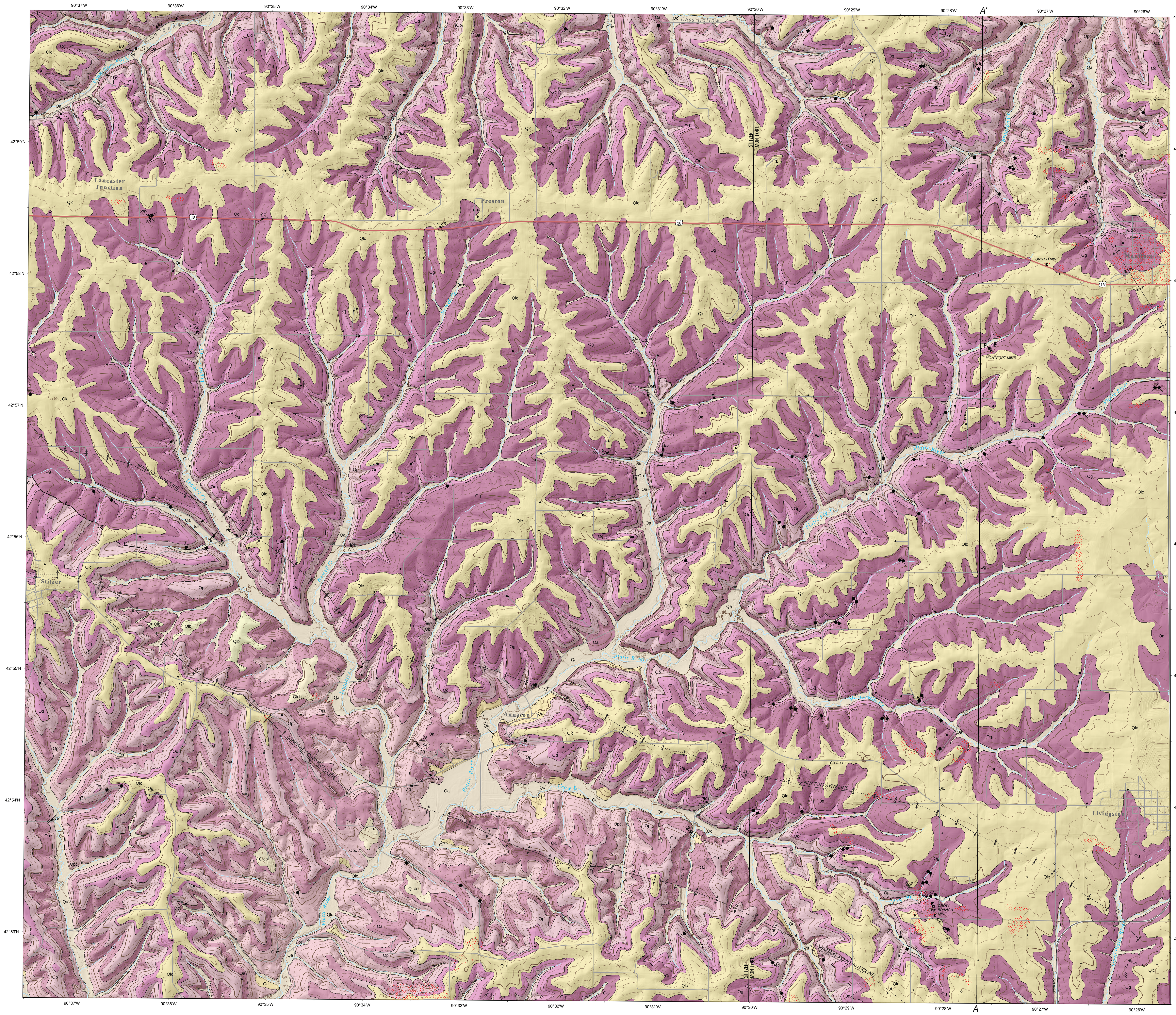
Geologic map of the Stitzer and western part of the Montfort 7.5-minute quadrangles, Grant County, Wisconsin

Eric D. Stewart, Stephen W. Mauel, William G. Batten



Mapped and compiled by
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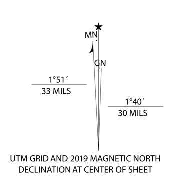
Geodatabase and cartography by Stephen Mauel and Eric Stewart

The map and cross sections are interpretations of the data available at the time of preparation. Every reasonable effort has been made to ensure that this interpretation conforms to sound scientific and cartographic principles; however, the map should not be used to guide site-specific decisions without verification. Proper use of the map is the sole responsibility of the user.

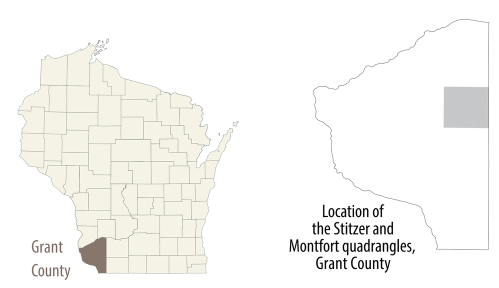
This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program under Earth MRI award number G21AC10500-00, 2021. GIS files that accompany this map can be found at: https://doi.org/10.54915/icay3440.

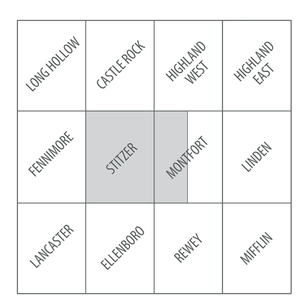


SCALE 1:24 000

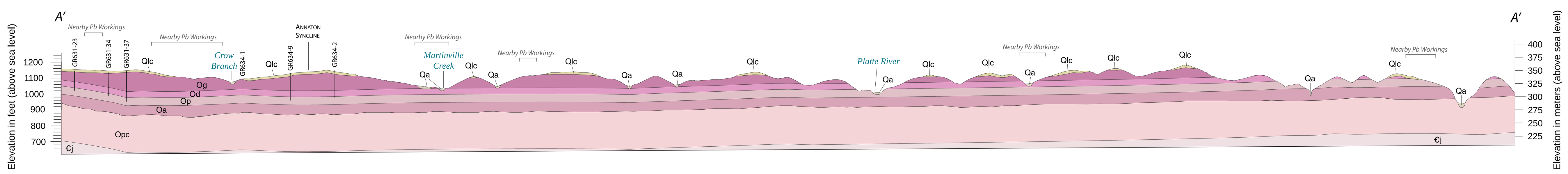
NAD 1983 HARN Wisconsin Transverse Mercator Projection (Meters)
Contour interval is 20 feet

Map hillshade and topographic contours sourced from the Grant County 5 foot LIDAR DEM. USDA-NRCS 2012. Magnetic north, hydrologic features, and roads from the National Map digital data, US TOPO map series, 2018.



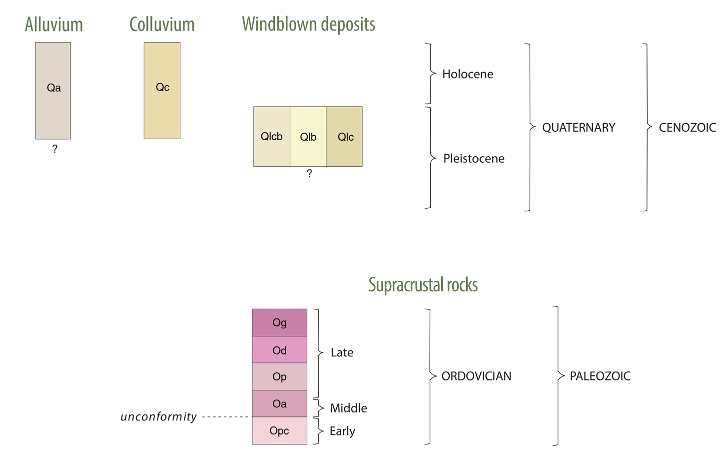


Stitzer, Montfort, and adjacent quadrangles



Vertical exaggeration × 5

CORRELATION OF MAP UNITS



INTRODUCTION

The Stitzer and Montfort 7.5-minute quadrangles are located in southwestern Wisconsin in the Driftless Area, a part of Wisconsin that was never glaciated. The landscape is composed of flat to gently undulating plateaus cut by steep stream and river valleys. Quaternary loess (windblown deposits) covers much of the upland surfaces.

The Stitzer and Montfort quadrangles are underlain by Ordovician siliciclastic and carbonate bedrock units that occur near the northern margin of the historic Upper Mississippi Valley lead (Pb) and zinc (Zn) mining district. The Upper Mississippi Valley district was the leading producer of lead in the United States from about 1830 to 1871 and was the fourth leading producer of zinc from 1906 to 1910 (Heyl and others, 1959). Mining production slowly declined in the 20th century and finally ended in the district in 1978. Pb-Zn mines and Pb diggings occur in the western half of the Montfort quadrangle, but few occur within the Stitzer quadrangle. Paleozoic units in both quadrangles are folded into the regionally significant Mineral Point anticline, but historic prospects are not equally distributed along the structure.

Mapping was initiated to investigate the potential structural controls on Mississippi Valley Type Pb-Zn sulfide deposits in southwestern Wisconsin as part of the U.S. Geological Survey's Earth Mapping Resources Initiative (Earth MRI). The district's Pb-Zn deposits have the potential to host base, precious, and industrial minerals critical to the nation's infrastructure, including Pb, Zn, cobalt, germanium, copper, and high-calcium limestone. Mississippi Valley Type sulfide mineralization can also impact groundwater quality, as the same deposits that potentially host critical minerals have the potential to release metals and arsenic into groundwater wells. This map uses historic prospects and mines as a guide for identifying mineralized areas and uses changes in structural setting to assess structural control on mineralization.

The Montfort quadrangle was previously mapped by Carlson (1961), while the Stitzer quadrangle has not been mapped at 1:24,000 scale. This map includes both the western half of the Montfort quadrangle and the Stitzer quadrangle because a large exploratory drilling program was initiated in the southwestern corner of the Montfort quadrangle by New Jersey Zinc in the 1960s after publication of the Montfort map. The records from this drilling campaign were compiled into the unpublished Mineral Development Atlas, part of which is stored in the archives of the Wisconsin Geological and Natural History Survey. These records along with new and historic geologic mapping were used to produce a structure-contour map of the base of the Platteville Formation (fig. 1). Bedrock contacts and structural measurements from Carlson (1961) were digitized, compiled, and used in this map. Quaternary units were not mapped by Carlson (1961), and have been added to this map.

SYMBOLS

- Contact; dashed where approximate
- Normal fault; dashed where approximately located, dotted where concealed. Ball and bar on downthrown block
- Anticline; dashed where approximately located, dotted where concealed
- Syncline; dashed where approximately located, dotted where concealed
- Inclined bedding—showing strike and dip
- Vertical joint—showing strike
- Inclined joint—showing strike and dip
- Outcrop
- Mine or mine shaft
- Mineralized rock at surface or beneath surficial material
- Geologic log, Mineral Development Atlas
- Geologic log, Mineral Development Atlas (cross section only)
- Well construction report

MAP UNITS

CENOZOIC

QUATERNARY

Mapped where estimated thicknesses exceed 3 m (10 feet). Most Quaternary unit descriptions follow Stewart and others (2022a). Windblown deposit units were updated with input from E. Carson (WGNHS, oral commun., 2023).

Alluvium

Qa — Well-sorted Holocene and Pleistocene sand, silt, and mud. Deposited as overbank deposits in modern valleys. Cobble beds are uncommon, but can be found in river valleys where adjacent hillslopes are draped by colluvial deposits.

Colluvium

Qc — Angular, poorly sorted boulders, cobbles, sand, and silt. Deposited at the base and lower reaches of valley slopes from gravity-driven mass wasting, soil creep, and non-channelized overland flow. The unit tends to fine towards the valley bottoms, and can interfinger with alluvium. Thicknesses are generally in excess of 3 m (10 ft), but rapid changes are likely due to an uneven, underlying bedrock surface.

Windblown deposits

Ql (Qlc, Qlb, Qlcb) — **Ql** – Undivided loess. Windblown deposits of very fine sand, silt, and clay. May include parts of the Roxana and Peoria Members of the Kieler Formation, a loess formation. Loess is present on upland surfaces, and is generally thicker on broad plateaus than narrow ridges. **Qlc** – Undivided loess over carbonate rocks. The Rountree Formation, formed from the surface weathering of carbonate rocks, is probably discontinuously present beneath the loess. **Qlb** – Undivided loess over siliciclastic bedrock. **Qlcb** – Undivided loess over mixed carbonate and siliciclastic bedrock.

PALEOZOIC

Paleozoic bedrock units were mapped where bedrock is estimated to be within 3 m (10 ft) of land surface. Within Paleozoic units, outcrops are generally discontinuous at the surface. Stratigraphic units use the classification scheme of Agnew and others (1956), which has different divisions for the Sinnipee Group than Wisconsin Geological and Natural History Survey (2011). Unit descriptions generally follow Stewart and others (2022a). Carbonate units follow the classification of Dunham (1962).

ORDOVICIAN

Galena Formation

Og — Tan to gray, vuggy dolomite. Thin- to medium-bedded. The upper Galena Formation is composed of granular, sandy dolomite, but is not exposed in the map area. The lower approximately 36.5 m (120 ft) of the Galena Formation contains sandy dolomite with interbedded gray chert. *Receptaculites* is common in the lower Galena. At the surface, the dolomite often weathers into a distinctive honeycomb appearance. Honeycomb-weathering is thought to result from preferred dissolution and weathering of *Thalassinoides* burrows (Dockal, 2021; Stewart and others, 2022b). Though the entire section is not exposed in the map area, the full thickness of the Galena Formation elsewhere ranges from approximately 70–76 m (230–250 ft).

Decorah Formation

Od — The Decorah Formation contains the upper Ion Member, the middle Guttenberg Member, and the basal Spechts Ferry Member. The Ion Member contains thin- to medium-bedded gray dolomitic mudstone and wackestone. Shale partings are common, and they define bedsets in the field. The Guttenberg Member is composed of 0.5–10 cm (0.2–2.4 in) thick gray to tan mottled mudstone to wackestone with interbedded chocolate brown to gray shaley mudstone around 1 cm (0.4 in) thick. The Spechts Ferry Member contains green-blue laminated, fissile shale with subordinate interbedded gray limestone and dolostone. The Spechts Ferry Member is around 0.6–0.9 m (2–3 ft) thick in the Stitzer and Montfort area, but thickens westward to around 2.6 m (8.5 ft) at the type section in Dubuque County, Iowa (Kay, 1929). The Decorah Formation contains abundant brachiopod fossils throughout. The Decorah Formation is around 9–12 m thick (30–40 ft).

Platteville Formation

Op — The Platteville Formation contains the upper Quimbys Mill Member, the middle McGregor Member, and the basal Pecatonica Member. The Quimbys Mill Member contains thin-bedded, fine-grained gray to brown mudstone. The mudstone fractures conchoidally, which helps distinguish the unit. Millimeter- to centimeter-thick brown shale partings and interbeds define bedsets. The McGregor Member contains thin-bedded gray wackestone interbedded with dark gray, shaley mudstone. Bedding is wavy and mottled. Brachiopods are common. The Pecatonica Member is a tan to gray, thin- to medium-bedded dolomitic wackestone. Bedding is typically tabular. The total thickness of the Platteville Formation is approximately 15 m (50 ft).

Ancell Group

Oa — The Ancell Group includes the Glenwood Formation and the St. Peter Formation. The Glenwood Formation is a light to dark green, fissile shale 0.6–1 m thick. The underlying St. Peter Formation contains the upper Tonti Member and the basal Readstown Member. The Tonti member is a clean, tan to white, fine- to medium-grained quartz arenite. Bedding ranges from thin to medium. Large cross-beds are common. Near the contact with the Glenwood, the Tonti is cemented with iron sulfides and carbonate. The Readstown Member is poorly exposed in the Stitzer and Montfort areas, but elsewhere it contains interbedded white to tan, fine-grained quartz arenite and mottled, maroon to green shale. Soft-sediment deformation is common. The base of the Readstown forms an unconformity with the underlying Prairie du Chien Group. The thickness of the St. Peter Formation is variable, but the combined Ancell-Prairie du Chien thickness in southwest Wisconsin is around 82–98 m (270–320 ft) (Agnew and others, 1956).

Prairie du Chien Group

Opc — The Prairie du Chien Group in the Stitzer and Montfort area is largely composed of the Oneota Formation. The Oneota Formation is generally a tan to gray, thin- to thick-bedded, fine-grained dolostone. Vugs and chert are common. Fine-grained micrite and stromatolites occur locally. The base of the Prairie du Chien Group is not exposed in the map area.

STRUCTURE

Mineral Point anticline

The Mineral Point anticline is an asymmetric, north-vergent anticline with a maximum structural relief of approximately 60 m (200 ft). The fold is a composite structure composed of overlapping to underlapping lateral segments. Along the steeply dipping north limb of the fold, isolated to dense webs of deformation bands occur in the St. Peter sandstone. The bands have significantly lower porosity than the surrounding sandstone matrix. Bedrock fractures near the fold typically strike parallel or perpendicular to the fold axis, and have a vertical or sub-vertical dip. Fracturing appears to be more intense in places where bedding has a measurable dip.

The fold is interpreted to be a fault propagation fold. The asymmetry of the fold limbs and the correspondence between aeromagnetic basement anomalies and Paleozoic structure contours (Bremmer and others, in press) suggest reactivation of Precambrian faults in the Paleozoic induced folding in the cover sequence. Buried thrust faults likely exist in the Cambrian section at depth in the core of the Mineral Point anticline.

MINERALIZATION

Crow Branch area

Historic prospects and mines near Crow Branch and adjacent areas are concentrated in a broad area that bounds the junction of three anticline-syncline pairs (fig. 1). Each of the fold segments is probably cored by a small thrust fault at depth. Thus, the junction zone between the folds overlies an area of strain accommodation between fault segments, known as a transfer zone or relay zone. Displacement vectors within relay zones can change rapidly, potentially resulting in heavy fracturing of rock and providing conduits for vertical fluid flow (Fossen and Rotevatn, 2016).

Mines and prospects west of Crow Branch are uncommon even though the amplitude of the Mineral Point anticline is larger. There is a notable lack of historic mining prospects from Annaton to Stitzer. The cause of this change is unclear, but intense webs of deformation bands in sandstones and/or clay smearing along buried faults could both potentially reduce permeability and shift mineralizing fluids towards the relay zones.

Crow Branch mine

The Crow Branch mine was active from the 1830s until the 1880s (Carlson, 1961). Mines in this area produced lead ore from the Galena, Decorah, and Platteville formations. A roughly horizontal adit was dug that started near the top of the St. Peter Formation and passed into the Platteville Formation. The adit was connected to the surface by vertical shafts. The total production is not known with certainty, but by 1859, 2,000 to 2,500 tons of lead concentrate was produced (Hall and Whitney, 1862). Carlson (1961) estimated total production at 100,000 tons of lead at 6-10% grade (6,000 to 10,000 tons lead concentrate).

Sulfide mineralization at the Crow Branch mine was unique for the district. Early diggings identified 3 mineralized flats (horizontal beds), connected by iron-sulfide-rich pitches (inclined veins or small faults) that strike N25W (Percival, 1856; Heyl and others 1959). The lowermost flat contains lateral sheets of sphalerite, the middle flat contains sheets of iron sulfide, and the uppermost flat contains pyrite disseminated within shale (Percival, 1856). Above the flats are vertical Pb-bearing gash-vein deposits in the Galena Formation (Hall and Whitney, 1862). Chamberlin (1882) recognized that unlike most pitch-and-flat zinc deposits in the Upper Mississippi Valley, which contain two oppositely dipping sequences of mineralized pitches, the Crow Branch mining area contains only a single set of SW-dipping pitches. They named this unique mineralization style "parallel pitches."

The Crow Branch area is also notable for its deep root system. Hall and Whitney (1862) reported vertical galena veins running through the St. Peter sandstone, and extensive mineralization starting within the lower Platteville Formation, and rising through pitches and flats into the Decorah Formation. More recent exploratory drilling by the U.S. Geological Survey largely corroborated the early work, finding that lead, zinc, and iron sulfide mineralization extends vertically much deeper than is typical in the Upper Mississippi Valley district, extending from the Galena Formation down into the Prairie du Chien Group (Heyl and others, 1951).

Montfort area

The western half of the Montfort mining subdistrict occurs within the map area, and it contains several Pb and Zn mines and prospects in the Galena, Decorah, and Platteville formations. Barite, marcasite, and pyrite are common in mineralized zones in the subdistrict. Galena occurs in the Galena Formation as typical gash veins in vertical or subvertical fractures (Heyl and others, 1959). Sphalerite mineralization occurs along bedding-parallel flats and nascent pitches (Heyl and others, 1959).

Montfort mine

The Montfort Mine (fig. 1) was an iron sulfide mine active from 1894 to 1906. Iron sulfide occurs as a bedding-parallel vein at the top of the Spechts Ferry member of the Decorah Formation (Heyl and others, 1959). Pb and Zn sulfide were recovered as byproduct commodities (Heyl and others, 1959). Seven shafts were sunk into the deposit.

United mine

Heyl and others (1959) report a 91-foot-deep shaft was dug at the United Mine (fig. 1) around 1906. No production is known from this property, and additional drilling around the shaft yielded little mineralization (Heyl and others, 1959).

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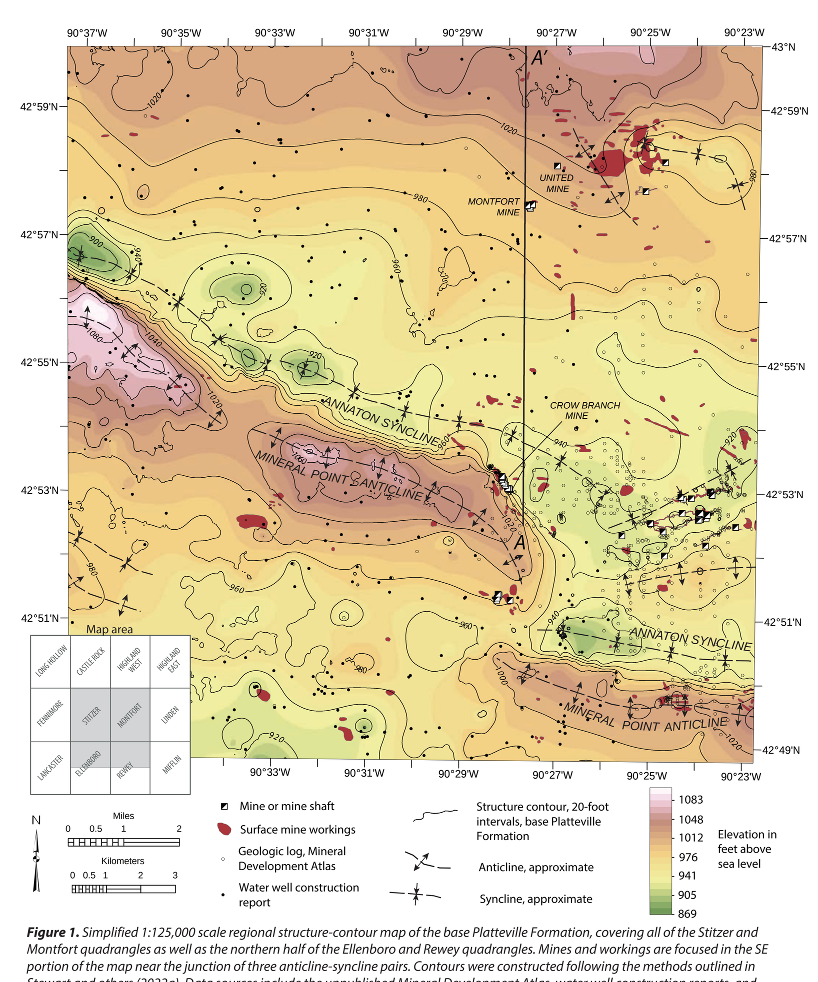

Figure 1. Simplified 1:125,000 scale regional structure contour map of the base Platteville Formation, covering all of the Stitzer and Montfort quadrangles as well as the northern half of the Ellenboro and Rewey quadrangles. Mines and workings are focused in the SE portion of the map near the junction of three anticline-syncline pairs (fig. 1). Contours were constructed following the methods outlined in Stewart and others (2022a). Data sources include the unpublished Mineral Development Atlas, water well construction reports, and map contacts from this map, Carlson (1961), West (1971), and Taylor (1964).

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https://doi.org/10.54915/icay3440
Open-File Report 2023-03 • 2023