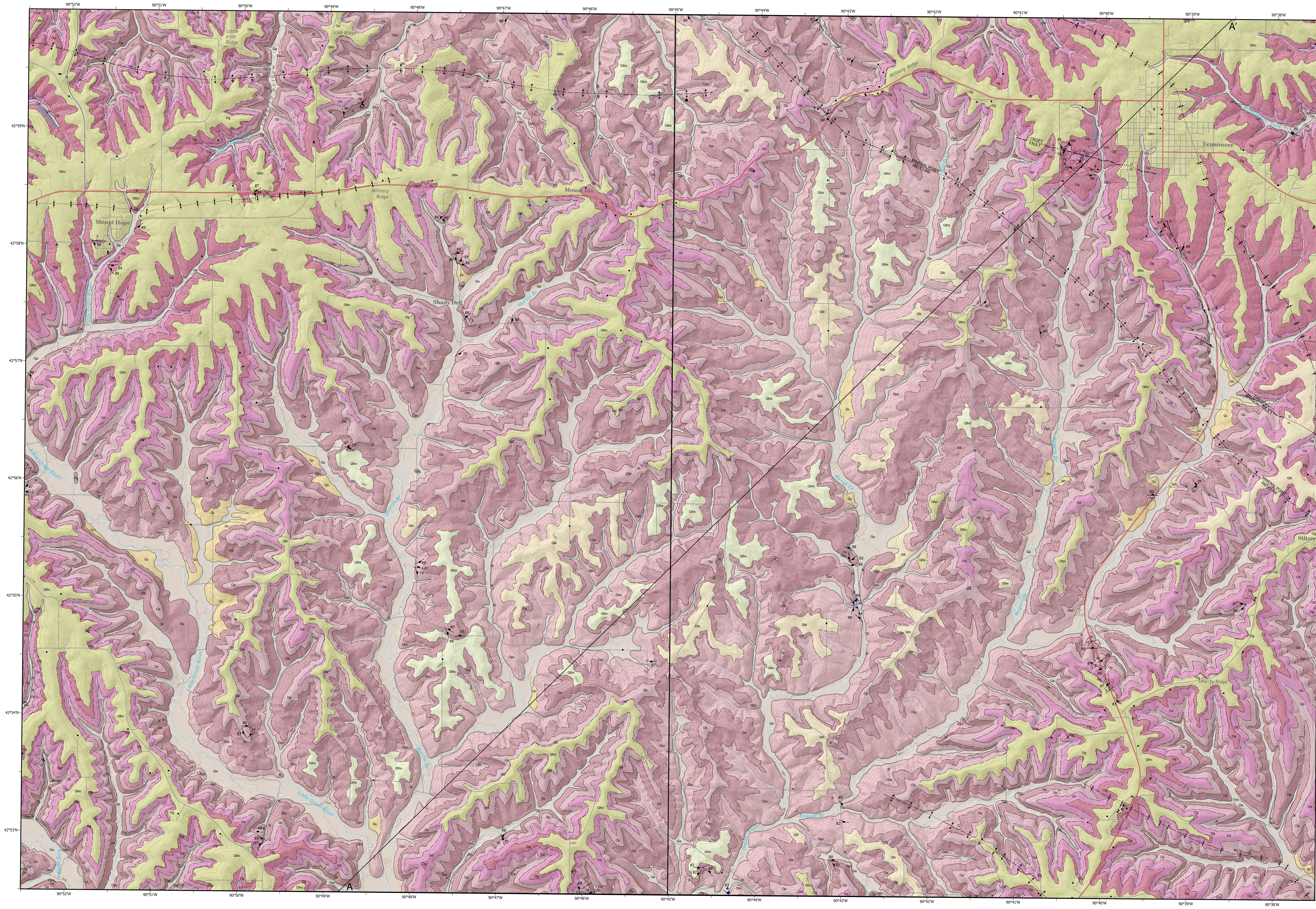
Geologic map of the Fennimore and Mount Hope 7.5-minute quadrangles, Grant County, Wisconsin

Sarah E. Bremmer, Eric D. Stewart, William G. Batten, Allison R. Kusick, and Natalie McNall



MAP UNITS

This map depicts geologic units at the land surface. Quaternary cover, shown where thickness is estimated to exceed 10 ft (3 m), is underlain by Early to Late Ordovician-age siliciclastic and carbonate strata. Paleozoic unit names and lithologic divisions follow Agnew and others (1956). Ordovician chronologic subdivision are from Witzke and others (2010), with numerical ages from (Cooper and Sadler, 2012). Paleozoic unit descriptions modified from Stewart and others (2022) using field observations and core descriptions (WGNHS cores: Croft Quarry Core 1 #22000428, Croft Quarry Core 2 #22000429, Croft Quarry Core 3 #22000430). Quaternary unit descriptions modified from ongoing Quaternary mapping in Grant County with input from E. Carson (WGNHS, oral commun., 2022).

CENOZOIC

QUATERNARY

Alluvium

Qa Unlithified, primarily sand and slightly gravelly sand deposited in modern stream valley bottoms and on modern floodplains during the Holocene and late Pleistocene. Thickness commonly greater than 15 ft (4.5 m); local deposits of 30 to 60 ft (9 to 18 m) or greater, in large stream valleys. Commonly overlain by modern thin peat and colluvial deposits at valley edges.

Colluvium

Qc Unlithified, angular, poorly sorted clay, silt, sand, cobbles and boulders, found at the base of valley slopes. Deposits commonly dominated by sand, silt and clay. Fines towards the valley and coarsens upslope. Derived from Paleozoic bedrock and Quaternary loess and residuum moving downslope through gravity driven processes. Thickness commonly between10 and 20 ft (3 and 6 m); local deposits exceed 30 ft (9 m) and overlie alluvial deposits and Paleozoic bedrock.

Loess

Qlbc, Qlbs, Qlb Noncalcareous windblown silt. Deposits are massive and show evidence of soil formation. Thickness commonly between 10 and 25 ft (3 and 7.6 m); locally exceed 30 ft (9 m) on ridge tops. Primarily composed of the Peoria Member of the Kieler Formation, and may include the Wyalusing, Loveland, and Roxana Members of the Kieler Formation (Syverson and others, 2011). Loess thickness and average grain size generally increases westward towards the Mississippi River, and northward towards the Wisconsin River (Leigh and Knox, 1994). Loess has been subdivided based on underlying bedrock lithology: **Qlbc** – Loess overlying Paleozoic bedrock units that are dominantly composed of carbonate (Galena, Decorah, Platteville Formations and Prairie du Chien Group). Locally, loess overlies residuum, primarily of the Rountree Formation, which forms from weathering of Paleozoic carbonate bedrock (Syverson and others, 2011). The Rountree Formation is patchy, discontinuous, and entirely concealed in the map area. **Qlbs** – Loess deposits overlying Paleozoic bedrock of the Ancell Group, composed primarily of siliciclastic material. **Qlb** – Loess deposits overlying both siliciclastic and carbonate Paleozoic bedrock units.

PALEOZOIC

ORDOVICIAN

Galena Formation (Late Ordovician)

Og The Galena Formation is not subdivided here or on the map. Except for quarries and road cuts in the NE portion of the Fennimore quadrangle and the NW portion of the Mount Hope quadrangle, the Galena Formation is poorly exposed due to Quaternary surficial cover. The full thickness of the Galena Formation is not present in the map area, but in southern Grant County it ranges from approximately from 215 to 230 ft (65 to 70 m) (Agnew and others, 1956). The Galena Formation is composed of tan, grey, to pale orange-brown, medium- to thick-bedded, drab, fine-medium sparry dolomite that weathers to a moderately-dark to dark-gray to tan. Commonly vuggy, bioturbated, and sandy. Vugginess ranges from low to very high (honeycomb texture). Locally, a patchy sucrosic texture is abundant, largely composed of dolomitic rhombohedra of uniform size. Less commonly, the Galena Formation is thinly bedded or massive. The fossil Receptaculites common at several stratigraphic intervals and characteristic of the Galena Formation (Agnew and others, 1956; Heyl and others, 1959). The upper approximately 120 ft (36 m) of the Galena Formation is non-cherty, whereas the lower approximately 100 ft (30 m) of the Galena Formation contains abundant interbedded gray and white chert beds. Pale-green shale partings are rare in upper sections of the map area and become more common, along with pale-green shale beds, in the lower-most 30 to 50 ft (9 to 15 m). A pale-green to orange-tan sandy to shaly dolomitic layer, less than 1 ft (0.3 m) thick , is commonly observed near the contact with the underlying Decorah Formation. The Galena Formation rests conformably on the Decorah Formation (Agnew and others, 1956) across an approximately 5-ft-thick (1.5 m) gradational contact.

Decorah Formation (Late Ordovician)

Od The Decorah Formation includes the Ion, Guttenberg, and Spechts Ferry Members (not subdivided on the map). The Decorah Formation is poorly exposed in the map area. The total thickness of the Decorah Formation is approximately 30 to 40 ft (9 to 12 m).

— **Ion Member**. The Ion Member is composed of light-gray and gray-blue, thin- to medium-bedded, dolomite micrite to micritic and fine-sparry wackestone with common gray to pale olive-green lamina-to very-thin shale beds. Burrows and very thin (dominantly 2–3 cm) packstone beds are abundant. Burrows are typically silt-or mud-filled. Brachiopod fossils and fossil fragments are abundant in packstone beds. Other less commonly observed fossils include ostracods, bivalves, and crinoids. Localized bioturbation is relatively common. The Ion Member is approximately 10 to 15 ft (3 to 5 m) thick and overlies the Guttenberg Member across a gradational contact that is less than one ft (0.3 m) thick.

— **Guttenburg Member**. The Guttenberg Member is composed of tan, gray to light brown, dense, thinly-bedded micritic to fine-sparry dolomite to silty-dolomite and micritic to fine-sparry wackestone with abundant light-orange to dark-brown organic-rich shale lamina to very-thin shale beds. Weathered shale beds are commonly recessed and not observed, or weathered to a light gray color in outcrop. Wavy bedding is abundant and pronounced, creating a mottled and nodular appearance. Burrows and very thin (0.4 in or 1 cm) packstone beds with abundant brachiopods and fossil fragments are common. Other fossils observed less commonly include ostracods, crinoids, and cephalopods. Localized bioturbation in dolomite beds is relatively common but is less abundant than it was observed in the Ion Member. The Guttenberg Member ranges from approximately 10 to 15 ft (3 to 5 m) thick and overlies the Spechts Ferry Member across a sharp contact. Bioturbation observed at this contact in all three Croft Quarry cores.

— **Spechts Ferry Member**. The Spechts Ferry Member is composed of interbedded silty and shaly dolomite micrite, shale, and micritic packstone. The upper part of the Member is characterized by abundant pale-to dark-grey-green shale with grey, very thin packstone to grainstone beds dominantly composed of brachiopods and fossil fragments, to thin wackestone to packstone beds. In the Croft Quarry cores, a 2-inch-thick (5 cm) pale-green shale with abundant light-grey, micrite-filled flattened horizontal burrows marks the contact with the overlying Guttenberg Member. The base of the upper unit is marked by a 1-inch-thick (2 to 3 cm) green-gray shale bed overlain by a 2 to 4-inch (5 to 10 cm) dolomite micrite. The upper unit is approximately 3 ft (0.9 m) thick. The middle part of the Member is characterized by brown-grey to grey, silty to shaly dolomite micrite with abundant very thin packstone beds and brown to green-brown lamina and very thin wavy shale beds. The middle unit is approximately 3 ft (0.9 m) thick. The lower part of the Member is characterized by light-brown to grey silty to shaly dolomite micrite with brown shale lamina. The upper and lower contacts are marked by a 2-inch-thick (5 cm) light-grey bentonite. The lower unit is less than 2 ft (0.6 m) thick. The total thickness of the Spechts Ferry Member is approximately 5 to 10 ft (1.5 to 3 m) thick and disconformably overlies the Quimbys Mill Member of the Platteville Formation (Agnew and others, 1956) across a sharp contact.

Platteville Formation (Late Ordovician)

Op The Platteville Formation includes the Quimbys Mill, McGregor, and Pecatonica Members (not subdivided on the map). The latter two members, particularly the McGregor, are well exposed in the map area, whereas the Quimbys Mill Member was not observed in outcrop. The total thickness of the Platteville Formation is approximately 40 to 50 ft (12 to 5 m).

— **Quimbys Mill Member**. The Quimbys Mill Member is composed of light-brown, well indurated dolomite micrite and dark-to very-dark-brown shale lamina. Fossil fragments and burrows are common. The Quimbys Mill Member is less than 1 ft (0.3 m) thick and overlies the McGregor Member across a sharp contact.

— **McGregor Member**. The McGregor Member is composed of well indurated light-gray to tan-gray, very-thin- to thin-bedded silty and shaly dolomite micrite and silty and shaly micritic to fine-sparry wackestone, with abundant dark-grey shale lamina to very-thin shale beds. Shale beds are commonly weathered to a light-tan-gray to grey color in outcrop. Less commonly, the dolomite beds are light-blue-grey. Wavy bedding is abundant and pronounced, creating a mottled and nodular appearance. Very-thin to thin packstone beds are common and contain abundant fossils: brachiopods, bivalves, ostracods; fragments of crinoids, bryozoans, and cephalopods are common; trilobites are rare. Burrows and localized bioturbation are common. Iron-sulfides are common, particularly near the base of the member. The member becomes brown-grey at bottom. Two sections, of approximately equal thickness, are recognized within the member. The upper section is characterized by decreased shale content, less pronounced wavy bedding, and slightly increased bedding thickness. A distinct purple-gray, thin, crystalline wackestone bed observed in outcrop near the base of the upper section. The McGregor Member ranges from approximately 20 to 30 ft (6 to 9 m) thick and overlies the Pecatonica Member across a sharp contact. Bioturbation and black iron sulfides observed at this contact in all three Croft Quarry cores.

— **Pecatonica Member**. The Pecatonica Member is composed of gray to tan, sandy, fine-to medium- sparry, thin-to thick-tabular-bedded dolomite wackestone with grey and light-brown shale partings and very thin shale beds. Fossil fragments and bioturbation are abundant. Brachiopods and cephalopods are common. Omission surfaces, marked by sulfide mineralization and vertical burrows are common. The Pecatonica Member ranges from 15 to 20 ft (3 to 6 m) thick and overlies the Glenwood Formation of the Ancell Group across a sharp contact marked locally by bioturbation and sulfide-mineralization.

Ancel Group (Middle to Late Ordovician)

Oa The Ancell Group includes the Glenwood and St. Peter Formations (not subdivided on the map). The St. Peter Formation is well exposed in the map area. The Glenwood Formation is poorly exposed. The total thickness of the Ancell Group is approximately 40 to over 130 ft (12 to over 39 m) thick. The large variation in thickness is due to the paleo-topographic relief on the underlying Prairie du Chien Group.

Glenwood Formation.The Glenwood Formation is composed of pyritic and phosphatic green shale and shaly sandstone. The upper part of the formation is characterized by a dolomite-cemented quartz sandstone with black, fine-to granule-size phosphate clasts, locally less than 0.5 ft (15 cm) overlying grey-green, shaly, silica-cemented, medium-grained quartz sandstone. Bioturbation and sand-filled burrows are abundant. The upper part of the formation is approximately 2 ft (0.6 m) thick in the Croft Quarry cores and was not observed in the field. The lower part of the formation is characterized by pale-to dark-green and grey-green shale with lesser sandy shale. Sulfide mineralization common between shale lamina. The Glenwood Formation is less than 5 ft (1.5 m) thick and overlies the St. Peter Formation across a sharp contact marked by sulfides, iron oxides, phosphate, and burrows.

St. Peter Formation. The St. Peter Formation includes the Tonti and Readstown Members. The Tonti Member is very well exposed in the map area and commonly creates a prominent topographic scarp in the landscape. The Readstown Member was observed at only one outcrop.

— **Tonti Member**. The Tonti Member is composed of grey, white, yellow, orange, and red, fine- to course-grained, well- to moderately-well-sorted, rounded to sub-rounded, well-cemented to friable, thin-to thick-bedded, quartz arenite. Medium-to thick-bedding exhibiting high-to low-angle cross beds is abundant; massive bedding (internally structureless) is common. Locally, thin, tabular, planar-bedding near top of member. The variable color of this member is controlled by iron oxide (including limonite) and sulfide mineralization, coatings, and cements. Iron oxide coating is locally abundant and common; coating ranges from well-distributed to localized by fractures, deformation bands, and subtle changes in grain-size. Abundant iron oxide cement commonly present in the upper-most 5 ft (1.5 m) of the member. Bioturbation and burrows common at contact with overlying Glenwood Formation. Carbonate cement is rare. The Tonti Member ranges from approximately 30 to 120 ft (9 to 37 m) thick, and overlies the Readstown Member across a commonly gradational contact (Stewart, 2021; Fitzpatrick and others, in press) that is locally sharp.

— **Readstown Member**. The Readstown Member is composed of white to tan, fine-to medium-grained sandstone, silty sandstone, and green to gray shale to sandy shale. Angular, white to grey, coarse pebble-sized chert, silicified dolostone, and silicified oolite clasts common, with lesser rounded course-pebble-sized clasts. The thickness of the Readstown Member, where observed, is less than 10 ft (3 m) thick and disconformably overlies the Prairie du Chien Group across a sharp erosional contact.

Prairie du Chien Group (Early Ordovician)

Opc The Prairie du Chien Group includes the Shakopee and Oneota Formations (not subdivided on the map). The Oneota Formation is well exposed in the map area, although nowhere is the entire section exposed. The Shakopee Formation is poorly exposed (likely locally absent), observed at only one outcrop. The total thickness of the Prairie du Chien Group is estimated to be approximately 200 to 250 ft (61 to 76 m) thick (West and Heyl, 1985).

Shakopee Formation. North of the map area, the Shakopee Formation is described as sandy dolostone and shale (Deal, 1947). At the one exposure in the map area, it is composed of light-brown, coarse- to very coarse-grained carbonate and silica-cemented sandstone and silt with low-angle cross-bedding. Topsets and foresets commonly defined by granule-and pebble-scale moderately angular to rounded, white clasts of clay and chert, and elongated, oblate vugs. Stromatolites and arcuate vugs (likely microbially-derived) mark the top of the outcrop.

Oneota Formation. The Oneota Formation is commonly composed of light tan, gray and brown, locally pink to pink-orange, thin-to massive-, planar- to wavy-bedded, vuggy, micritic to sparry dolomite mudstone to wackestone. Locally stromatolitic and oolitic. Thin to thick, grey and white chert beds and nodules are common. Lamina to thin, pale-green shale beds locally common, particularly in the upper-most 20 to 40 ft (6 to 12 m). Lesser sandy dolomite and very-thin to thin dolomitic quartz sandstone beds.

SYMBOLS

Contact—Dashed where approximate

Near vertical fault—D on downthrown block. Dashed where approximately located, dotted where concealed

Anticline—Dashed where approximately located, dotted where concealed

Syncline—Dashed where approximately located; dotted where concealed

Slickenlines—Showing plunge

Inclined bedding—Showing strike and dip

Vertical joint—Showing strike

Inclined joint—Showing strike and dip

Seep—Observed in field

Spring—Either observed in the field, from USGS topographic maps, or Swanson and others (2019)

Outcrop

Well construction report or geologic log

Core locations

Major highway

Small road

REFERENCES

Agnew, A.F., Heyl, A.V., Jr., Behre, C.H., Jr., and Lyons, E.J., 1956, Stratigraphy of the Middle Ordovician rocks in the Zinc-Lead District of Wisconsin, Illinois, and Iowa: U.S. Geological Survey Professional Paper 274–K, p. 251–312, https://doi.org/10.3133/pp274K.

Cooper, R.A., and Sadler, P.M., Hammer, O., and Gradstein, F.M., 2012, Chapter 12—The Ordovician Period, *in* Gradstein, F.M., Ogg, J.G., Schmitz, M.D., Ogg, G.M., eds., The Geologic Time Scale: Amsterdam, Elsevier, p. 489–523, https://doi.org/10.1016/B978-0-444-59425-0.00020-2.

Deal, C.S., 1947, The areal geology and stratigraphy of Boscobel quadrangle, Wisconsin: Madison, University of Wisconsin–Madison, M.S. Thesis, 55 p., 1 pl. 16 figs.

Fitzpatrick, W.A., Stewart, E.D., in press, Geologic map of the Highland West and Highland East 7.5-minute quadrangles, Grant County, Wisconsin: Wisconsin Geological and Natural History Survey Map 510, 1 pl., scale 1:24,000.

Heyl, A.V., Jr., Agnew, A.F., Lyons, E.J., and Behre, C.H., Jr., and Flint, A.E., 1959, The Geology of the Upper Mississippi Valley Zinc-Lead District: U.S. Geological Survey Professional Paper 309, 310 p., 24 pls., https://doi.org/10.3133/pp309.

Leigh, D.S., and Knox, J.C., 1994, Loess of the Upper Mississippi Valley Driftless Area: Quaternary Research, v. 42, no. 1, p. 30–40, https://doi.org/10.1006/qres.1994.1051.

Stewart, E.D., Mauel, S.W., Carson, E.C., and Graham, G.E., 2022, Geologic map of the Castle Rock and Long Hollow 7.5-minute quadrangles, Grant County, Wisconsin: Wisconsin Geological and Natural History Survey Open-File Report 2022-03, 1 pl., scale 1:24,000, https://doi.org/10.54915/qfnf9732.

Stewart, E.K., 2021, Bedrock geology of Dodge County, Wisconsin: Wisconsin Geological and Natural History Survey Map 508, 1 pl., scale 1:100,000, https://wgnhs.wisc.edu/pubs/000975.

Syverson, K.M., Clayton, L., Attig, J.W., and Mickelson, D.M., eds., 2011, Lexicon of Pleistocene stratigraphic units of Wisconsin: Wisconsin Geological and Natural History Survey Technical Report 001, 180 p., https://wgnhs.wisc.edu/pubs/000555.

Swanson, S.K., Graham, G.E., and Hart, D.J., 2019, An Inventory of Springs in Wisconsin: Wisconsin Geologic and Natural History Survey Bulletin B113, 24 p., https://wgnhs.wisc.edu/pubs/000968.

West, W.S., and Heyl, A.V., 1985, Geologic map of the Hurricane quadrangle, Grant County, Wisconsin: U.S. Geologic Survey Geologic Quadrangle Map GQ–1582, scale 1:24,000, https://doi.org/10.3133/gq1582.

Witzke, B.J., Anderson, R.R., and Pope, J.P., 2010, Bedrock Geologic Map of Iowa: Iowa Geological and Water Survey Open File Map 2010-1, 1 pl., scale 1:500,000, https://doi.org/10.25820/006401.

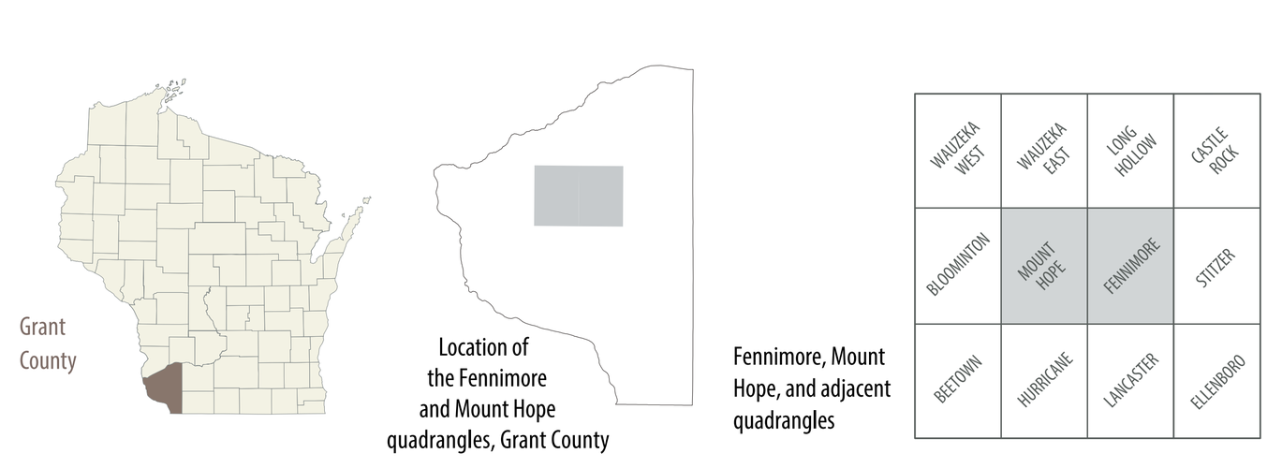
Mapped and compiled by SEB, EDS, SWM, WB 2020-2021.
Revised by GEG and ECC, 2021. Cartography by EDS.
This geologic map was funded in part by the U.S. Geological Survey National Cooperative Geologic Mapping Program under STATEMAP award number G20AC00201, 2020. A supplemental report and GIS files that accompany this map can be found at: https://doi.org/10.54915/lmnw3300.

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.

SCALE 1:24 000

NAD 1983 HARN Wisconsin Transverse Mercator Projection (m)
Contour interval is 20 ft

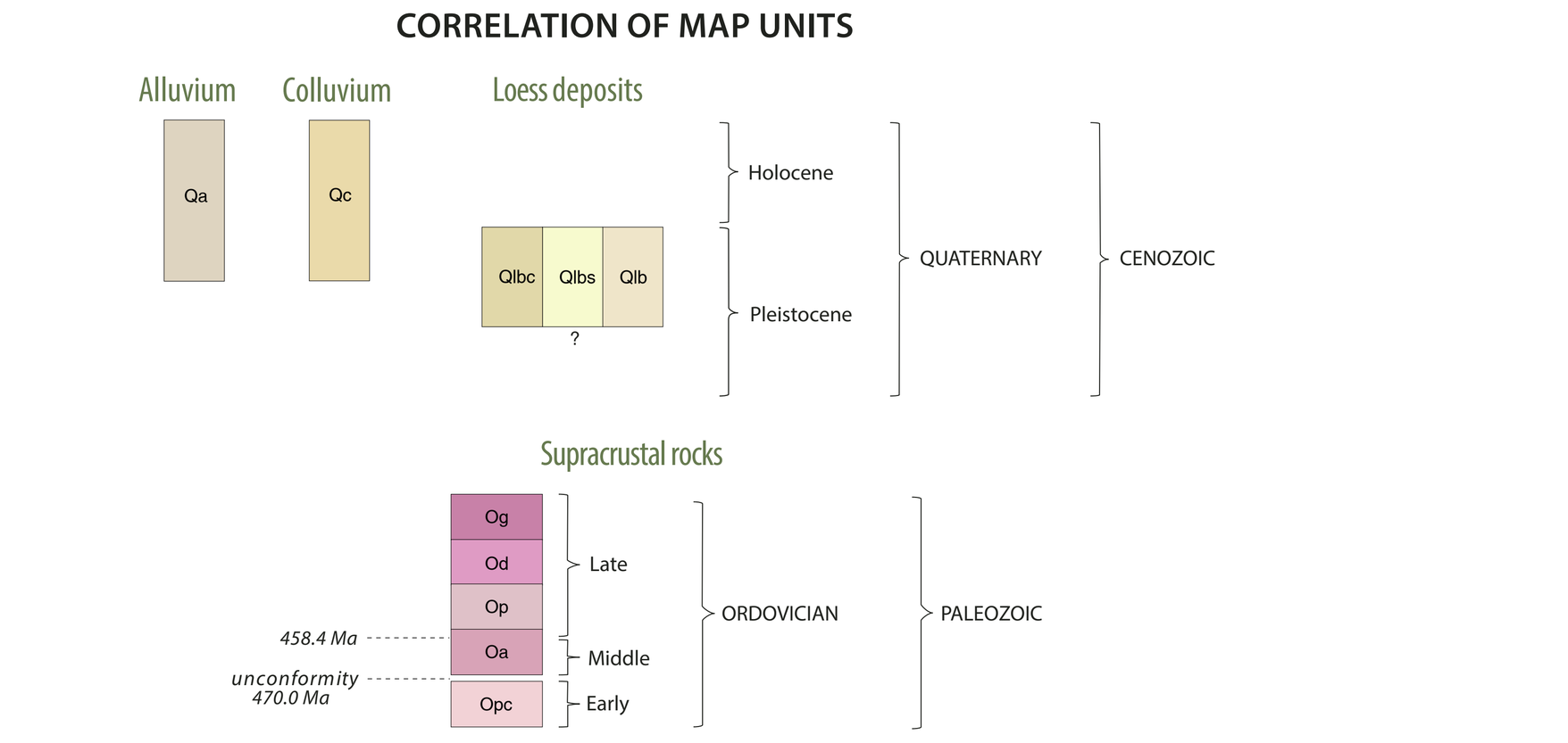
Shaded-relief image and topographic contours from 5-foot lidar-based digital elevation model, Natural Resources Conservation Service (written commun., 2012). Magnetic north, hydrologic features, and topographic features from The National Map digital data, U.S. Geological Survey, 2018.

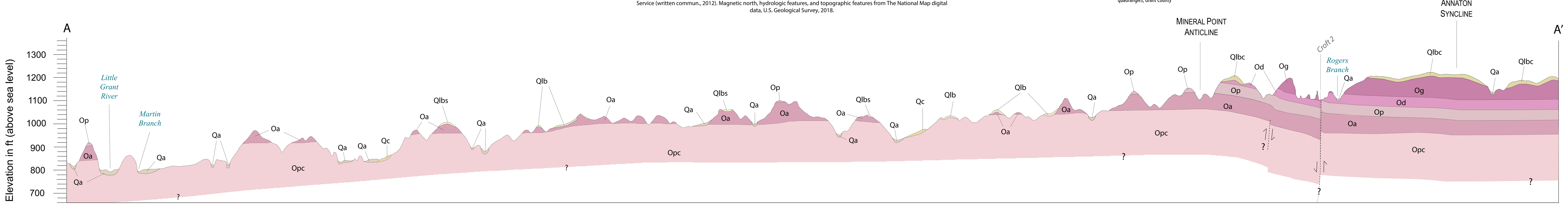


Location of the Fennimore and Mount Hope quadrangles, Grant County

Fennimore, Mount Hope, and adjacent quadrangles

CORRELATION OF MAP UNITS





10 times vertically exaggerated

Wisconsin Geological and Natural History Survey
DIVISION OF EXTENSION
UNIVERSITY OF WISCONSIN–MADISON

An EEO/AA employer, University of Wisconsin–Madison Division of Extension provides equal opportunities in employment and programming, including Title VI, Title IX, the Americans with Disabilities Act (ADA), and Section 504 of the Rehabilitation Act requirements.

Wisconsin Geological and Natural History Survey
Susan K. Swanson, Director and State Geologist
3817 Mineral Point Road, Madison, WI 53705 • 608/262.1705
WGNHS.org
Open-File Report 2023-04 • 2023