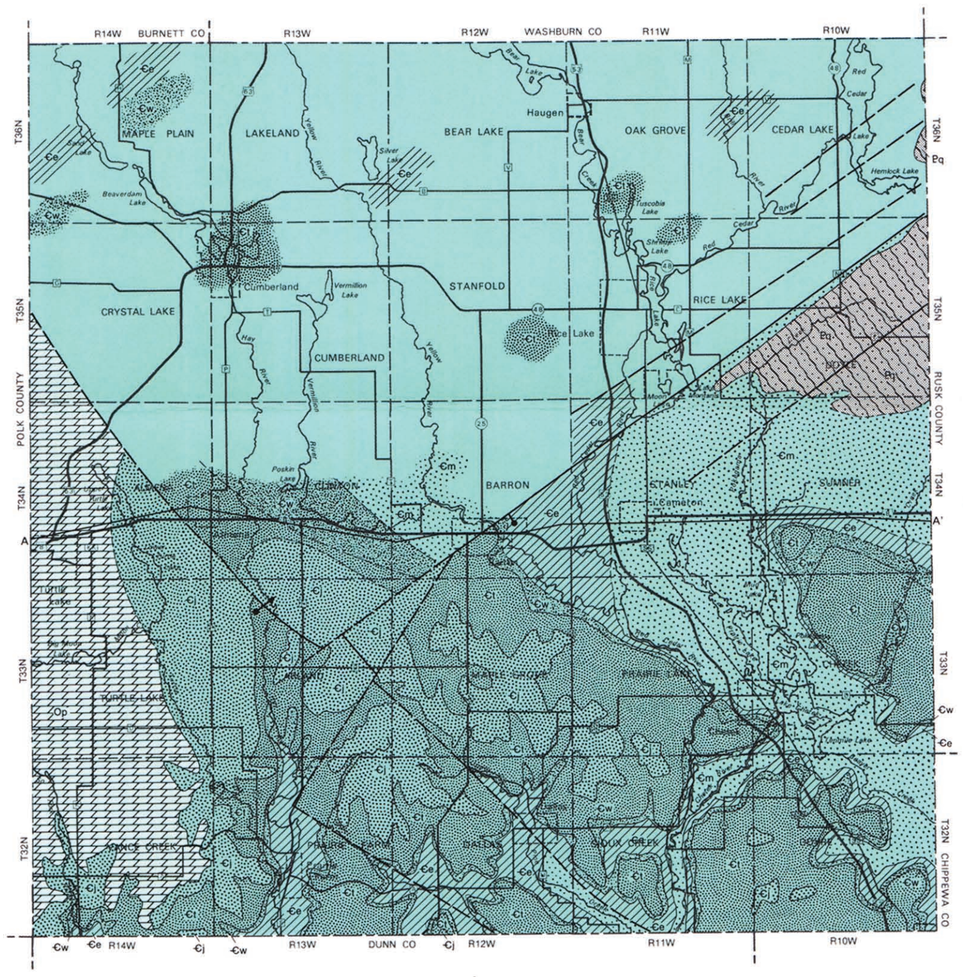
BEDROCK GEOLOGY OF BARRON COUNTY WISCONSIN

M.G. Mudrey, Jr. 1987



Geologic contact—Located within 1/4 mile of probable position, dashed where inferred in cross section

Fault—Dashed where approximately located, ball and bar on down-thrown side, dip of fault plane shown by arrow

A——A' Line of cross section

SCALE 1:250,000

1 0 1 2 3 4 5
KILOMETRES

1 0 1 2 3 4 5
MILES

PRINCIPAL DATA SOURCES AND LIMITATIONS OF MAP

The bedrock geologic map of Barron County was prepared from reconnaissance geologic mapping; data from Wisconsin Department of Natural Resources well constructor's reports; Wisconsin Geological and Natural History Survey geologic logs for high-capacity wells; mineral exploration records; and Wisconsin Department of Transportation highway borings. Outcrop is abundant in the southern half of the county, whereas sparse outcrops and few wells are in the northern half of the county. Thus, the northern half of the county is mapped in significantly less detail than the southern half. The bedrock elevation map* was used locally to extrapolate the geology from areas of good control into areas of poor control.

Mapping was undertaken in 1976 for the preparation of a small-scale geologic map of Wisconsin. Some detail was added in 1982, 1983, and 1985 for the preparation of a 1:250,000-scale geologic map of the Wisconsin Northwest Map area. As such, geologic boundaries in Barron County are considered to be accurate to 1/4 mile over the southern half of the county, and to generally less than 1 mile over the remainder of the county. The report is based on field examination of outcrop, hand specimens, and drill cuttings. No laboratory work was undertaken. Various stratigraphic and sedimentologic reports of adjoining areas were evaluated and incorporated when deemed appropriate.

The bedrock geologic map shows the exposure of bedrock units if all the overlying soil and other unconsolidated material were removed. The cross section illustrates the vertical geologic relationship of the units. On the cross section the thickness of the units is exaggerated 20 times so that relationships are made clearer. The time sequence of the units is shown on the stratigraphic section. Subunits can be recognized in all of the main units; however, geologic control and cartographic limitations do not permit the depiction of those units.

*See Wisconsin Geological and Natural History Survey Map 87-2d

PALEOZOIC

- Op — Prairie du Chien Group
- Cj — Jordan and St. Lawrence Formations
- Ct — Tunnel City Group
- Cw — Wonewoc Formation
- Ce — Eau Claire Formation
- Cm — Mount Simon Formation

PRECAMBRIAN

- Pq — Barron Quartzite Formation
- Pg — Proterozoic granite—known only from boreholes

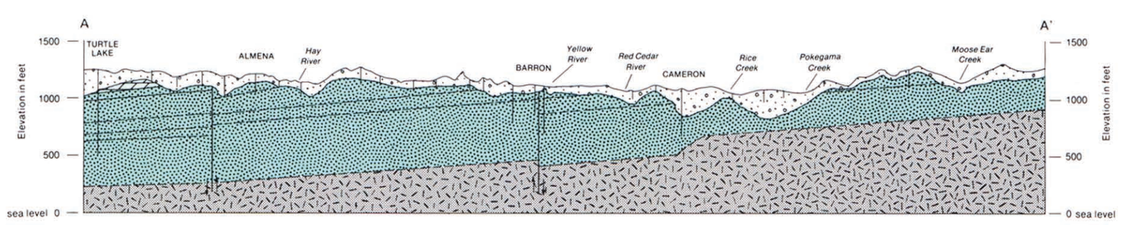
Complete unit descriptions in stratigraphic column

Isolated geologic symbol indicates probable sub-Pleistocene geologic unit in that area.

STRATIGRAPHIC SECTION OF BARRON COUNTY

System	Series	Lithostratographic units		Lithology	Map symbol	Thickness (in feet)	Description	Hydro–geologic units
Ordovician	*Lower Ordovician*	Praire du Chien Group	undivided		Op	>80	Dolomite, light gray or tan; small amount of chert, some shale, locally vuggy.	Upper sandstone aquifer
Cambrian	*Upper Cambrian*	Jordan Formation	Coon Valley Member		Cj	20—45	Dolomite, yellow to tan or brown, sandy.	
			Van Oser Member			30—50	Sandstone, white to brown to yellow or orange, fine to medium grained, poorly sorted, medium to thin bedded, cross bedded; with calcite-cemented nodules, locally iron cemented, may be locally interbedded with underlying unit.	
			Norwalk Member			50—60	Sandstone, white, fine grained, sorted and rounded quartz sandgrains, medium bedded; trace of garnet.	
		St. Lawrence Fm.	Lodi Member		unconformity Cj	<10	Siltstone, light brown to blue brown, and very fine-grained dolomite, massive.	
		Tunnel City Group	Mazomanie Formation / Lone Rock Formation		Ct	100—185	Interbedded: Mazomanie Fm., facies 1—sandstone, yellow to white, fine grained, well sorted, cross bedded, quartzose; glauconite less than 5%. Mazomanie Fm., facies 2—sandstone, light gray to yellow, fine to very fine grained, thin bedded, micaceous; similar to Tomah Member but with no shale. Lone Rock Fm., Reno Member—glauconitic sandstone, fine and very fine grained, thin bedded, cross bedded. Lone Rock Fm., Tomah Member—sandstone, light gray to yellow, very fine grained, micaceous, thin bedded; beds separated by laminae and partings of gray-green shale. Lone Rock Fm., Birkmose Member—sandstone, green, fine grained, commonly cross bedded, glauconitic; includes burrowed beds and flat-pebble conglomerate.	Lower sandstone aquifer
		Wonewoc Formation	Ironton Member		Cw	15—60	Sandstone, white to brown with iron staining, medium to coarse grained, poorly sorted, subrounded, wavy bedded, vertically worm-burrowed, cemented. The individual bedding units are about 3 to 5 ft thick with a thin, intervening clay bed.	
			Galesville Member			15—60	Quartz sandstone, white, fine to medium grained, poorly cemented, well sorted, rounded to subrounded, thick bedded, cross bedded. Individual bedding units may be 10 to 15 ft thick.	
		Eau Claire Formation			unconformity Ce	100—150	Sandstone, light brown, fine grained to silty, poorly sorted, medium to thin bedded, locally thick bedded, flaggy bedded; locally fossiliferous (*Cedaria sp.*), some beds glauconitic.	
		Mount Simon Formation			Cm	170—285	Sandstone, white to light gray to pale brown, medium to coarse grained, angular, feldspathic, medium bedded, lenticular bedding.	
						125	Sandstone, pale yellow orange to pale gray orange, very fine to fine grained, angular, limonite-cemented.	
						60	Shale, gray to pale orange, silty; known only in boreholes.	
						>115	Sandstone, very pale orange, very fine grained, fine grained, subangular, subrounded; known only in boreholes.	
Middle Proterozoic	*"Baraboo Interval"*	Barron Quartzite Formation			unconformity Pq	>700	Quartzite, pink to maroon to very light gray, medium grained, sorted, conglomeritic, medium bedded, subrounded to rounded; with ripplemarks, dessication cracks, small-scale channels, locally, red argillite (pipestone) beds present.	Local Precambrian aquifers
			Proterozoic granite		unconformity Pg	unknown	Granite to tonalite, red to gray, medium grained; hornblende- and biotite-bearing varieties.	

GEOLOGIC CROSS SECTION OF BARRON COUNTY



Pleistocene

Ordovician

Cambrian

Precambrian

SCALE 1:250,000

1 0 1 2 3 4 5
KILOMETRES

1 0 1 2 3 4 5
MILES

Vertical scale exaggerated 20X.

STRATIGRAPHY

Precambrian units

Proterozoic granite (unit Pg) is known only from boreholes Br-9 and Br-138 in Chetek. Granitic rock is the principal bedrock unit in counties to the east and probably underlies the eastern half of the county.

Barron Quartzite Formation (unit Pq) is exposed at the surface in the towns of Cedar Lake, Doyle, and Sumner and forms the Blue Hills in Barron and Rusk counties. Quartzite occurs in the subsurface in the eastern half of the county, and has been recovered from a well north of Dallas. The greatest known thickness of Barron Quartzite is in angle drill hole Br-501, which penetrates the upper third of the formation and indicates that at least 585 ft are present in the county. The formation dips gently to the west-north-west. Its contact with the older granite is not known in Barron County, but from relations observed at Mount Atlanta in Rusk County, it is presumed that the granite was weathered prior to deposition of the basal conglomerate of the Barron Quartzite Formation. The granite and quartzite were subsequently weakly metamorphosed. Thin argillite beds, locally known as pipestone, are found near the top of the formation. Where sufficiently thick (about 6 in.) and shallow, the pipestone was quarried for carving by early Indians and for facing stone. A small facing-stone quarry is located in sec. 22, T. 35 N., R. 10 W. The Barron Quartzite Formation represents a near-shore to subaerial clastic sequence of quartzitic to arkosic sand. Late during deposition of the Barron Quartzite, the sea must have been shallow or the bottom intermittently exposed because shallow water ripples and mudcracks are known from the argillite beds. The time of deposition of the Barron Quartzite is not known, but paleomagnetic data and cross-cutting relations of younger diabase dikes suggests deposition ceased well before 1,100 million years ago (Ma). Around 1,630 Ma the Barron Quartzite was folded into a gently northwestward-plunging syncline.

Cambrian units

The Mount Simon Formation (unit Cm) is exposed only in the southern part of Barron County, but is penetrated by many shallow water wells throughout the county. In outcrop it generally forms a distinctive cliff. The formation consists of four facies (see stratigraphic section). The three lowest facies are known only from borehole Br-191 in Rice Lake, which was drilled to 625 ft. These facies are recognized only where the Mount Simon is thick. On the basis of cross sections in Barron and adjoining counties, the Mount Simon Formation is about 200 ft thick in eastern Barron County, where it rests unconformably on crystalline bedrock, and is at least 460 ft thick in central and western Barron County, where it rests unconformably on the Barron Quartzite.

The Eau Claire Formation (unit Ce) is exposed extensively throughout Barron County. It generally forms the lower part of slopes and bluffs and is approximately 100 ft thick. The lower contact is transitional with the coarser sandstone of the Mount Simon Formation.

The Wonewoc Formation (unit Cw) is exposed extensively throughout Barron County. It generally forms the crests and cliffs of hills. Two sandstone members compose the Wonewoc Formation: the older Galesville Member and the younger Ironton Member (see stratigraphic section). The contact of the two members is conformable. The combined thickness of the Galesville and Ironton Members at any locality is 50 to 60 ft. The Ironton Member is a distinct ridge-forming unit. The lower contact of the Wonewoc Formation with the Eau Claire sandstone is disconformable to unconformable.

The Tunnel City Group (unit Ct) includes five interbedded lithologic facies in Barron County (see stratigraphic section). The units interfinger, and some of them grade into others laterally. The Lone Rock Formation consists of three glauconitic sandstone facies: the Birkmose, the Tomah, and the Reno Members. The Mazomanie Formation consists of two unnamed, less glauconitic sandstone facies. The Lone Rock and the Mazomanie Formations are interbedded in Barron County, but facies of the Mazomanie Formation are more common higher in the section; facies of the Lone Rock are more common in the lower part of the group. The Tunnel City Group is 185 ft thick in central Barron County, and appears to thin to 100 ft in the western part of Barron County.

The Lone Rock Formation generally seems to be the basal unit of the Tunnel City Group. It is extensively exposed in Barron County, and is approximately 100 ft thick. The formation consists of three dominant facies (see stratigraphic section). The Birkmose Member is generally the lowest unit in the Tunnel City Group. Because it is less than 10 ft thick, it is not readily recognized in drill cuttings. Where observed, the Birkmose Member rests conformably on the underlying Ironton Member of the Wonewoc Formation. A thin, flat-pebble conglomerate is found within 1 foot of the contact with the underlying Ironton Member. The Tomah Member is a thin-bedded sandstone; the individual beds are separated by laminae of gray-green shale. The Reno Member appears to consist of individual sandstone beds of Tomah and Birkmose lithology.

The Mazomanie Formation is extensively exposed in Barron County, and consists of two unnamed sandstone facies (see stratigraphic section). It is about 100 ft thick in Barron County.

The St. Lawrence Formation (unit Cj) is probably less than 10 ft thick, and is represented by the dolomitic sandstone of the Lodi Member. Nelson (1956) and some water-well records report a greater thickness of the St. Lawrence, but this could not be confirmed. On the map, this unit is shown together with the overlying Jordan Formation. The Lodi Member is recognized only in well exposed outcrop with the Tunnel City Group at the base and the Jordan Formation at the top. The lower contact is conformable with the Mazomanie facies of the Tunnel City Group.

Jordan Formation (unit Cj). Three facies are recognized in the Jordan Formation in Barron County: the Norwalk and Van Oser Members, which consist of interbedded sandstone, and the Coon Valley Member, which consists of sandy dolomite (see stratigraphic section).

The Norwalk Member is reasonably well exposed in southwestern Barron County. The unit is poorly lithified, but can form steep slopes. It is 50 to 60 ft thick. The lower contact with the St. Lawrence Formation is seen at only two places where the contact is sharp and well defined with no suggestion of unconformity.

The Van Oser Member is well exposed in western Barron County, and generally forms the bedrock above 1250-ft elevation. The sandstone is strongly iron-cemented in places. The Van Oser is poorly lithified, but forms steep slopes, particularly where overlain by the Coon Valley Member. It is 30 to 50 ft thick. The lower contact is transitional over 50 ft, and the fine sandstone of the Norwalk is interbedded with the coarser sandstone of the Van Oser.

The Coon Valley Member only occurs above an elevation of 1300 ft in Barron County. The dolomite is vuggy, but provides good crushed stone for construction. It is 20 to 45 ft thick. The lower contact with the Van Oser Member is sharp.

Ordovician units

The Prairie du Chien Group (unit Op) is known only from water wells in the extreme western part of the county. It is represented in Barron County by the dolomite of the Oneota Formation, which is at least 30 ft thick. The lower contact is transitional with the sandy dolomite of the Coon Valley Member. The upper contact is a major unconformity with Pleistocene and younger units.

GEOLOGIC HISTORY

Cycles of deposition in the Late Cambrian and Early Ordovician represent a shallowing sequence, which broadly consists of quartz sandstone grading upward through a succession of finer-grained units with increasing clay and carbonate, ideally terminating with a carbonate unit (Ostrom, 1978). There are three sedimentary cycles in Barron County that are generally separated by unconformities. Rock units that compose the three, incomplete cycles are: 1) Mount Simon and Eau Claire Formations; 2) Wonewoc Formation, Tunnel City Group, and St. Lawrence Formation; and 3) Jordan and Oneota Formations. These cycles have been ascribed to repeated emergence, which was caused by rejuvenation of tectonically active parts of the earth's crust, and by submergence, which resulted from subsidence of the Appalachian geosyncline and of the neighboring shelf area of the crust.

The geologic history from the end of deposition in the Ordovician to the Pleistocene can only be inferred from exposures in adjacent counties and from the general geologic framework of the north-central region. Intermittent submergence and emergence probably continued, followed by a long period of weathering that lasted until the beginning of the Pleistocene. Except for the emergence of the Transcontinental Arch during the Devonian Period, the region has been tectonically stable.

STRUCTURAL GEOLOGY

Recognized structures in Barron County include folds and faults. The Barron Quartzite Formation was folded in Proterozoic time into a broad, gently northwestward-plunging syncline. The syncline itself is best defined in adjacent Rusk County. In Barron County the quartzite dips 10 degrees to the northwest. The Paleozoic units form a gentle homocline dipping to the northwest into the River Falls syncline. Faults are recognized in the Precambrian Barron Quartzite Formation and in younger rock. Some of the faults in the younger rock appear to be reactivated Precambrian structures.

In Barron County contacts between units can be traced at the same elevation over many square miles. These large structural blocks are separated from other coherent blocks by faults, which generally appear as aeromagnetic lineaments and topographic lows presently occupied by streams. Other smaller faults are shown on the map and are required to explain the difference in elevation of geologic contacts among various structural blocks.

The most significant regional fault in the county is the Barron Fault (Sims and others, 1978) that trends northeast to southwest across almost the entire county (see map). The fault is defined by a strong magnetic lineament and by offset of Proterozoic units in Rusk and Iron counties, Wisconsin, and Gogebic County, Michigan. There appears to have been reactivation after deposition of the Jordan Formation. Well data near the city of Barron clearly define 135 ft of vertical offset with the southeast side down. In the eastern part of the county, the fault defines the northwestern side of one of the ridges in the Blue Hills.

A second major fault trends northwest to southeast through the west-central part of Barron County. This fault is observed in outcrop in sec. 8, T. 33 N., R. 13 W. in the west wall of a gravel pit. At this locality the Van Oser Member is in contact with Tunnel City Group. The fault projects to the southeast down the Lower Pine River and is defined in outcrop in Chippewa County and by water wells in the Bloomer vicinity. Total displacement across this fault is 100 ft with the southwest side down.

REFERENCES

Nelson, C.A., 1956, Upper Croixan stratigraphy, upper Mississippi Valley: Geological Society of America Bulletin, v. 67, no. 2, p. 165-184.

Ostrom, M.E., 1978, Stratigraphic relationships of lower Paleozoic rocks of Wisconsin: Wisconsin Geological and Natural History Survey Field Trip Guide Book 3, p. 3-22.

Sims, P.K., Cannon, W.F., and Mudrey, M.G., Jr., 1978, Preliminary geologic map of Precambrian rocks in part of northern Wisconsin: U.S. Geological Survey Open-file Report 78--318, scale 1:250,000, 2 sheets.

UWEX University of Wisconsin—Extension

Published by and available from
Wisconsin Geological and Natural History Survey
M. E. Ostrom, Director and State Geologist
3817 Mineral Point Road, Madison, Wisconsin 53705

Cartography by K. Campbell Roushar

Wisconsin Geological and Natural History Survey
Map 87-2c A part of the Barron County Atlas