Geologic map of the Castle Rock and Long Hollow 7.5-minute quadrangles, Grant County, Wisconsin

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INTRODUCTION

The Castle Rock and Long Hollow 7.5-minute quadrangles are located in the Driftless Area of southwestern Wisconsin, an unglaciated region with a relatively thin Quaternary cover of loess, colluvium, and alluvial deposits. The landscape is marked by upland plateaus that range from less than half a mile to over a mile in width. Uplands are dissected by flat-bottomed stream valleys. Relief between uplands and valleys can exceed 300 feet (ft).

The Castle Rock and Long Hollow quadrangles are underlain by Late Cambrian to Late Ordovician siliciclastic and carbonate strata. The Late Cambrian to Early Ordovician section (Elk Mound Group through Prairie du Chien Group) is weakly deformed into a series of gentle folds with amplitudes of 100 to 200 ft, whereas the overlying Middle and Late Ordovician section is largely undeformed.

Mapping was initiated as part of a larger effort to build a three-dimensional (3D) geologic framework for groundwater contamination studies in the Grant County area and to better understand controls on zinc-lead mineralization. Elevated concentrations of nitrates and fecal bacteria have been found in many groundwater wells in southwestern Wisconsin (M. Borchardt, J. Stokdyk, K. Bradbury, K. Abbott, L. Schweikert, and T. Loeffelholz, United States Geological Survey and Wisconsin Geological and Natural History Survey, written commun., 2019). Three-dimensional geologic mapping is useful for groundwater studies because contact surfaces can be used to quickly determine which units are within the open interval of tested and untested wells. Understanding which geologic unit(s) a well is open to is important because some geologic units may be more prone to contamination than others. Mapping is also useful for metallic mineralization studies. The Castle Rock and Long Hollow quadrangles are outside the main Upper Mississippi Valley zinc-lead mineral district. The quadrangles to the south (Fennimore) and east (Highland West) are along the northern edge of the district. The differences in geology between the Castle Rock and Long Hollow quadrangles and areas within the mineral district may help explain controls on mineralization.

MAP UNITS

CENOZOIC

QUATERNARY

Quaternary units are shown where estimated thicknesses of unconsolidated materials exceeds 10 ft. Quaternary units were mapped using lidar, well construction reports, and field observations to estimate unconsolidated thicknesses. The thickness of unconsolidated material is typically greater in stream bottoms and broad upland plateaus than along narrow ridges and valley walls. For example, across the Driftless Area, Chamberlin and Salisbury (1885) estimated the average thickness of unconsolidated materials on narrow ridges to be 8 ft based on 360 depth-to-bedrock measurements; on broad upland plateaus, they estimated the average thickness of unconsolidated thickness to be 14 ft based on 219 depth-to-bedrock measurements. The thickness of unconsolidated sediment in upland areas generally decreases with distance from the Mississippi River and Wisconsin River valleys (Leigh and Knox, 1994).

Alluvium

Qa | Qtu | Qt_1 | Qt_2 | Qaf | Qbt

Qa – Alluvium – Holocene sand, silt, and mud deposited as overbank deposits in modern stream and river valleys. Holocene sediment overlies the late Pleistocene fine-grained sand and silt of slackwater deposits resulting from the ponding of tributary streams during periods of higher base level and (or) higher sedimentation rates (Chamberlin and Salisbury, 1885; Heyl and others, 1959). **Qtu** – Alluvial terrace, undivided – Well-sorted sand, silt, and mud deposits found along north-flowing tributaries to the Wisconsin River. Deposited in the late Pleistocene because of a rise in local base level along the Wisconsin River valley, which caused ponding in tributary streams (Chamberlin and Salisbury, 1885; Heyl and others, 1959). The increase in base level was due to deposition of sediment-laden glacial meltwater from the Green Bay Lobe of the Laurentide Ice Sheet and perhaps earlier glacial advances. Carson (2012) correlated these terraces to the Elderon phase during the last stage of the most recent glaciation. **Qt1** – Alluvial terrace 1 – Alluvial terrace composed of gravel, sand, and silt along the Wisconsin River. Forms a relatively flat surface approximately 14 ft above the modern flood plain (Qa) and probably was deposited during the Elderon phase (Carson, 2012). The terrace was cut sometime between the latest Pleistocene and the Holocene, after the Green Bay Lobe of the Laurentide Ice Sheet retreated. The retreat reduced the sediment load, causing a switch from aggradation to incision of the Wisconsin River valley. **Qt2** – Alluvial terrace 2 – Alluvial terrace composed of sand and silt found along the Wisconsin River near Boscobel, where Crooked Creek and Sanders Creek enter the wider Wisconsin River valley. Forms a relatively flat surface approximately 23 ft above Qt1. Likely represents a remnant alluvial apron formed from deposition of sediment carried by Crooked Creek and Sanders Creek when it reached the flatter Wisconsin River valley. Truncated by the Qt1 surface and incised by the modern Crooked Creek and Sanders Creek. Sediment in the terrace was probably deposited in the late Pleistocene, and incision to create the terrace occurred sometime between the latest Pleistocene and the Holocene. **Qaf** – Alluvial fan – Gravel, sand, and silt deposited along the slope break between steeper, smaller tributary streams and larger, flatter streams. **Qbt** – Bridgeport terrace – Thin veneer of windblown sediment too thin to map overlying east-dipping fluvial sand and gravel (Knox and Attig, 1988). Overlies a bedrock strath or erosional terrace along the Wisconsin River.

Colluvium

Qc

Angular, poorly sorted boulders, cobbles, sand, and silt deposited at the base of valley slopes from gravity-driven mass wasting, soil creep, and nonchannelized overland-flow processes. Fines towards the valley bottom. The unit is unlithified, so where trees and other large vegetation have been removed on moderate to steep slopes and roadcuts, it is prone to slope failures.

Windblown deposits

Qws | Qlr | Qlb | Qlrb

Undivided loess. Windblown very fine sand, silt and clay. May include sediment derived from the Pleistocene Roxana and Peoria Members of the Kieler Formation. Loess generally thins eastward, and average grain size decreases away from the valleys of the Mississippi and Wisconsin Rivers (Leigh and Knox, 1994). Loess is thickest on upland surfaces, but it is often present on erosional bedrock terraces, such as beneath the St. Peter Formation scarp. **Qws** – Aoelian sand and silt deposited in dunes. **Qlr** – Undivided loess deposited over the Tertiary Rountree Formation (not shown because it does not occur at the surface, but it formed as a residuum from weathering of Paleozoic carbonate bedrock). **Qlb** - Undivided loess over bedrock. Mapped where loess overlies sandstone. **Qlrb** - Undivided loess deposited over Paleozoic bedrock and Tertiary Rountree Formation.

PALEOZOIC

Paleozoic bedrock units were mapped where bedrock appears discontinuously at the surface. Quaternary unconsolidated sediment may overlie areas mapped as bedrock but is not shown where its thickness is generally less than 10 ft. On the basis of roughly 1,000 measurements across the Driftless Area, Chamberlin and Salisbury (1885) estimated an average unconsolidated material depth of 5 ft along valley slopes, which are areas where bedrock is often exposed. Except where substantial colluvial deposits occur, slopes were generally mapped as bedrock. Bedrock units follow the classification scheme of Agnew and others (1956). The placement of the base of the Galena Formation in Agnew and others (1956) differs from Wisconsin Geological and Natural History Survey (2011), but the divisions in Agnew and others (1956) more closely match the stratigraphic section in the map area.

ORDOVICIAN

Galena Formation

Og

Tan, medium-bedded, variably porous dolomite. The upper Galena Formation consists of sandy dolomite, and the lower approximately 120 ft of the Galena Formation contains abundant gray chert beds interbedded with medium- to very thick bedded dolomite. Vugs commonly form on weathered surfaces, producing a honeycomb appearance; less common on fresh surfaces. Only the basal portion of the Galena Formation is present along flat upland surfaces in these quadrangles, although it is generally poorly exposed due to surficial cover. The full thickness of the Galena Formation section is not present in these quadrangles, but elsewhere it ranges from approximately 230 to 250 ft.

Decorah Formation

Od

The Decorah Formation consists of the upper Ion Member, the middle Guttenburg Member, and the basal Spechts Ferry Member. The Ion Member consists of gray and gray-blue, thin- to medium-bedded dolostone with minor shale partings. The Guttenburg Member consists of brown to gray, thin-bedded, wavy dolostone and limestone with abundant organic-matter-rich shale partings. The Spechts Ferry Member consists of gray to green, laminated to thin-bedded shale with subordinate gray limestone and dolostone; thickens to the west (Carlson, 1961). The Decorah Formation contains abundant brachiopod fossils. Poorly exposed in these quadrangles and found only along the margins of flat upland surfaces. Total thickness is 30 to 40 ft.

Platteville Formation

Op

The Platteville Formation consists of the the upper Quimbys Mill Member, the middle McGregor Member, and the basal Pecatonica Member. The Quimbys Mill Member was not observed in outcrops, but consists of a brown limestone with a characteristic concoidal fracture. The McGregor Member is a gray dolostone with abundant dark-gray, wavy shale partings; it is poorly exposed in these quadrangles, generally due to surficial cover. The Pecatonica Member is a tan to gray, fine-grained, thin- to medium-bedded dolostone. Brachiopods are locally abundant throughout the Platteville. Total thickness is around 45 to 50 ft.

Ancell Group

Oa

The Ancell Group consists of the upper Glenwood Formation and the basal St. Peter Formation. The Glenwood Formation is a green, laminated shale with a thickness of 2 to 3 ft. The St. Peter Formation contains the upper Tonti Member and the lower Readstown Member. The Tonti Member is a tan to white, fine- to medium-grained sandstone. It is locally cemented with iron sulfides, which are often weathered near the surface to iron hydroxides. Percival (1855), Whitlow and West (1966), and Agnew (1963) reported iron-hydroxide- and iron-sulfide-cemented beds near the top of the St. Peter in parts of Grant County. These beds are resistant to weathering and form a prominent scarp. Quartz grains contain variable degrees of terminated overgrowth cement. Authigenic potassium feldspar is also variably present. Significant variation in cementation and compaction results in variation in both porosity and rock competency between and within outcrops. Deformation bands are locally present. The Tonti Member generally contains no carbonate cement, and crossbedding is common throughout. The Readstown Member consists of interbedded white to tan, fine-grained sandstone; green to dark-red shale; and lesser carbonate rocks.

Mapped and compiled by EDS and SM, 2019–2020. Revised by ECC and GEG, 2021. Geodatabase and cartography by SWM and EDS.

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.

For additional information about the geology presented here, please refer to the report that accompanies this map at: https://doi.org/10.54915/qfnf9732. Plate revised in 2022.

MN
GN
1°52′ 33 MILS
1°40′ 30 MILS
UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

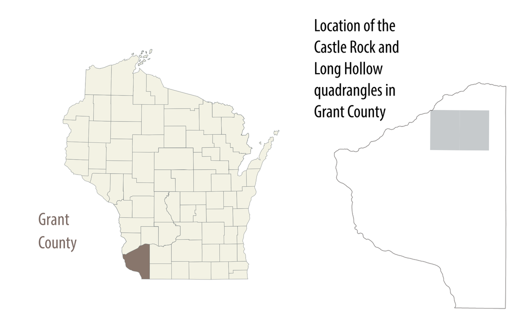
SCALE 1:24 000

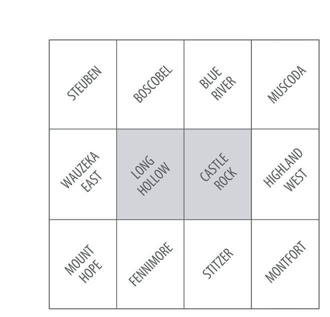
MILES

KILOMETERS

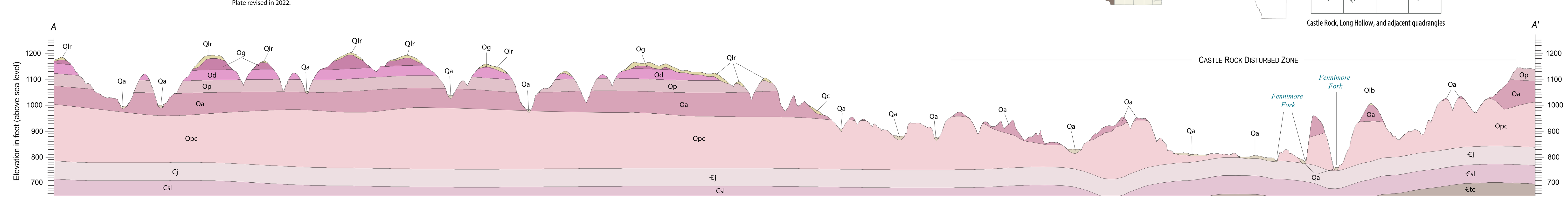
NAD 1983 HARN Wisconsin Transverse Mercator Projection (Meters)
Contour interval is 20 feet

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.





Castle Rock, Long Hollow, and adjacent quadrangles



Vertical exaggeration ×10

Prairie du Chien Group

Opc

Only the Oneota Formation of the Prairie du Chien Group is mapped in these quadrangles; stratigraphically higher units of the group were not observed, and it is unclear if they are present (Deal, 1947). The Oneota Formation is generally a tan to gray, fine-grained, thin- to thick-bedded dolostone with subordinate limestone. Sandy dolostone and limestone—some containing minor glauconite, chert, and (or) oolite—are present in the lower 40 ft of the unit (Deal, 1947). Fine-grained micrite occurs locally. Gray chert and drusy quartz commonly fill vugs in beds with significant secondary porosity. Chert rarely occurs as isolated elliptical pods along bedding planes. Local millimeter-thick clay partings define bedsets, and rip-up clasts occur along the bases of beds.

CAMBRIAN

Jordan Formation

Ꞓj

Tan to white, fine- to medium-grained, thin-bedded to very thickly bedded quartz arenite. Crossbedding is common, with crossbeds reaching up to 3 ft in thickness. Generally contains little carbonate cement except near the contact with the Prairie du Chien Group. Light-green shale partings occur locally near the top of the formation. The unit is approximately 70 ft thick.

St. Lawrence Formation

Ꞓsl

The St. Lawrence Formation consists of the upper Lodi Siltstone Member and the basal Black Earth Dolostone Member. The Lodi Siltstone Member is a tan, fine-grained, laminated to thin-bedded, carbonate-cemented sandstone to siltstone. Burrows occur locally on bedding planes, and bed bases locally contain rip-up clasts. Crossbedding is locally observed in fine-grained sandstone intervals. The Black Earth Dolostone Member is a gray, thin- to medium-bedded dolostone to sandy dolostone. Vugs are common locally. Shale partings often define bed sets.

Tunnel City Group

Ꞓtc

Tan to dark-green, fine- to medium-grained sandstone. Beds vary from clean quartz arenite, to carbonate cemented sandstone, to glauconitic sandstone. Green shale partings locally occur.

REFERENCES

Agnew, A.F., 1963, Geology of the Platteville Quadrangle, Wisconsin, in Geology of parts of the Upper Mississippi Valley zinc-lead district: U.S. Geological Survey Bulletin 1123–E, p. 245–277, 1 pl., scale 1:24,000, https://doi.org/10.3133/b1123E.

Agnew, A.F., Heyl, A.V., Behre, C.H., Jr., and Lyons, E.J., 1956, Stratigraphy of 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.

Carlson, J.E., 1961, Geology of the Montfort and Linden Quadrangles, Wisconsin, in Geology of parts of the Upper Mississippi Valley zinc-lead district: U.S. Geological Survey Bulletin 1123–B, p. 95–138, 2 pls., scale 1:24,000, https://doi.org/10.3133/b1123B.

Carson, E.C., 2012, Preliminary Quaternary geology of Grant County, Wisconsin: Wisconsin Geological and Natural History Survey Open-File Report 2012–06, scale 1:100,000, https://wgnhs.wisc.edu/catalog/publication/000910.

Chamberlin, T.C., and Salisbury, R.D., 1885, Preliminary paper on the Driftless Area of the upper Mississippi Valley, in Powell, J.W., Sixth annual report of the United States Geological Survey to the Secretary of the Interior 1884–1885: Washington, D.C., Government Printing Office, p. 199–322, https://doi.org/10.3133/ar6.

Deal, C.S., 1947, The areal geology and stratigraphy of the Boscobel quadrangle, Wisconsin: Madison, University of Wisconsin–Madison, unpublished M.S. thesis, 55 p.

Heyl, A.V., Jr., Agnew, A.F., Lyons, E.J., 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.

Knox, J.C., and Attig, J.W., 1988, Geology of the pre-Illinoian sediment in the Bridgeport terrace, lower Wisconsin River Valley, Wisconsin: The Journal of Geology, v. 96, no. 4, p. 505–513, https://doi.org/10.1086/629244.

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.

Percival, J.G., 1855, Annual report on the Geological Survey of the State of Wisconsin: Madison, Beriah Brown, 101 p.

Swanson, S.K., Graham, G.E., and Hart, D.J., 2019, An inventory of springs in Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 113, 24 p., https://wgnhs.wisc.edu/catalog/publication/000968.

Whitlow, J.W., and West, W.S., 1966, Geology of the Potosi quadrangle, Grant County Wisconsin, and Dubuque County, Iowa, in Geology of parts of the Upper Mississippi Valley zinc-lead district: U.S. Geological Survey Bulletin 1123–I, p. 533–571, 4 pls., https://doi.org/10.3133/b1123I.

Wisconsin Geological and Natural History Survey [WGNHS], 2011, Bedrock stratigraphic units in Wisconsin: Wisconsin Geological and Natural History Survey Educational Series 51, 2 p., https://wgnhs.wisc.edu/catalog/publication/000200.

SYMBOLS

Contact; dashed where approximate

Anticline; dashed where approximately located, dotted where concealed

Syncline; dashed where approximately located, dotted where concealed. Large arrowhead shows direction of plunge

42 Inclined bedding—Showing strike and dip

Vertical joint—Showing strike

44 Inclined joint—Showing strike and dip

Well construction report

Sand or gravel pit

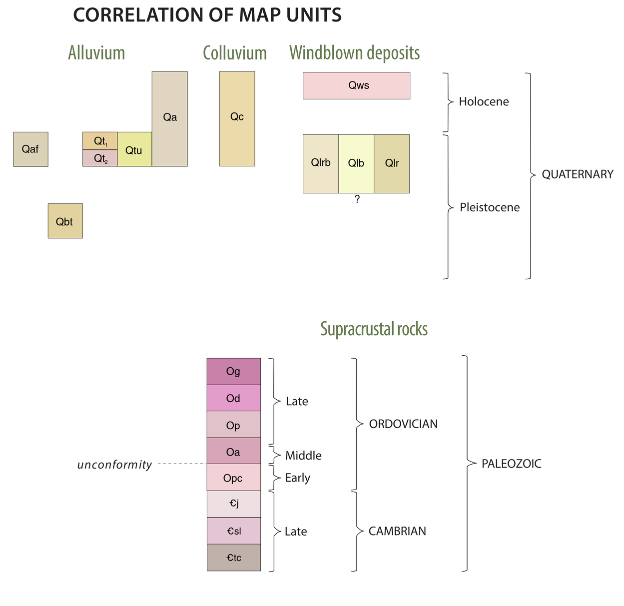
Bedrock quarry

Seep—Observed in field

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

Outcrop

CORRELATION OF MAP UNITS



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