (mine index 3225 in Obrad and Chenoweth 2009) (Figures 5 and 6). This unit is attributed to the Seahorne Limestone Member.

Quaternary System

Pleistocene and Holocene (Quaternary) sediments mantle bedrock throughout the Coal Valley Quadrangle. From oldest to youngest, these sediments include 4 distinct formations that consist of:

(1) The Glasford Formation that includes tan to gray-brown compact silty till with gravel, sand and silt interlays of the Kellervillle Till Member. The base of the diamicton contains a conglomerate with well-rounded igneous, metamorphic and locally derived limestone or chert pebbles and occasional boulders;

(2) The Roxana Silts of the Equality Formation that includes yellow brown to gray, calcareous, silty- to sandy in the lower part;

(3) The Peoria Silt;

(4) The Cahokia Formation that includes sandy gravel, sand, silt or clay as observed in Rock River.

The Illinoian Glacial Episode comprises the Glassford Formation, while the Wisconsinan Glacial Episode comprises the Roxana Silts. The thickness of Quaternary sediments ranges from 5 to 120 feet, being thickest to the southwest of the study area. The Quaternary System is omitted from the map.

Paleontology

Paleontology of the Cambrian to Silurian Systems is scarce in rock cuttings from wells bored for groundwater and petroleum resources. Only the paleontological content of the Devonian and Pennsylvanian Systems is described below.

The Middle Devonian Wapsipinicon Limestone is mostly unfossiliferous, but scattered molds of the brachiopod *Emanuella sublineata*, stromatolites and disarticulated fish remains have been identified in the Quad Cities area (Anderson 1998). The upper Middle Devonian Cedar Valley Limestone is fossiliferous. The Solon Member contains brachiopods, disarticulated crinoids, trilobites and bryozoans. The brachiopod *Atrypa independensis* is the most common fossil in this member. The overlying Rapid Member contains disarticulated crinoids, in which *Orthospirifer iowensis* was found along Rock River in the Davenport East and Milan Quadrangles (Devera and Krienert 2020). The Coralville Member, the terminal unit of the Cedar Valley Limestone, is very fossiliferous. A natural exposure located downstream in the Rock River floodplain near the intersection between the 78th Ave. and Shaffer Creek (sec 24, T 17 N, R 1 W, GPS coordinate: N41.45055°, W090.44938°) contains abundant fossils that include brachiopods (*Atrypa*, *Stropheodonta*, *Spinatrypa*, *Orthospirfier*, *Protoleptostrophia*, *Elita*), colonial rugose and tabulate corals (*Heliophylum* and *Cladopora*), disarticulated crinoids, stromatoporid sponges and trilobites. In the Coal Valley area, the paleontology of the Upper Devonian Sweetland Creek Shale is scarce, but it mostly contains brachiopod *Lingula*. The type section, about 4 miles east of Muscatine, Iowa, contains abundant fossils of brachiopod *Lingula*, gastropods, chiton-like *Solenocaris*, and conodonts that include the *Ancyrognathus triangularis*, *Palmatolepis gigas*, *Palmatolepis triangularis* zones (Udden 1899; Miller and Youngquist 1947; Klapper and Furnish 1963; Klapper et al. 1971).

The Morrowan Muscatine Formation is non fossiliferous, while fossils of plants have been described in the Atokan-Desmoinesian Tradewater Formation. In the adjacent Davenport East and Milan Quadrangles, fossil plants were found in the Muscatine Formation at the Allied Quarry that largely includes flora *Megalopteris*, *Lesleya*, *Cordaites*, lycopods

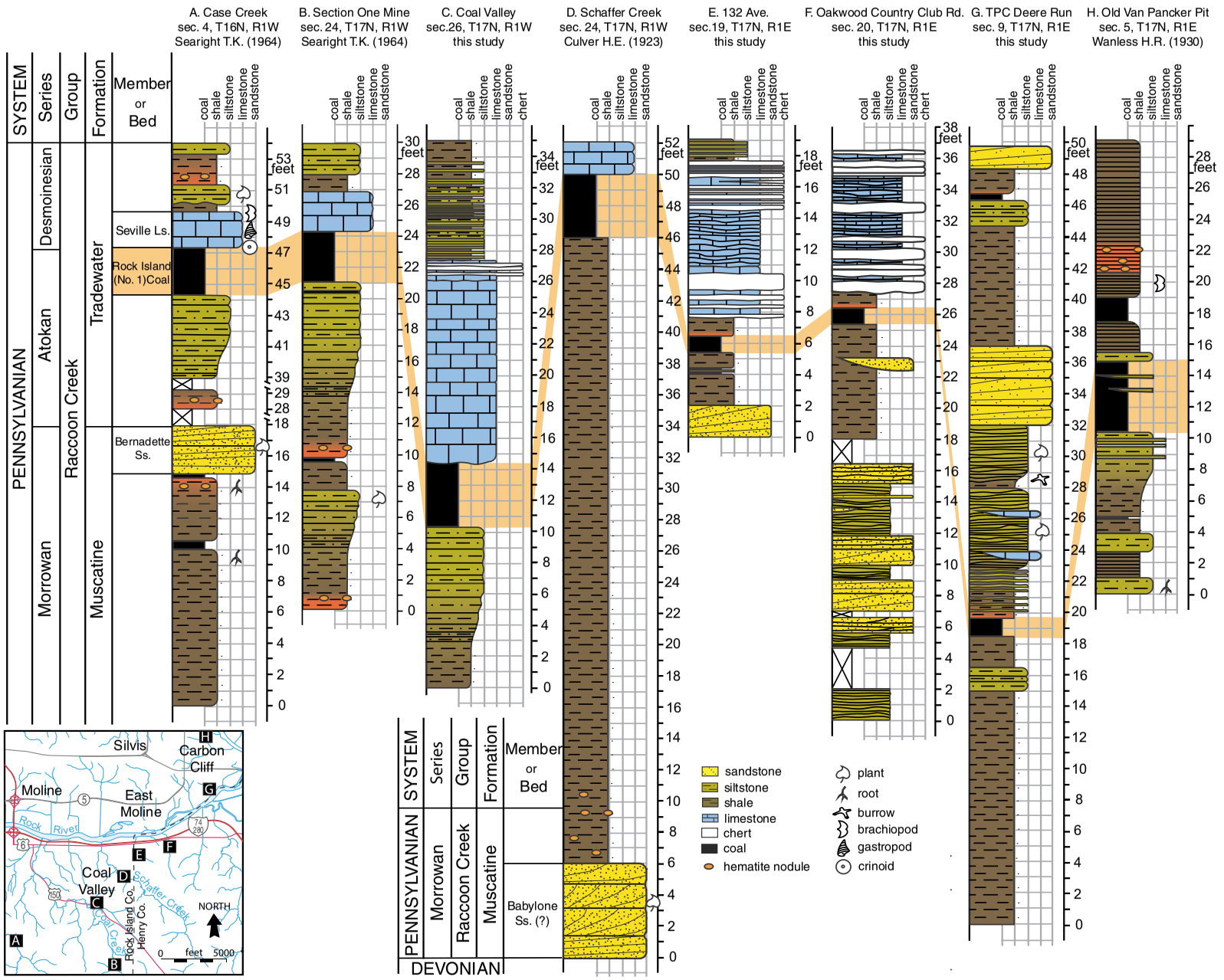

Figure 5 West-to-east trending stratigraphic profile of the Morrowan Muscatine Formation (Lower Pennsylvanian) and the Atokan-Desmoinesian Tradewater Formation (Middle Pennsylvanian) in the Coal Valley area. All formations show significant lateral and vertical variations of facies in the area. The maximum thickness of the Muscatine Formation is much as 80 feet, but it is locally missing or shows a few feet. The Rock Island (No. 1) Coal bed of the Tradewater Formation locally varies between 1.7 to 6.0 feet in thickness. The Seville Member of the Tradewater Formation shows a lenticular architecture, in which its maximum thickness is located in the center of the quadrangle.

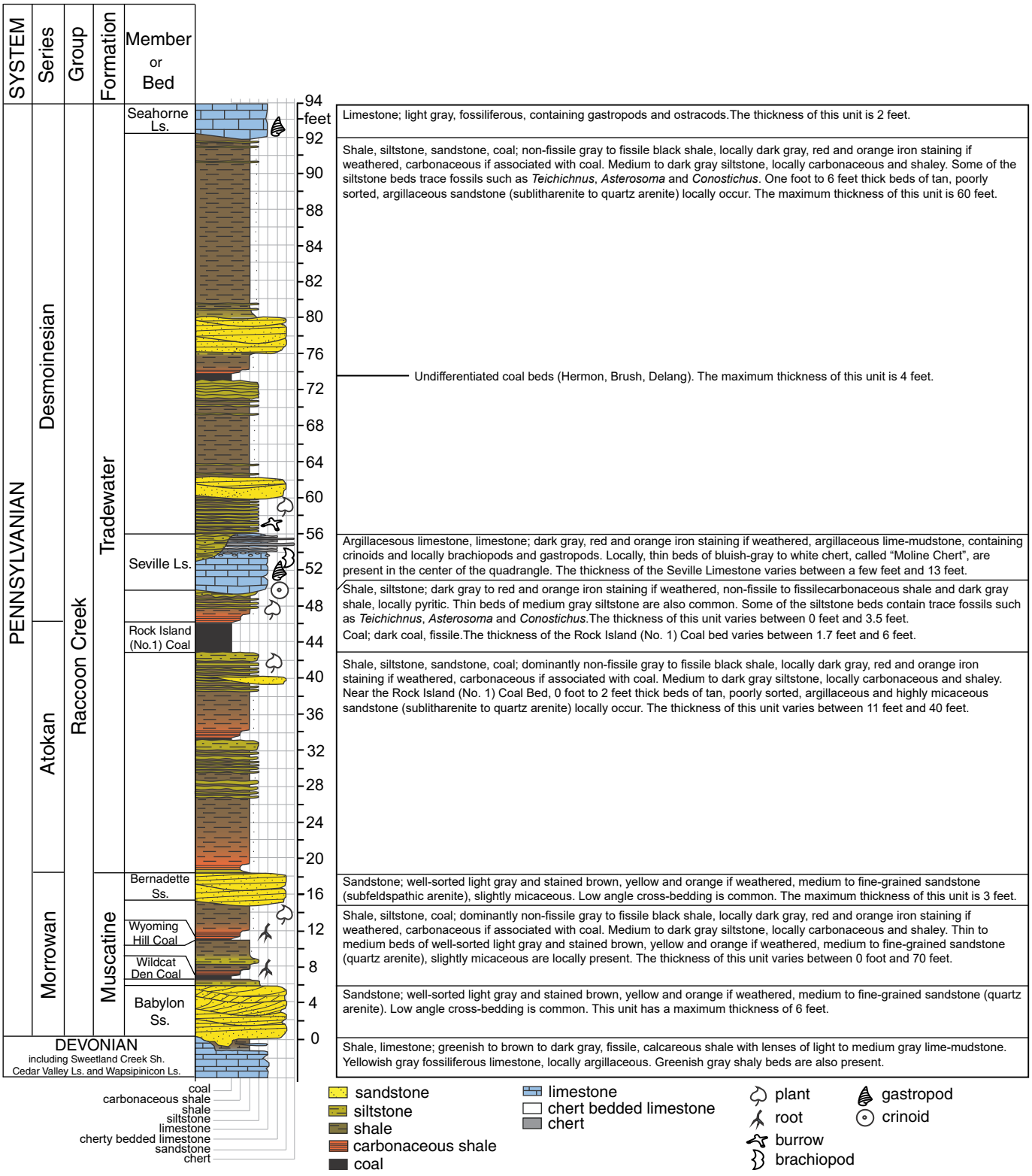

Figure 6 Composite lithologic log of the Morrowan Muscatine Formation (Lower Pennsylvanian) and the Atokan-Desmoinesian Tradewater Formation (Middle Pennsylvanian) in the Coal Valley area.

and *Mesocalamites*, and rare arthropod such as *Labriscorpio alliedensis*, fish jaws and scales (Leary 1974, 1980). Tree-like lycopsid (mosses) (*Lepidendron*, *Sigillana*) and fusulinid *Fusulinella iowensis* have been identified in the Tradewater Formation near the village of Carbon Cliff and Shaffer Creek (Culver 1922, 1923; Thompson 1934). An assemblage of 14 fossil-taxa is overwhelmingly dominated by pteridosperms, including *Laveineopteris rarinervis*, *Neuropteris flexuosa*, *Alethopteris serlii*, *Macroneuropteris scheuchzeri*, and *Mariopteris nervosa*, whereas lycopsids, sphenopsids, and ferns have been described in the Rock Island (No.1) Coal bed from the Quad Cities area (Bashford and Nelson 2015). Recent palynology in the Rock Island (No. 1) Coal bed has identified arborescent lycopsid spores (*Lycospora* and *Granasporites medius*), tree fern spores, Calamite spores (mainly *Calamospora*, *Laevigatosporites minor* and *L. vulgaris*), and cordaite pollen (*Florinites*) (Personal communication, Cortland F. Eble, Kentucky Geological Survey). Fragments of plant are abundant in siltstone beds above and below the Rock Island (No. 1) Coal bed. Trace fossils including *Teichichnus* (vertical stack of horizontally-oriented burrow with spreiten attributed to an annelid worm; Figure 7A), *Asterosoma* (radiating bulb-like swelling burrow) and *Conostichus* (long-ranging and plug-shaped form attributed to a solitary polypoid cnidarian; Figure 7B) are common in siltstone beds of the Tradewater Formation. Such specimens of plant and trace fossils are exposed south of TPC Deere Run golf club (sec 9, T 17 N, R 1 E, GPS coordinate N41.28652°, W090.23282°). The Seville Limestone Member is non fossiliferous, but rare brachiopods, gastropods and crinoids have been identified (Searight 1964). The argillaceous Seahorne Limestone Member contains a marine fauna that includes gastropods, ostracods, and rare brachiopods and polychaete worm *Spirorbis*.

Biostratigraphy

The biostratigraphy of the bedrock exposed in outcrops within the Coal Valley Quadrangle ranges in age from Middle Devonian and Middle Pennsylvanian (Desmoinesian Stage). Biostratigraphy of the Devonian System was assigned on the occurrence of conodont biozones that are summarized by R.D. Norby (1990), F.S. Rogers (1998), J. Day (2006) in Iowa and Illinois.

The conodonts *Tortodus kockelianus australis* and *Tortodus kockelianus kockelianus* were found in the lower member of the Wapsipinicon Formation in Iowa (Klapper and Barrick 1983). This fauna is correlated to the conodont *Ozarkodina raaschi* from east-central Iowa, which is correlated to the terminal Eifelian *ensensis* Zone (Sandberg et al. 1989). The conodont *Polygnathus linguiformis linguiformis gamma*, *Icriodus brevis* and *Icriodus latericrescens latericrescens* within the Solon Member of the Cedar Valley Limestone have been correlated to Middle *varcus* Zone. The upper part of the Solon Member was assigned on the occurrence of the conodont *Schmidtognathus latifossatus* that is attributed as the base Upper *varcus* Zone. These zones are assigned to the Givetian Stage of the Middle Devonian. The conodonts of the overlying Rapid Member of the Cedar Valley Limestone contain *Schmidtognathus wittekindti*, *Icriodus difficilis*, *Polygnathus xylus xylus*, *Icriodus aff. Subterminus* that are correlated to the conodont hermanni Zone. The Interval of the *Icriodus subterminus* Fauna is correlated with the conodont *disparilis* Zone that is considered Upper Givetian in age (Witzke et al. 1985, 1989; Sandberg et al. 1989; Rogers 1990, 1998; Day et al. 1996). The Coralville Member, the terminal unit of the Cedar Valley Limestone, was assigned on the occurrences of conodonts *Mehlina gradate* and *Pandorinellina insita* that

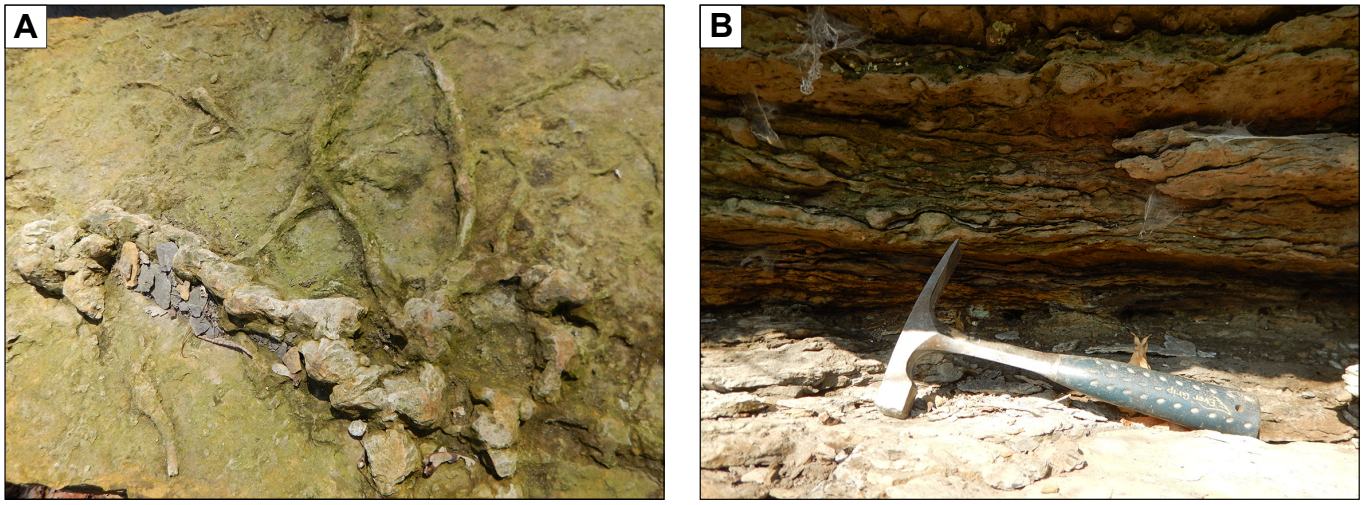

Figure 7 Paleontology. (A) Trace fossil Teichichnus showing horizontally-oriented burrows with spreiten. Location: TPC Deere Run golf club, 0.7 miles SE of the intersection between Heather Knl and Colona Rd in NW¼ SE¼ NW¼ sec 9, T 17 N, R 1 E, N41.48027°, W090.38950°. (B) Possible trace fossil Conostichus. Location: TPC Deere Run golf club, 0.65 miles SE of the intersection between Heather Knl and Colona Rd in NW¼ SE¼ NW¼ sec 9, T 17 N, R 1 E, N41.47757°, W090.38807°.

mark respectively the base of the Upper *subterminus* and *norrisi* Zones (Witzke et al. 1989; Bunker and Witzke 1992; Day 2006). The Upper *subterminus* and *norrisi* Zones are interpreted as uppermost Givetian in age (Rogers 1998; Narkiewwicz and Bultynck 2010). The *Ancyrognathus triangularis*, *Palmatolepis gigas* and Middle *Palmatolepis triangularis* Zones were identified from the type section of Sweetland Creek Shale in Iowa (Klapper and Furnish 1963; Klapper et al. 1971). The Frasnian-Famenian boundary is defined by the first occurrence of the conodont *Palmatolepis triangularis* (Klapper et al. 1994). Consequently, the Sweetland Creek Shale is considered as Frasnian-Famenian in age.

Biostratigraphy of the Pennsylvanian System was assigned on the occurrence of foraminifera and palynological biozones that are summarized R.D. Norby (1990), A.R. Bashford and W.J. Nelson (2015) in the Rock Island area. The Tradewater Formation in Indiana and Kentucky was assigned by the occurrence of the *Profusulinella* Zone that is interpreted in age of Upper Morrowan-early Atokan Stages in North America (Bashkirian Stage of the Lower Pennsylvanian) (Douglass 1979; Douglass and Nestell 1984; Shaver et al. 1985; Groves 1986). The *Fusulinella iowensis*, fossil grouped in the *Fusulinella* Zone, found in the Seville Limestone Member of the Tradewater Formation in Illinois, and many places in Indiana, were assigned to the base of the Desmoinesian in North America (Moscovian Stage of the Middle Pennsylvanian) (Weller et al. 1942; Shaver et al. 1985). A recent palynology of the Rock Island (No.1) Coal bed in the Quad Cities area highlighted a dominance of the assemblage of *Medullosalean pteridosperms*, in which this macrofloral biozonation yields a Lower Desmoinesian (Lower Moscovian) age in North America (Bashford and Nelson 2015). However, the latest work of palynology indicated placement in the upper part of *Radiizonates difformis* (RD) miospore assemblage zone, which is late Atokan (Bolsovian, Moscovian) in age (Personal communication, Cortland F. Eble, Kentucky Geological Survey).

Deposition of the Coal Valley area

During Devonian time, the Iowa Basin developed an epeiric carbonate ramp system in the southern hemisphere of Laurussia (Day 2006). The Iowa Basin was separated from the Illinois Basin by the roughly east-west-trending Sangamon Arch in central Illinois (Collinson et al. 1967). At that time, the Quad Cities area was located on the eastern margin of the Iowa Basin, in which the Wapsipinicon and Cedar Valley carbonate succession were accumulated on a low relief, locally marked by channels and ridges, over the unconformable Silurian System rocks. Deposition of these strata is marked by five major transgressive-regressive depositional sequences that are bounded regionally by a disconformity over a transgressive surface at the onset of the relative sea-level rise, and evaporites during the relative sea-level fall (Day 2006). The Mid-Upper Eifelian marine transgression into the Iowa Basin flooded wide areas that breached the basin with the present-day Elk Point and Williston basins to the west, and the Illinois, Michigan and Appalachian basins to the east. The Bertram Member, the basal unit of the Wapsipinicon Limestone, was deposited in local channel fillings and fissures on the Silurian erosional surface. This member is missing in the Coal Valley area. The skeletal and peloidal limestones of the Otis Member correspond to low-energy, shallow-water peritidal carbonate deposits, in which decomposition of organic tissue (e.g., corals, possibly sponges) and organic substance (e.g., shells) by microbial activity occurred. The member ended by a relative fall of sea level that drowned the carbonate ramp system, and developed an erosional topography and karst solution cavities. A new cycle of sea-level rise expanded through the basin (Witzke et al. 1989; Witzke and Bunker 1996), in which the Pinicon Ridge Member filled the underlying karst surfaces. The typical cyclic deposition of aphanitic mudstone-evaporite-shale sequences of the Pinicon Ridge Member was interpreted as the deposition in a restricted peritidal environment that ended by significant eustatic sea-level fall across the Iowa Basin (Day et al. 1996; Witzke and Bunker 1996). This sea-level lowstand drowned the newly formed Pinicon Ridge carbonate ramp system, which becoming restricted, facilitated the deposition of evaporites. These formed later collapse breccias during post-depositional diagenesis. The top bedrock of the Wapsipinicon Limestone is marked by a low relief in the Coal Valley area, in which the sediments of the Cedar Valley Limestone widely accumulated.

The Upper Givetian and Lower Frasnian time was marked by a significant marine expansion across most of Iowa and adjacent areas of Missouri and eastern Nebraska (Witzke et al. 1989; Witzke and Bunker 1996; Day et al. 1996). A significant marine flooding event during the Upper Givetian controlled the development of carbonates of the Cedar Valley Limestone. The abundance of marine organisms within this formation indicates an open-marine subtidal environment, which was tidally- or storm-influenced as show the abundance of brachiopod shell lags described by J. Day (2006) and M. Brady and C. Bowie (2017) in Iowa. Such storms and nearshore tidal currents are common in an epeiric carbonate ramp system (Lukasik et al. 2000). In places, the sediments were intensively burrowed by marine animals before they were lithified. Local biostromes of colonial rugose and tabulate corals and calcareous stromatoporid sponges were accumulated during a sea-level highstand stage when the carbonate factory was optimal. At the end of the Givetian, below the deposition of the Sweetland Creek Shale, a pronounced regression terminated Coralville deposition in the Central Iowa Basin, which marked significant subaerial erosion and meteoric diagenesis (Plocher et al. 1992).

The Middle Devonian marine transgression reaches its acme in the Lower Frasnian, then followed by slight dip at the Frasnian-Famennian boundary, the sea level declined in Upper Famennian with a punctuated sea-level fall near the Devonian-Carboniferous boundary (Haq and Schutter 2008). At that time, the shale of the Sweetland Creek Shale was accumulated in open-marine inner- and middle-ramp system (Witzke

and Bunker 2006a,b). The occurrence of the brachiopod *Lingula* indicates a very nearshore environment, particularly when found in monospecific assemblages (Cherns 1979).

The decline of sea level progressed in Mid-Mississippian time, reaching a low sea level near the boundary between the Mississippian and Pennsylvanian (Haq and Schutter 2008). A new long-term rise of sea level expanded during the Moscovian Stage of the Middle Pennsylvanian (Desmoinesian Stage in North America). In the Quad Cities area, the Pennsylvanian strata deeply eroded the underlying strata, which in the Coal Valley area, the Cedar Valley and Sweetland Creek Shale were partially or completely eroded. This erosional surface is revealed by a significant eroded bedrock atop the Sweetland Creek Shale that shows confined paleo-valleys or random paleo-karst features, north-to-south- and north northwest-to-south southeast-trending, east and south of the Coal Valley Quadrangle. In these paleo-valleys, fluvio-deltaic deposits of the Muscatine Formation, which were derived from the Canadian Shield or Wisconsin Highland, were accumulated (Leary and Trask 1985; Devera and Krienert 2020). Cross-bedded sandstone, shale and fossils including plants and marine organisms may be interpreted as fluvio-deltaic sand and/or mouth bars formed by, locally tidally-influenced, low-energy traction flows, in which the fine materials, that were accumulated under flocculation of clay suspension or suspension settling from standing water, were probably deposited in brackish estuaries, bays, or lagoons (Anderson et al. 1999).

The deposition of the overlying Tradewater Formation eroded the underlying strata, where the Muscatine Formation was completely eroded. The Atokan-Desmoinesian boundary was marked by the onset of a significant sea-level rise. However, this rise was progressive, where short-term periods of sea-level lowstand occurred. During the sea-level rise, shale was deposited in an estuarine deltaic environment, while coal, derived from plants such as ferns, cordaitaleans, lycopsids and pteridosperms, was accumulated in lowland swamps. The estuarine delta was locally bordered by a thin belt of carbonate muds, which were formed in an open-marine nearshore environment. That cycle, termed as "cyclothem", is typically associated unstable shelf or interior basin conditions.

Electric profile

Electric logging is a passive wireline logging method used to obtain a continuous record of a formation's rock properties. This technique measures the electrical resistivity of rocks, which are the ability to impede the flow of electric current. The Spontaneous Potential (SP) log is commonly used to detect permeable beds and to estimate clay content and formation water salinity. The SP log can be used to distinguish between impermeable shale and permeable shale and porous sands. The SP log is expressed in millivolt. The resistivity (R) logging is used to differentiate between formations filled with salty waters (good conductors of electricity) and those filled with hydrocarbons (poor conductors of electricity).

The R log is expressed in ohms meter^2/meter. The electrical conductivity log measures the ability of the rock to conduct an electrical current to move through the rock. Resistivity is the reciprocal of conductivity. The Dauffenback's oil and gas well record (API 121610036400, total depth: 710 feet), located 356 feet northwest of the intersection between the 120 Ave. and the Case Creek in 271 feet south and 678 feet east of the line sec 4, T 16 N, R 1 W, is used as a reference well for electric stratigraphy in the Coal valley area (Figure 8).

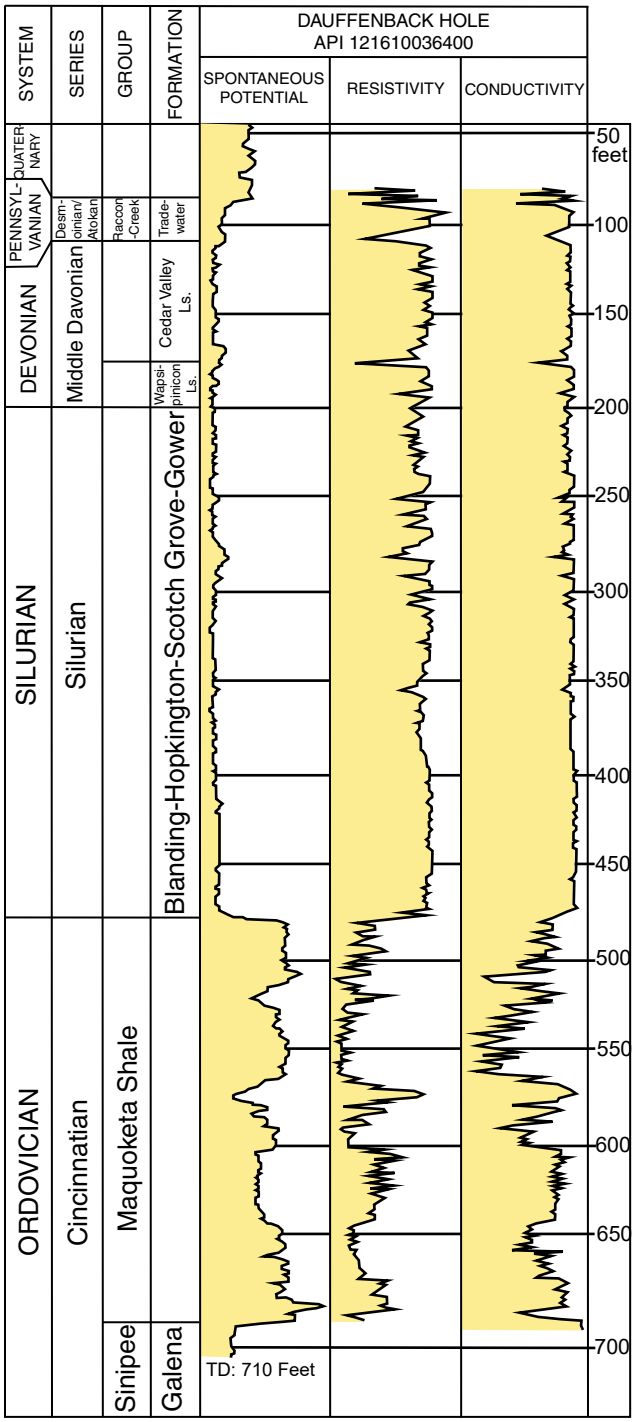

Figure 8 Electric log of oil and gas Dauffenback's oil and gas well record (API 121610036400) within the Coal Valley Quadrangle.

The Cincinnatian Maquoketa Shale Group is characterized by a trend of relative moderate and high SP baselines that are inversed in the R and conductivity logs. This trend is interpreted as an alternation of non-porous and impermeable shale and shaly dolomite. The Silurian System shows a low and flat SP and R baselines that are interpreted as an alternation of non-porous and impermeable dolomite, locally argillaceous or sandy. The conductivity log shows a similar trend as the R baseline. The Middle Devonian Wapsipinicon and Cedar Valley Limestones show a similar trend as the underlying Silurian System. This indicates alternation of non-porous and impermeable limestone, argillaceous limestone and shale. The Upper Devonian Sweetland Creek Shale and Morrowan Muscatine Formation are eroded in the area, where the Atokan Desmoinesian Tradewater Formation overlies the Cedar Valley Limestone. The SP baseline of the Tradewater Formation is relatively higher than the underlying Middle Devonian strata, which indicate an increase of finer materials. The R and conductivity logs are similar to the Middle Devonian R and conductivity baselines.

Gamma ray profile

The Gamma Ray (GR) log is a passive wireline logging method widely used in petroleum exploration as well as mineral exploration (especially for coal, phosphates and salts), that measures the total gamma radiation emitted via natural radioactivity of the rock formation. This technique is useful in distinguishing units that are relatively high in primary radioactive isotopes (uranium, thorium, potassium-40) such as shale, argillaceous limestone and K-bentonite beds. A log of the total natural radioactivity is measured in API units. The Niabi Zoo core (API 121612475400; total depth: 260 feet) is proposed as a representative of the bedrock stratigraphy within the Coal Valley Quadrangle; its gamma-ray log (Figure 9) can be compared directly with the core.

Among rock types common in the Quad Cities area, pure limestone, dolomite, and quartz sandstone produce uniformly low gamma-ray readings, whereas clay-rich shales yield moderate to high GR values. Argillaceous sandstone and carbonate rocks produce intermittent GR values and commonly show a ragged log profile.

The Middle Devonian Wapsipinicon Limestone is characterized by low GR responses for the limestone, followed by variable medium and high GR readings for the breccia. The overlying upper Middle Devonian Cedar Valley Limestone shows variable GR responses. This variation is interpreted as an alternation of calcareous shale that is overlain by argillaceous to pure, fossiliferous, limestone. The Upper Devonian Sweetland Creek Shale is characterized by relative high GR readings due to the occurrence of calcareous shale. The overlying unit, the Lower Pennsylvanian Muscatine Formation (former Caseyville Formation), shows, from the oldest to the youngest, relative high GR responses, followed by relative medium and high GR readings. These GR responses are interpreted by a relatively high content of shale at the base and the top of the unit, which is interlayered by siltstone and silty-to-shaly sandstone. The GR log of the lower Middle Pennsylvanian Tradewater Formation is relatively high due the high shale content. The top of the Tradewater Formation shows an upward decrease in GR values, which is followed by a relative increase of GR values. These variations are interpreted by the decreasing of shale. The lowest GR values correspond to silicified limestone of the Seville Limestone Member, while the highest GR values are associated with coal beds and shales.

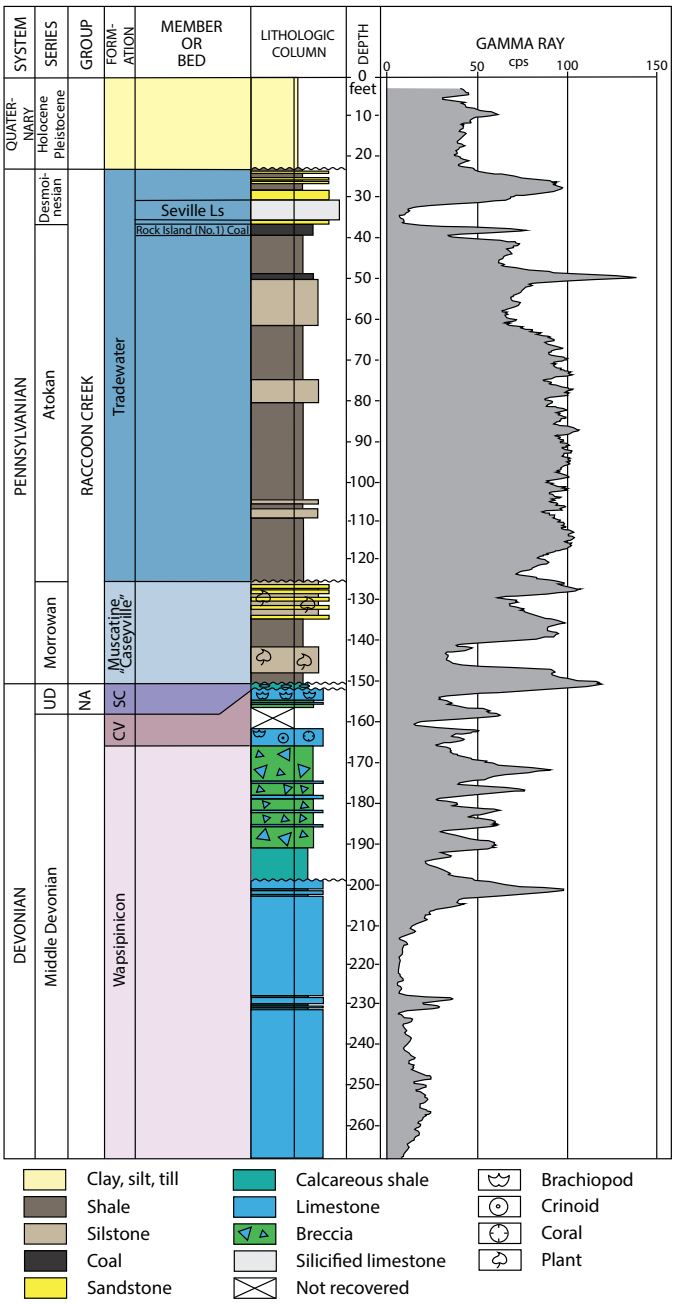

Figure 9 Gamma Ray (GR) log of Niabi Zoo's drill core (API 121612475400). The GR log shows relative low GR responses in the Devonian strata, followed by relative high GR readings in the Lower and Middle Pennsylvanian strata. The top of the Middle Pennsylvanian Tradewater Formation shows relative low GR values due to the occurrence of the Seville Limestone Member. Coal beds are well identified in GR logging.

Structural Geology

The structural geology of the Coal Valley area is poorly documented. In the Quad Cities area, the structural geology has been investigated using aeromagnetic and gravity surveys by the U.S. Geological Survey (Kucks and Hill 2005; Daniels et al. 2008). The Iowa composite magnetic anomaly map (Kucks and Hill 2005) shows that the Quad Cities area is bound to the west by the Mississippi River Arch, to the south by the Sangamon Arch, and to the north the Wisconsin Arch. The Mississippi River Arch separates, respectively from the east to the west, the Illinois and Iowa basins. The bedrock outcrops observed are nearly flat-lying, however the dip of Paleozoic strata can locally range between 1 and 15° toward the south and southeast. The highest dip is caused by the irregular surface that are largely eroded by the Atokan-Desmoinesian Tradewater Formation over the Middle and Upper Devonian strata, resulting in a primary dip. Such erosive surfaces are identified in many places along Shaffer Creek in sec 24, T 17 N, R 1 W (GPS coordinate: N41.45055°, W090.44938° and N41.44517°, W090.44615°). H.E. Culver (1923) has been indicated that the regional geology is structurally tilted, but none of this structure is evidenced in the Coal Valley area. Faulting is not documented, but joints are subvertical and northwest-to north-northwest oriented.

Economic Resources

Groundwater

The Mississippi River serves as the water source for Moline and East Moline, while the village of Coal Valley and rural areas are supplied by wells at depths of 100 to 300 feet. Most of the water from water wells is obtained from cracks and crevices in the Silurian System. The village of Coal Valley sources its water from three wells withdrawing 260 to 280 gallons per minute from the Middle Devonian Cedar Valley and Wapsipinicon Limestones aquifer (Village of Coal Valley's annual drinking water quality report, 2021). The 1,000 feet-deep aquifers within the Middle-Upper Ordovician Glenwood-St. Peter and Galena-Platteville Formations are the main supplied water from 4 wells withdrawing 130 to 150 gallons per minute for the village of Carbon Cliff (Carbon Cliff's Annual drinking water quality report, 2019). Waters from these aquifers generally have low concentrations of dissolved solids. In the Mississippi River and Rock River floodplains, Quaternary floodplain aquifers yield as much as 1000 gallons per minute, but they are generally unfavorable for potable supply due to a high concentration of total dissolved solids (Devera and Krienert 2020). The largest towns, such as Moline and East Moline, takes water from Mississippi River and treats up to 5 billion gallons per year at their Water Filtration Plant (Moline and East Moline's Annual drinking water quality reports 2019).

Sand and gravel

The inactive sand borrow pit of C.E. Peterson and Sons (NW¼ NE¼ sec 27, T 17 N, R 1 W), located 0.32 miles southeast of the intersection between the 78 Ave. and U.S. Highway 150, displays 56 feet thick succession that is composed from the oldest to the youngest, by gravels of the Kellerville Till of the Glasford Formation, silts of the Roxana Silt, silts and fine sands of the Equality Formation, and loess of the Peoria Loess. A stratigraphic column has been proposed by Anderson et al. (1999).

Coal

Coal has historically been mined in numerous small underground mines extracting the Rock Island (No. 1) Coal bed mostly operating in the area around the village of Coal Valley and in the southeastern and eastern portions of the Moline Upland near the village of Carbon Cliff. The Rock Island (No. 1) Coal bed, basal member of the Tradewater Formation, varies in thicknesses from between 1.7 and 6 feet in the Coal Valley area. The thickest coal beds are between 3.5 and 5.75 feet thick were actively mined. Coal balls were common in some mines, ranging in size from 1 to 8 inches in diameter. The earliest record of coal mining in the Coal Valley Quadrangle is 1847 and mining activity ceased in 1959. During that period, 3,846,000 tons (3,488,000 metric tons) of coal was extracted. The most productive coal mines produced more than 300,000 tons, in which the County Line (mine index 3234; sec 1, T 17 N, R 1 W) and Baracks & Kuhlman (mine index 301; sec 28, T 17 N, R 1 W) mines extracted a total of 662,056 tons (respectively 325,780 and 336,276 tons) between 1898 and 1942. A few of the mines in the study area produced a low volume of coal from a lenticular and discontinuous coal seam within the Muscatine Formation. The latest active coal mine, the Gem mine (mine index 2434; sec 32, T 17 N, R 1 E), closed in 1959, after producing 193,888 tons during 20 years. All the mines in the Coal Valley Quadrangle mined underground using the room and pillar method. The coal occurred 120-140 feet and 15-60 feet below the surface respectively around the village of Coal Valley and in the southeastern and eastern portions of the Moline Upland. Most were shaft (vertical openings) and slope (inclined openings) mines that were mining the Rock Island (No.1) Coal bed. The longwall method (mined in single slice) was tried prior to 1885 by the Eureka Coal Company (mine index 4949, not reported in this map) in Moline, but that attempt failed due to geologic conditions in the area. The coal near the surface was accessed directly from the outcrop and dug into the hillside. All mines are now abandoned.

Oil and Gas

The possibility of discovering commercial oil and gas reservoirs in Rock Island County was considered in the early 1960's, but no known structures within the Paleozoic bedrock offered promise for developing storage reservoirs for natural gas (Anderson 1980). In the Coal Valley area, 9 oil and gas wells have been drilled for regional study. The deepest well is 780 feet, and bored through the Middle Pennsylvanian to Upper Ordovician strata. The total depth of this well reached the Cincinnatian Maquoketa Shale Group. All wells are located in the west edge of the Coal Valley Quadrangle.

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List of cited well records

Stratigraphic test well
API: 121612475400
Farm: Niabi Zoo
Total depth: 260 feet
Elevation: 695 feet
Location: 150 feet and 860 feet respectively from the east and north lines sec 25, T 17 N, R 1 W
Latitude: 41.439722ºN
Longitude: 090.433301ºW

Water wells
API: 121610021000
Farm: Christianson Brothers
Total depth: 2,890 feet
Elevation: 620 feet GL
Location: 1100 feet S line, 50 feet E line of sec. 8, T17N, R1E
Latitude: N41.474006º
Longitude: W090.396094º

API: 121610043000
Farm: John Deere Co
Total depth: 1,651 feet
Elevation: 610 feet TM
Location: 530 feet N line, 150 feet E line of NE¼ SW¼ sec 7, T17N, R1E
Latitude: N41.477104º
Longitude: W090.425879º

API: 121612122500
Farm: City of Silvis
Total depth: 1,371 feet
Elevation: 690 feet TM
Location: 2190 feet S line, 1400 feet W line of sec. 5, T17N, R1E
Latitude: N41.491694º
Longitude: W090.410503º

API: 120730052400
Farm: McGraw
Total depth: 278 feet
Elevation: 725 feet GL
Location: 400 feet N line, 500 feet E line of SW¼ SE¼ sec 5, T16N, R1E
Latitude: N41.400895º
Longitude: W090.40231º

API: 120730026800
Farm: Orion School District 223
Total depth: 346 feet
Elevation: /
Location: 200 feet S line, 50 feet E line of sec 6, T16N, R1E
Latitude: N41.399265º
Longitude: W090.415084º

Oil and gas wells
API: 121610036100
Farm: Wadsworth
Total depth: 1,160 feet
Elevation: 696 feet GL
Location: 113 feet S line, 497 feet E line of SW¼ SE¼ sec 33, T17N, R1W
Latitude: N41.414000º
Longitude: W090.497000º

API: 121610037000
Farm: Wilson
Total depth: 780 feet
Elevation: 741 feet GL
Location: 691 feet S line, 53 feet E line of SW¼ NW¼ sec 11, T16N, R1W
Latitude: N41.393000º
Longitude: W090.467000º

API: 121610036400
Farm: Dauffenback
Total depth: 710 feet
Elevation: 663 feet GL
Location: 271 feet south and 678 feet east of the line sec 4, T16N, R1W
Latitude: N41.400000º
Longitude: W090.494000º

List of cited coal mines

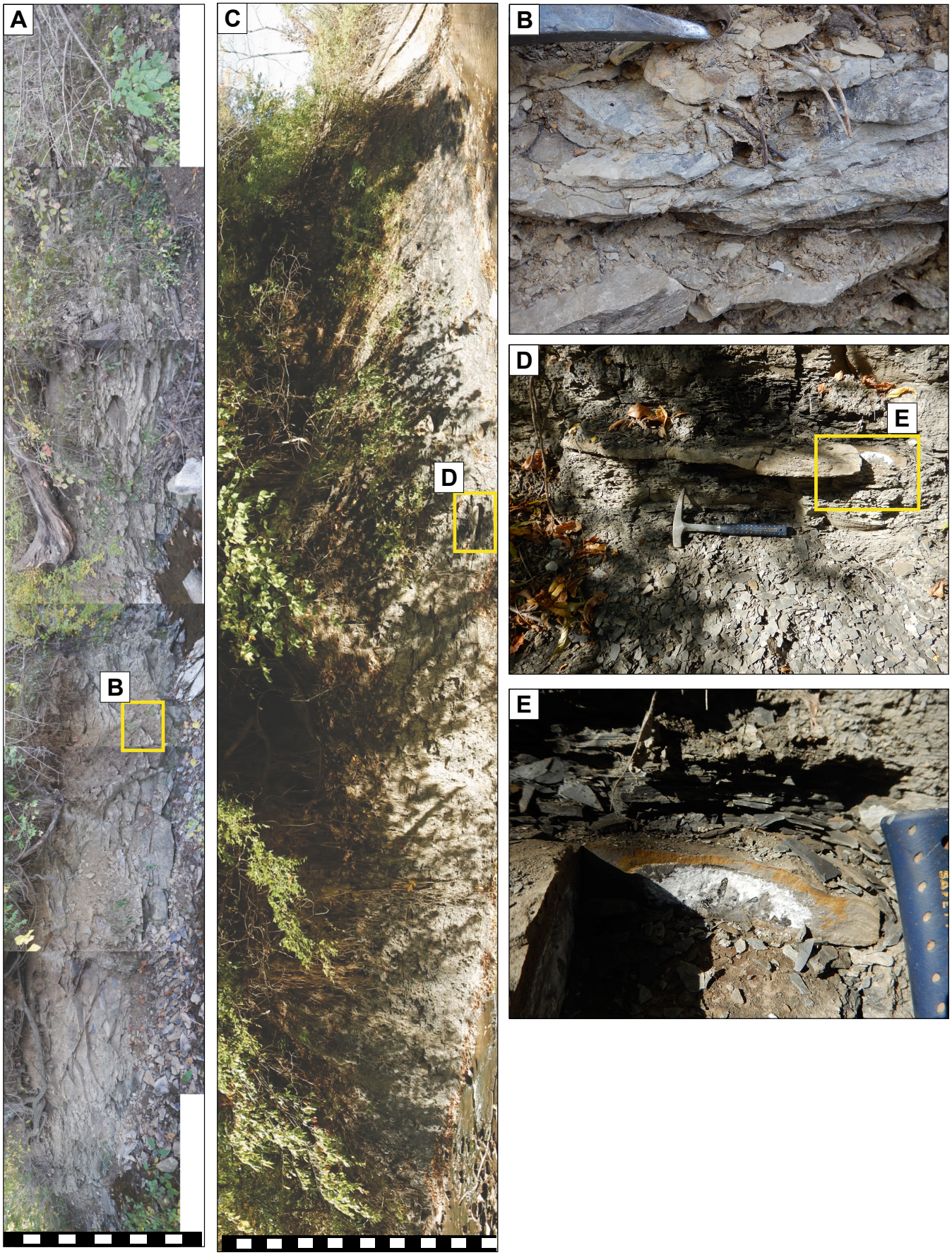
Mine index: 3234
Mine name: County Line
Company name: Mielke Brothers
Type underground: Mine shaft
Seam mined: Rock Island (No.1) Coal
Depth: 140 feet
Thickness: 3.67-5.3 feet
Production date: 1930-1942
Production history: 325,780 tons
Location: 1 T17N, R1W

Mine index: 301
Mine name: Baracks & Kuhlman
Company name: Baracks Brothers & Kuhlman
Type underground: Mine slope
Seam mined: Rock Island (No.1) Coal
Depth: 60 feet
Thickness: 3.8-4.7 feet
Production date: 1898-1920
Production history: 336,276 tons
Location: sec 28, T17N, R1W

Mine index: 2434
Mine name: Gem
Company name: Cook Gem Coal Company Inc.
Type underground: Mine shaft
Seam mined: Rock Island (No.1) Coal
Depth: 130-140 feet
Thickness: 2.5-3.5 feet
Production date: 1939-1959
Production history: 193,888 tons
Location: 32, T17N, R1E

Mine index: 4949
Mine name: Eureka
Company name: Eureka Coal Company
Type underground: Mine shaft
Seam mined: Rock Island (No.1) Coal
Depth: 56 feet
Thickness: 3.5 feet
Production date: 1884-1887
Production history: 14,082 tons
Location: /

Plate 1 Outcrop photographs. Middle and Upper Devonian. (A) Coralville Member of the upper Middle Devonian Cedar Valley Limestone - N85E-orented 1/10-1 feet-thick beds of wackestone and mudstone, locally grainstone at the top, with abundant brachiopods (Atrypa, Stropheodonta, Spinatrypa, Orthospirfier, Protoleptostrophia, Elita), colonial rugose and tabulate corals (Heliophylum and Cladopora), disarticulated crinoids, rare stromatoporid sponges and trilobites. Thickness: 7 feet. Location: 78th Ave. near the intersection with the Shaffer Creek in NW¼ SW¼ SW¼ sec 24, T 17 N, R 1 W, N41.45055°, W090.44938°. (B) Coralville Member of the upper Middle Devonian Cedar Valley Limestone - Light gray, fine- to medium-grained, fossiliferous wackestone and mudstone separated by light greenish gray thin shale partings. Location: 78th Ave. near the intersection with the Shaffer Creek in NW¼ SW¼ SW¼ sec 24, T 17 N, R 1 W, N41.45055°, W090.44938°. (C) Upper Devonian Sweetland Creek Shale – Massive beds of silty shale with 1-4 feet-long lenses of siltstone. Thickness: 15 feet. Location: left bank of Coal Creek in SE¼ SE¼ NW¼ sec 27, T 17 N, R 1 W, N41.213090°, W090.47379°. (D) Upper Devonian Sweetland Creek Shale – Massive beds of dark gray, fissile, slightly calcareous, silty shale with 1-4 feet-long lenses of light gray to dark gray, massive to finely laminated, slightly calcareous, siltstone. Location: left bank of Coal Creek in SE¼ SE¼ NW¼ sec 27, T 17 N, R 1 W, N41.213090°, W090.47379°. (E) Sphalerite and galena in calcite veins of the siltstone bed within the Upper Devonian Sweetland Creek Shale. Location: left bank of Coal Creek in SE¼ SE¼ NW¼ sec 27, T 17 N, R 1 W, N41.213090°, W090.47379°.


A
B
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D
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E

Plate 2 Outcrop photographs. Morrowan Muscatine Formation (Raccoon Creek Group), Lower Pennsylvanian. (A) Unconformable contacts, from the oldest to the youngest, between the Upper Devonian Sweetland Creek Shale and the Lower and Middle Pensylvanian (Morrowan and Atokan-Desmoinesian) Muscatine and Tradewater Formations. The Muscatine Formation shows 5-6 feet thick, light gray to yellow when weathered, fine-grained, well sorted, sandstone. Thickness: 10-12 feet. Location: 0.4 miles SSE of the intersection between 78th Ave. and Niabi Zoo Rd. in SW¼ SE¼ NW¼ sec 24, T 17N, R 1 W, N41.859774°, W89.354248°. (B) Massive beds of cross-bedded sandstone with thin (2 inches thick) greenish-gray siltstone layers. Thickness: 5 feet. Location: 0.33 miles NE from the north line of section 20, T 17N, R 1 E, N40.45486°, W090.40227°. (C) Bed pitches out on a lens of sandstone. Location: 0.33 miles NE from the north line of section 20, T 17N, R 1 E, N40.45486°, W090.40227°. (D) Cross-bedding with a yellow to buff, fine- to medium-grained, well sorted, slightly micaceous, sandstone (quartz arenite). Location: 0.33 miles NE from the north line of section 20, T 17N, R 1 E, N40.45486°, W090.40227°.

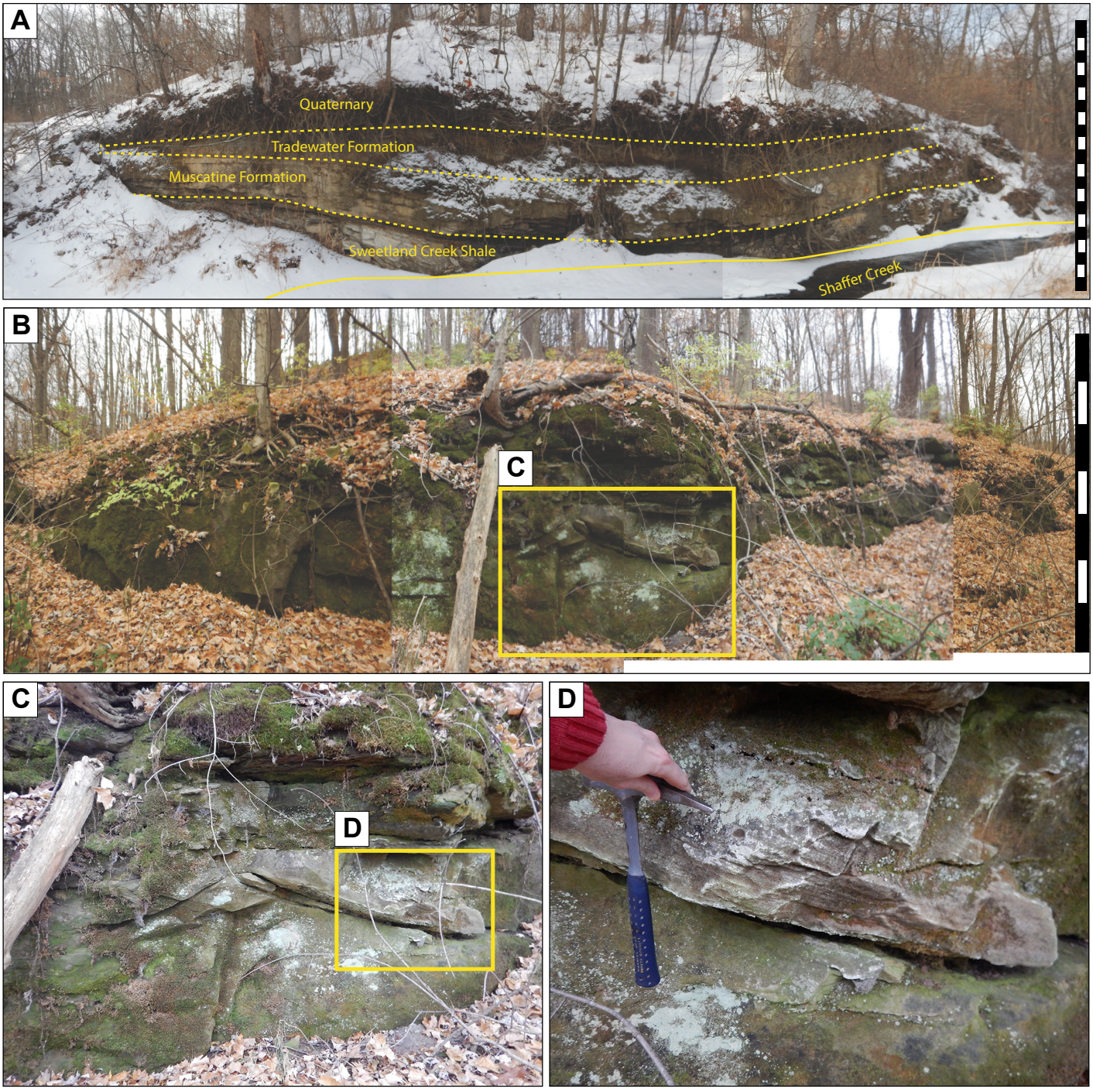
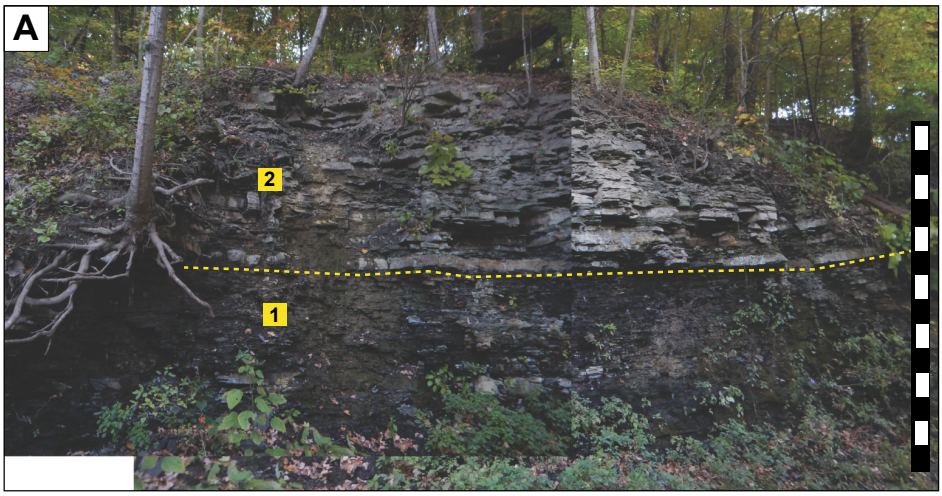


Plate 3 Outcrop photographs. Atokan-Desmoinesian Tradewater Formation (Raccoon Creek Group), Middle Pennsylvanian. (A) Lowemost Tradewater Formation that consists of (1) gray to dark gray, fissile, shale and siltstone, becoming carbonaceous the contact (yellow line) with the Seville Limestone Member (2). A few coal seams near this contact occur. In (2), the Seville Limestone Member consists of thin beds of bluish-gray to white chert, the "Moline Chert", within calcareous siltstone and shale. Thickness: 15 feet. Location: 0.3 miles S of the intersection between Oakwood Country Club Dr. and US. Highway 6 in NW¼ NW¼ SW¼ sec 20, T 17 N, R 1 E, N41.45177°, W090.41391°. (B) Lithostratigraphic contact between the Rock Island (No. 1) Coal bed and Seville Limestone Member. The Rock Island (No.1) Coal bed shows 5 feet thick dark, fissile, coal seams and coal bed, less than 11/2 feet thick, within a dark shale. The Seville Limestone Member contains chert beds associated with thin beds of calcareous siltstone and shale. Thickness: 12 feet. Location: 0.25 miles SE of the intersection 132nd St. and US. Highway 6 in SW¼ SW¼ SW¼ sec 19, T 17 N, R 1 E, N41.44906°, W090.43055°. (C) Coal bed of the Rock Island (No.1) Coal bed above the Seville Limestone Member. Location: 0.23 miles SE of the intersection 132nd St. and US. Highway 6 in SW¼ SW¼ SW¼ sec 19, T 17 N, R 1 E, N41.45111°, W090.41375°. (D) N60E-oriented beds of dark, fissile, coal (11/3 feet thick) at the base and gray dark shale (5-6 feet thick) at the top. Location: TPC Deere Run golf club, 0.42 miles SE of the intersection between Heather Knl and Colona Rd in NW¼ SE¼ NW¼ sec 9, T 17 N, R 1 E, N41.48059°, W090.30060°. (E) Lithostratigraphic contact between the lowermost Tradewater Formation and Seville Limestone Member. The surface is slightly erosive. Thickness: 10 feet. Location: 0.1 miles NW of the intersection Route 150 and 1st St. in SW¼ SW¼ SW¼ sec 26, T 17 N, R 1 W, N41.42984°, W90.46196°. (F) Tabular beds showing the lithostratigraphic contact between the Seville Limestone Member and uppermost Tradewater Formation. The base consists of 7-8 feet thick massive light gray to dark gray, non-fossiliferous, argillaceous limestone. Chert is absent. The upper part consists of thin beds of siltstone with thin shale partings, becoming shaly at the top. Thickness: 25 feet. Location: 0.1 miles NW of the intersection Route 150 and 1st St. in SW¼ SW¼ SW¼ sec 26, T 17 N, R 1 W, N41.42984°, W90.46196°. (E) Thin beds of bluish-gray to white "Moline Chert". Location: Location: 0.31 miles S of the intersection between Oakwood Country Club Dr. and US. Highway 6 in NW¼ NW¼ SW¼ sec 20, T 17 N, R 1 E, N41.45111°, W90.41375°.


A
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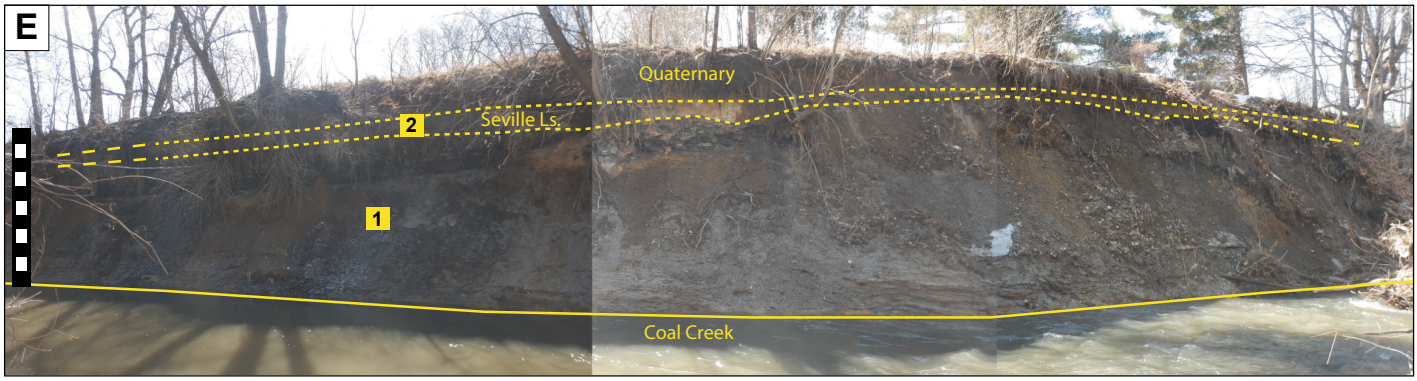
C


B
Quaternary
Seville Limestone (chert facies)
Rock Island (No. 1) Coal bed


D
Quaternary
Rock Island (No. 1) Coal bed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Quaternary
Seville Ls.
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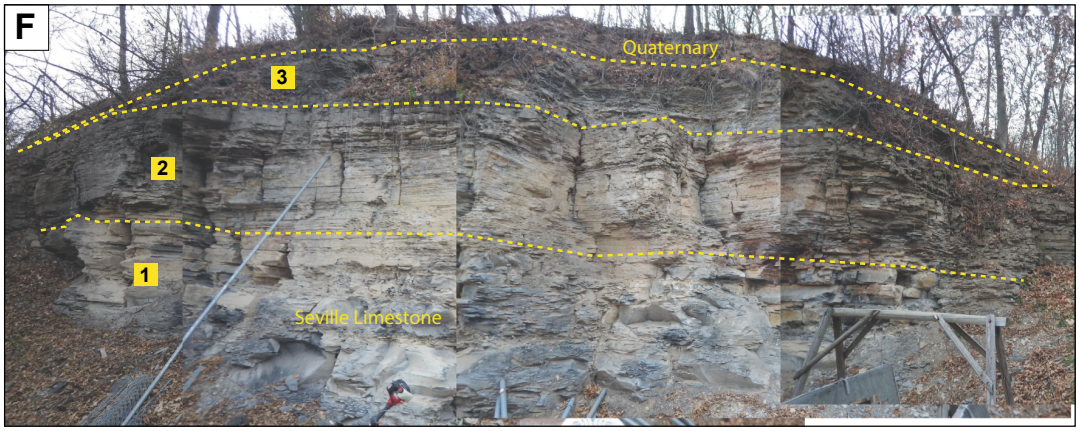
1
Coal Creek


F
Quaternary
3
2
1
Seville Limestone


G