Bedrock Geology of Jefferson County, Wisconsin

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Cartography by Nick Rompa

MAP 511
2024

Explanation

Map unit descriptions are taken or modified from Stewart (2021) and informed by Kusick (2022). Descriptions are based on drill cores Mobil Oil Corp. 8-16-21z1 (WID# 28000856), WGNHS HBFA (WID# 28001135), and WGNHS Mankowski (WID# 28001133). Jefferson County's position on the Wisconsin Arch results in facies variation and truncation that are especially pronounced in the Cambrian and lower Ordovician strata. In this region, unconformities converge, and the Jordan and St. Lawrence Formations are locally truncated or absent (e.g., Runkel, 1994; Byers and Dott, 1995; Parsons and Clark, 2006; Bojdak-Yates and others, 2023). In landward positions above the Wisconsin Arch, unconformities may amalgamate into a regionally extensive surface that separates regressive Cambrian strata from overlying transgressive early Ordovician strata. Sandstone interbeds are common, likely derived from the weathering of exposed highlands during marine regressions or reworking of underlying units during marine transgression. Existing stratigraphic picks in many of the geologic logs of water well cuttings in Jefferson County are inconsistent because of this truncation and facies variability. Many geologic logs designate what is here considered the Mazomanie Formation (Tunnel City Group) as the Wonewoc Formation (Elk Mound Group), and the Reno, Tomah, and Birkmose Members (Lone Rock Formation, Tunnel City Group) as the Eau Claire Formation (Elk Mound Group). Figure 3 of the accompanying report (https://doi.org/10.54915/xeeb5653) contains a generic stratigraphic column showing the gamma ray and portable X-ray flourescense (pXRF) profiles for the Sinnipee Group through upper Elk Mound Group. For much of the county, geophysical logs and observation of well cuttings indicate variable shale and dolomite content throughout the Cambrian and lower Ordovician succession. Only two cores penetrate below the top of the Ancell Group. This combination of facies variability and the absence of outcrop or cores that would allow direct observation of the rocks adds uncertainty to interpretation of bedrock unit contacts below the Sinnipee Group.

Acknowledgments

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Interpretation

For more information about the bedrock geology of Jefferson County, Wisconsin, please refer to the supplemental report that accompanies this map at: https://doi.org/10.54915/xeeb5653.

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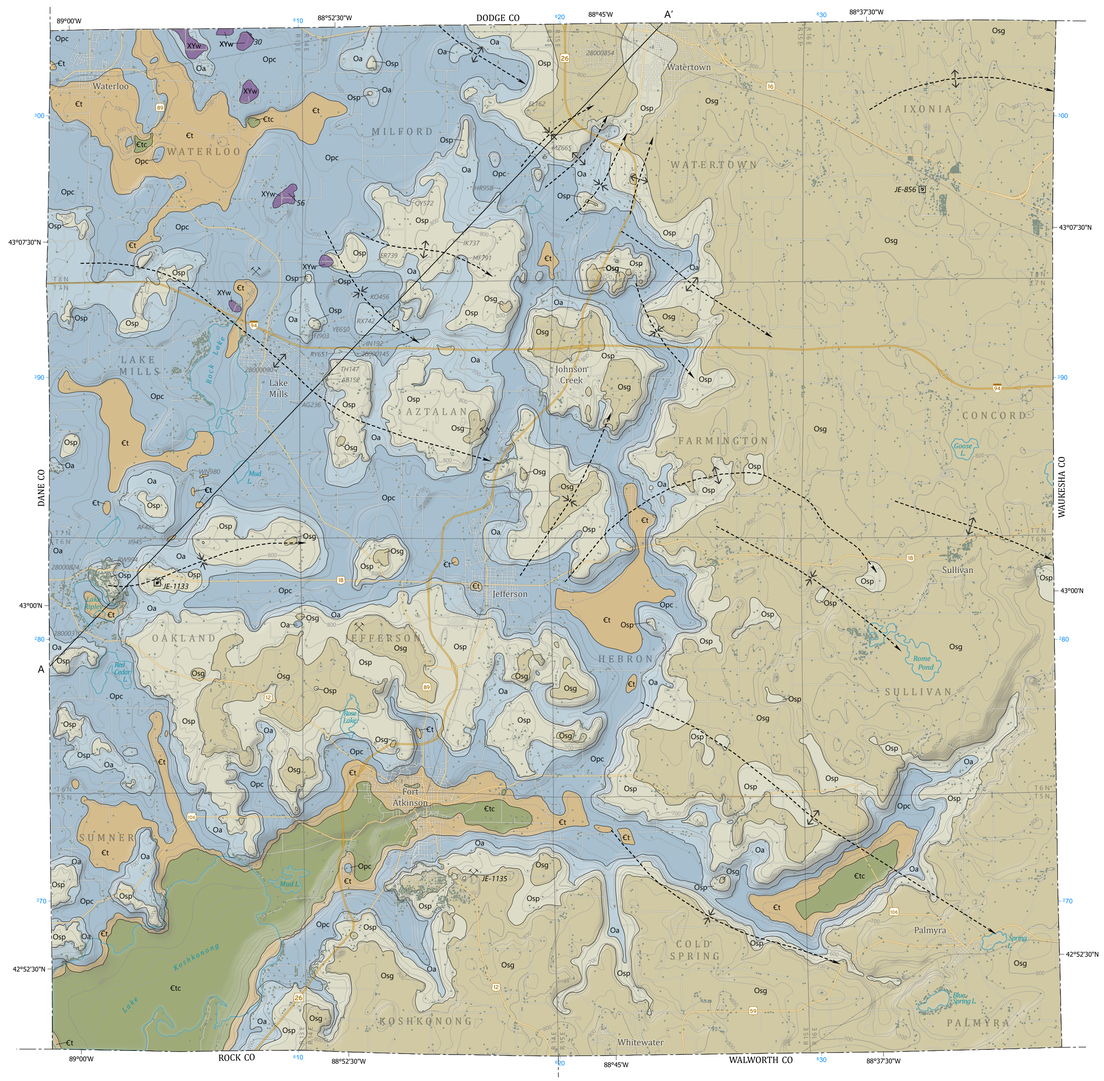


The map and cross section are interpretations of the data available at the time of preparation. Every reasonable effort has been made to ensure that this interpretation conforms to sound scientific and cartographic principles; however, the map should not be used to guide site-specific decisions without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

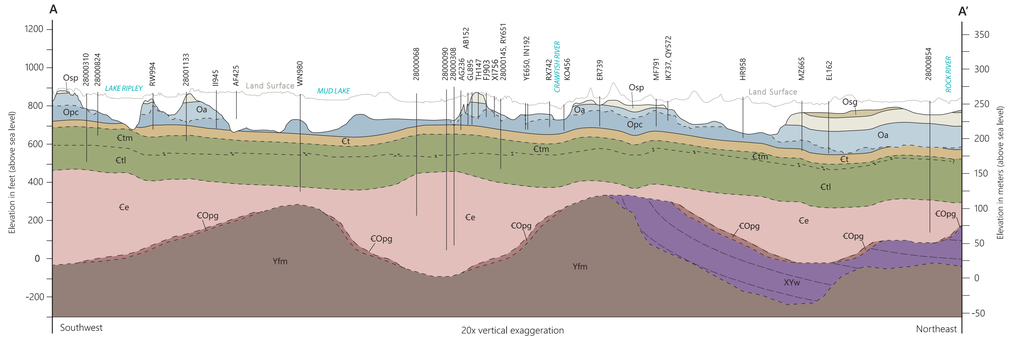
Scale 1:100,000

1 0 1 2 3 4 5
MILES
1 0 1 2 3 4 5 6 7 8
KILOMETERS

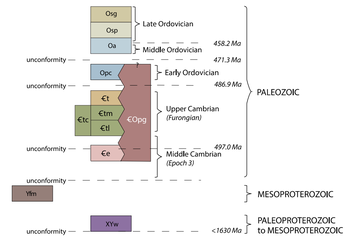
Wisconsin Transverse Mercator Projection,
1991 adjustment to the North American Datum of 1983 (NAD 83/91); EPSG 3071

The base map was constructed from U.S. Census Bureau TIGER/Line data (2015 release) and modified by the Wisconsin Geological and Natural History Survey (2022). Hydrography from U.S. Geological Survey National Hydrography Dataset (local resolution, 2016).

Contours represent the elevation of the bedrock surface in feet above sea level. The contour inverval is 25 ft.
Roads and hydrography are shown for reference.



Correlation of Map Units



Symbols

- **Geologic contact**—concealed beneath unconsolidated Quaternary sediments throughout map area
- **Anticline**—concealed. Solid arrow indicates direction of plunge
- **Syncline**—concealed. Solid arrow indicates direction of plunge
- **Line of cross section**
- **Drill core hole**—identifier provided
- **Quarry**
- **Well**—identifier provided if used in cross section
- **Inclined bedding**—showing strike and dip

Map Units

Ordovician

Sinnipee Group

Late Ordovician, upper Sandbian - upper Katian

Comprises three formations (Galena, Decorah, and Platteville). Crops out and is present as subcrop across Jefferson County. Uneroded thickness ~260 ft (79 m).

Osg **Galena Formation.** (190 ft/58 m). Yellow, beige, and gray dolostone and dark-gray to green dolostone and shale; basal shaly packstone to wackestone and intercalated shale transitions upward into variably argillaceous and bioturbated mudstone through packstone with lesser, intercalated oolitic to fossiliferous grainstone; common mm-scale, dark gray, wavy, discontinuous clay laminations, stylolites, and patches of vuggy, sucrose-textured dolomite often associated with chert nodules; molds, casts, and fragments of brachiopods, bryozoans, gastropods, crinoids, and lesser receptaculitids, trilobites, and orthocerida; iron mineralized omission surfaces; common to rare mm-wide *Chondrites* burrows; outcrops as thin (dm- to m-scale), laterally continuous, tabular beds locally capping isolated bedrock plateaus. Overlies the Decorah or Platteville Formation across an erosional omission surface (Choi, 1998).

Decorah Formation. (0–5 ft/1.5 m). Dark-gray to green dolostone and shale; shaly, skeletal wackestone to packstone with lesser, intercalated grainstone; moderately to heavily bioturbated with mud-filled burrows and brachiopod, crinoid, bryozoan, and lesser coral fragments; overlies Platteville Formation across a prominent, iron-mineralized omission surface characterized by brecciation, vuggy porosity below, and lithoclasts and quartz sand above. Unit thinning to absence in Jefferson County is attributed to onlap onto the Wisconsin Arch and Dome (Choi, 1998). This unit is too thin and laterally discontinuous to show on the map or cross section.

Osp **Platteville Formation.** (70 ft/21 m). Gray, yellow, and beige dolostone; basal sandy dolostone grades upward into dolostone and argillaceous dolostone; internally structureless mudstone to planar or wavy laminated and thin-bedded, variably bioturbated mudstone to packstone with molds, casts, and fragments of brachiopods and lesser trilobites, gastropods, crinoids, and orthocerida; common mm- to cm-thick, intercalated dark gray, wavy, discontinuous clay associated with cm-scale differential compaction; iron-mineralized omission surfaces; common to rare *Chondrites* and lesser *Thalassinoides* burrows; uncommon mm- to cm-scale grainstone laminae to thin beds composed of fossil hash or gastropod molds; outcrops as thin (dm- to m-scale), laterally continuous, tabular beds that locally cap isolated bedrock plateaus. Overlies the Glenwood Formation across a conformable contact (cf. Witzke and Bunker, 1996) or the St. Peter Formation across a sharp, unconformable contact (Choi, 1998; Ludvigson and others, 2004).

Ancell Group

Middle to Late Ordovician, upper Darriwilian – lower Sandbian

Oa Comprises two formations (Glenwood and St. Peter). The St. Peter Formation crops out and is present as subcrop across Jefferson County. The Glenwood Formation (carbonate cemented sandstone to sandy dolostone) is suggested only from well cuttings and is either absent or <10 ft (3 m) thick.

St. Peter Formation. Comprises two Members (Tonti and Readstown), not subdivided on map. Overlies the Prairie du Chien Group or Trempealeau Group across a sharp, erosional, and unconformable contact (Mai and Dott, 1985).

Tonti Member. (0–>100 ft/30 m). Gray, white, beige, green, yellow, orange, to red; medium- to coarse-grained, well rounded, well to moderately well sorted sandstone. High- to low-angle crossbedded or internally structureless; common, dm-scale brittle slumping of cross bedded and internally structureless strata, local soft-sediment deformation, bioturbation; locally intercalated with cm-scale beds of poorly sorted clay to silty sandstone; abundant iron and sulfur mineralization disseminated throughout matrix and concentrated along bedding planes and fractures; locally carbonate cemented; locally abundant high-angle, healed fractures. Gradational contact with the underlying Readstown Member.

Readstown Member. (0–~50 ft/15 m). White, gray, red, to green clay to siltstone; yellow, beige, to red, medium- to coarse-grained sandstone; m-scale interbeds of green or red silty clay and lesser, moderately well sorted sandstone with interlaminated clay; common scour-surfaces overlain by dm-scale, massive to convolute bedded or brecciated silt or clay with white silcrete or kaolinite (?) and silcrete or kaolinite (?) breccia, lesser cm-scale pebble lag beds composed of quartzite and silcrete pebbles (mm-scale) in a very coarse-grained sandstone matric lesser planar to wavy laminated silt and clay; commonly intercalated with cm- to dm-scale beds of medium- to coarse-grained, well to moderately well sorted, crossbedded sandstone; prevalent towards the middle to base of the St. Peter Formation, locally absent.

Prairie du Chien Group

Early Ordovician, Tremadocian – lower Floian (0–170 ft/52 m)

Opc Comprises two formations (Shakopee and Oneota), not subdivided on map. Uneroded thickness of ~170 ft. Overlies the Trempealeau Group across a sharp, erosional and unconformable contact (Smith and others, 1993).

Shakopee Formation. Beige to gray mottled dolostone and sandy dolostone interbedded, commonly across scour surfaces, with cm- to dm-scale beds of coarse-grained, well rounded sandstone, green to gray silt or clay; locally oolitic; massive, parallel-laminated, or vuggy wackestone to grainstone; vugs are mm- to cm- scale and locally quartz-filled, some are clustered and appear microbially derived (thrombolytic); molds of brachiopods; sandy dolostone is predominantly red with low-angle to planar-parallel crossbedding and scour surfaces; local sulfide mineralization; overlies the Oneota Formation across a sharp, unconformable contact (Ulrich, 1924; Smith and others, 1993).

Oneota Formation. Gray to beige sandy dolostone to dolostone with lesser interbedded sandstone; crossbedded, planar or wavy-laminated and vuggy, variably bioturbated wackestone to grainstone; vugs are round, ovoid, or vertical, clustered in cm- to dm-thick intervals and perhaps microbially derived (thrombolytic); local convolute bedding; cm- to dm-thick sandy oolitic grainstone beds, associated sandy dolostone with glauconitic flat pebble conglomerate, and interbedded sandstone common lower in unit may represent reworked sediment of the underlying Jordan Formation.

Cambrian

Trempealeau Group

Late Cambrian, Furongian

Ct Comprises two formations (Jordan and St. Lawrence), not subdivided on map. Overlies the Tunnel City Group across a gradational contact. Regionally significant unconformities are likely present within the Trempealeau and perhaps the Tunnel City Groups along the Wisconsin Arch in Jefferson County, separating regressive Cambrian strata from transgressive lower Ordovician strata (Kusick, 2022; Runkel and others, 2007).

Jordan Formation. (0–10 ft/0–3 m). White, beige, to yellow or green, medium- to coarse-grained sandstone. In the northern part of the county the formation comprises well rounded, well sorted white, beige, to yellow sandstone; local, green to gray, thin (cm-scale) interbeds of clay or interlaminated fine-grained sandstone, silt, and clay; poorly to moderately cemented; localized common high- and low-angle crossbeds and lesser, gray, cm- to dm-thick, wavy laminated, variably bioturbated siltstone to clay beds; localized sulfide mineralization; locally the interval immediately underlying the Prairie du Chien Group is characterized by brecciated, mixed sandstone and clay with abundant soft sediment deformation and silcrete or kaolinite (?) indicative of subaerial exposure. In the southern part of the county the formation is composed of green to beige, fine-grained, dolomite cemented, glauconitic (15–50%) planar- to low-angle crossbedded sandstone with moderate to minor bioturbation, flat pebble conglomerate clasts and minor interlaminations to thin beds of beige dolomite with load casts and flame structures. It is possible that some or all the sandstone attributed to the Jordan Formation may instead be part of the younger and overlying lower Oneota Formation, and that the Jordan Formation sandstone was partially or fully eroded away.

St. Lawrence Formation. (~30–40 ft/9–12 m).

Lodi Member. Red, green, and beige, glauconitic, mottled, dolomitic sandstone, silty sandstone, and sandy dolomite; typically fine- to medium-grained and poorly sorted with local, coarse-grained, glauconitic (15–20%), crossbedded, cm-scale beds overlying scour surfaces; common, cm-scale soft-sediment deformed beds with flame structures and mm-scale, lithified dolomite flat pebble conglomerate clasts; local hard grounds with sand-filled borings or shrinkage cracks; planar laminated fine-grained sandstone and siltstone to mudstone with *skolithos* burrows; overlies the Tunnel City Group across an ambiguous and gradational contact.

Black Earth Member. Tan, pink, to gray, mottled, fine-grained, silty dolostone; wispy, discontinuous, gray, fine-grained laminations; local hardgrounds with sand-filled borings; local gluconate-rich laminae and thin beds with or without flat pebble conglomerate more common towards base.

Tunnel City Group

Late Cambrian, Furongian

€tc Comprises two formations (Mazomanie and Lone Rock), only subdivided on cross section. Overlies the Elk Mound Group across a sharp contact. Within the map area formations and members of the Tunnel City Group intercalate laterally and vertically on scales of <1 ft (0.1 m) to >100 ft (30m).

€tm **Mazomanie Formation.** (~50–100 ft/15–30 m). White, tan, yellow and red sandstone with local green clay laminae. Sandstone is medium- to coarse-grained, internally structureless or mottled or planar laminated to high-angle crossbedded with minor to very little carbonate cement. Green clay laminae are mixed into sandstone due to bioturbation or soft sediment deformation, while thin bedded green clay is burrowed. Present across much of Jefferson County. Sharp contact with overlying Birkmose Member and gradational with the underlying Tomah Member of the Lone Rock Formation. Shown in cross section only.

€tl **Lone Rock Formation.** Shown in cross section only. Comprises three Members (Reno, Tomah, and Birkmose), not subdivided on cross section.

Reno Member. (~1–5 ft/0.3–1.5 m). White, green, and tan sandstone and beige dolomite. Sandstone is medium- to coarse-grained, high-angle to planar laminated, dolomite cemented and glauconitic with common flat pebble conglomerate. Dolomite is planar laminated with local burrows infilled with glauconite-rich sandstone.

Tomah Member. (~20–50 ft/6–15 m). Maroon, tan, or white dolomite cemented sandstone and interlaminated to thin-bedded clay. Dolomite cemented sandstone is bioturbated or soft-sediment deformed with sand-filled burrows in dolomite-rich interbeds and locally glauconitic. The upper Tomah Member is maroon, intercalated medium-grained, glauconitic (<15%), ripple-laminated and heavily bioturbated or soft-sediment-deformed sandstone with clay drapes and thin beds. The lower Tomah Member is tan to white fine-grained dolomite cemented, planar- to low-angle laminated, moderately bioturbated and burrowed sandstone and thinly interbedded to interlaminated green clay and beige dolomite.

Birkmose Member. (~5–30 ft/1.5–9 m). Green to beige glauconitic sandstone and gray, argillaceous dolomite. The upper part of the Member is composed of interlaminated to thinly interbedded glauconitic (to 90%) sandstone, dolomite, and clay with common load casts, flame structures, and differential compaction. The lower Member comprises planar to wavy-laminated argillaceous dolomite and lesser fine-grained glauconitic sandstone and green clay. Dolomite locally has minor, mm-scale ovoid burrows. Sandstone is flat to ripple-laminated with local rip-up clasts of the surrounding dolomite and clay.

Elk Mound Group

Mid- to Upper Cambrian; Epoch 3 – lower Furongian; uncertain thickness

Ce Includes Wonewoc, Eau Claire, and Mount Simon Formations (undivided). Overlies the Paleoproterozoic to Mesoproterozoic Waterloo Quartzite or Mesoproterozoic intrusive rocks across a nonconformity; grades laterally into Parfreys Glen Formation near elevated areas in underlying Precambrian surface. Known from geophysical logs and well cuttings only in Jefferson County; these indicate white, gray, and pink, medium- to fine-grained sandstone with clay and carbonate content present throughout and increasing with depth. Shown in cross section only.

€Opg **Parfreys Glen Formation.** White, gray, and pink coarse- to medium-grained sandstone with quartz pebble to cobble conglomerate interbeds. Overlies the Paleoproterozoic to Mesoproterozoic Waterloo Quartzite and associated Mesoproterozoic intrusive rocks across a nonconformity locally characterized by incisions of ~20–50 ft (6-15 m) or greater; grades laterally and vertically into Cambrian and lower Ordovician units based on observation of this contact in the Baraboo Hills, Sauk County (Clayton and Attig, 1990). The basal contact and ~20-50 ft (6-15 m) of conglomerate and sandstone are exposed in the Michels Materials Waterloo quarry (43°12'32"N 88°56'57"W) and indicated by geologic logs of water well cuttings in Jefferson County, while a thin veneer of coarse-grained sandstone and pebble conglomerate drapes low-relief outcrops of Waterloo Quartzite in northwest Jefferson County. Shown in cross section only.

Mesoproterozoic

Felsic and Mafic Intrusions

uncertain age

Yfm Felsic intrusions likely related to the 1.46 Ga Wolf River Batholith and Eastern Granite-Rhyolite province (e.g. Holm and others, 2007). Mafic intrusions of uncertain affinity; may be related to the 1.46 Ga Wolf River Batholith and Eastern Granite-Rhyolite province or the 1.1 Ga Midcontinent Rift. Mafic and felsic dikes are reported from the Waterloo quarry in southwest Dodge County. These units are mostly inferred from regional aeromagnetic data (Daniels and Snyder, 2002) and geochronologic data that indicates alteration of Baraboo Interval metasediments during emplacement of the Wolf River Batholith (Medaris and others, 2021). Shown in cross section only.

Meso- to Paleoproterozoic

Waterloo Quartzite

<1643 Ma; uncertain thickness—likely more than 800 ft/244 m

XYw Pink, white, and gray, pebble-conglomerate to medium-grained quartzite and green to gray andaluste schist; observed minerals include quartz, muscovite, chlorite, andalusite, hematite, rutile, zircon, opaques; normally graded beds 5–15 ft (1.5–4.5 m) thick fine upward from granule conglomerate to fine-grained sandstone and siltstone; pebbles (2–23 mm, long axis) of rounded quartzite and subrounded to subangular jasper and dark lithic fragments (probably slate) concentrated near the base of beds; sedimentary structures include trough cross beds, low-angle and high-angle cross beds, planar beds and internally structureless beds; fine-grained intervals are typically 5–100 mm thick, schistose, with common euhedral andalusite porphyroblasts in a foliated, muscovite-chlorite groundmass. Detrital zircons indicate a maximum depositional age of 1643 ± 11 Ma (Medaris and others, 2021).

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