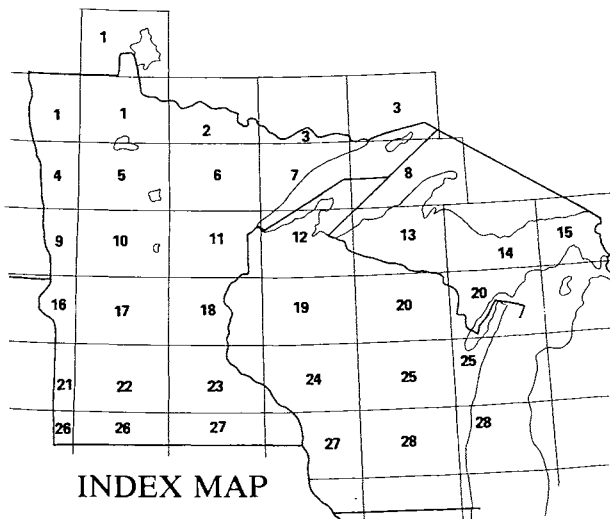


GEOLOGIC MAP OF THE LAKE SUPERIOR REGION

PRINCIPAL SOURCES OF GEOLOGIC DATA

Geologic data for the Lake Superior region were compiled principally from the maps cited below. Most of the cited maps in turn are compilations of other maps; references to the original map data are found in the bibliographies of the regional compilations listed here. All of the cited maps were generalized as necessary to fit requirements of scale, and some were modified from other sources indicated under the sheet headings.



INDEX MAP

**1. Kenora, Thief River Falls, and Roseau sheets**

Ojakangas, R.W., Mossler, J.H., and Morey, G.B., 1979, Geologic map of Minnesota—Roseau sheet, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

**2. International Falls sheet**

Southwick, D.L., and Ojakangas, R.W., 1979, Geologic map of Minnesota—International Falls sheet, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

**3. Quetico and Thunder Bay sheets**

Green, J.C., 1978, Geologic map of Minnesota—Two Harbors sheet, bedrock geology: Minnesota Geological Survey, file map, scale 1:250,000.

**4. Grand Forks sheet**

Oak Ridge Gaseous Diffusion Plant, 1981, Hydrogeochemical and stream sediment reconnaissance basic data for Grand Forks NTMS Quadrangle, North Dakota, Minnesota: U.S. Department of Energy Open-File Report GJBX-169(81), plate 8, scale 1:250,000.

**5. Bemidji sheet**

Sims, P.K., 1970, Geologic map of Minnesota, bedrock geology: Minnesota Geological Survey Miscellaneous map M-14, scale 1:1,000,000.

Southwick, D.L., 1980, Geologic map of Minnesota—Bemidji Sheet, bedrock geology: Minnesota Geological Survey, file map, scale 1:250,000.

**6. Hibbing sheet**

Sims, P.K., Morey, G.B., Ojakangas, R.W., and Viswanathan, S., 1970, Geologic map of Minnesota—Hibbing sheet, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

**7. Two Harbors sheet**

Green, J.C., 1978, Geologic map of Minnesota—Two Harbors sheet, bedrock geology: Minnesota Geological Survey, file map, scale 1:250,000.

**8. Hancock sheet**

Green, J.C., 1978, Geologic map of Minnesota—Two Harbors sheet, bedrock geology: Minnesota Geological Survey, file map, scale 1:250,000.

Hubbard, H.A., 1975, Lower Keweenawan volcanic rocks of Michigan and Wisconsin: U.S. Geological Survey Journal of Research, v. 3, p. 539-541.

**9. Fargo sheet**

Oak Ridge Gaseous Diffusion Plant, 1981, Hydrogeochemical and stream sediment reconnaissance basic data for Fargo NTMS Quadrangle, North Dakota, Minnesota: U.S. Department of Energy Open-File Report GJBX-167(81), plate 7, scale 1:250,000.

**10. Brainerd sheet**

Morey, G.B., Olsen, B.M., and Southwick, D.L., 1981, Geologic map of Minnesota—east-central Minnesota, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

Southwick, D.L., 1981, Geologic map of Minnesota—Brainerd sheet, bedrock geology: Minnesota Geological Survey, file map, scale 1:250,000.

### 11. Duluth sheet

- Dutton, C.E., and Bradley, R.E., 1970, Lithologic, geophysical, and mineral commodity maps of Precambrian rocks in Wisconsin: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-631, scale 1:500,000.
- Morey, G.B., Olsen, B.M., and Southwick, D.L., 1981, Geologic map of Minnesota—east-central Minnesota, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

### 12. Ashland sheet

- Aldrich, H.R., 1929, Geology of the Gogebic iron range of Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 71, 279 p.
- Dutton, C.E., and Bradley, R.E., 1970, Lithologic, geophysical, and mineral commodity maps of Precambrian rocks in Wisconsin: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-631, scale 1:500,000.
- Olmsted, J.F., 1967, Geologic map of part of the Marengo quadrangle: Wisconsin Geological and Natural History Survey, open-file map, scale 1:24,000.

### 13. Iron River sheet

- Aldrich, L.T., Davis, G.L., and James, H.L., 1965, Ages of minerals from metamorphic and igneous rocks near Iron Mountain, Michigan: *Journal of Petrology*, v. 6, p. 445-472.
- Bayley, R.W., 1959, Geology of the Lake Mary quadrangle, Iron County, Michigan: U.S. Geological Survey Bulletin 1077, 112 p.
- Cannon, W.F., 1978, Bedrock geologic map of the Iron River 1° x 2° quadrangle, Michigan and Wisconsin: U.S. Geological Survey, Open-File Map 78-342, scale 1:250,000.
- Cannon, W.F., and Klasner, J.S., 1976, Geologic map and geophysical interpretation of the Witch Lake quadrangle, Marquette, Iron, and Baraga Counties, Michigan: U.S. Geological Survey Miscellaneous Investigations Series Map I-987, scale 1:62,500.
- Foose, M.P., 1981, Geologic map of the Ned Lake quadrangle, Iron and Baraga Counties, Michigan: U.S. Geological Survey Miscellaneous Investigations Series Map I-1284, scale 1:62,500.
- Gair, J.E., and Wier, K.L., 1956, Geology of the Kieman quadrangle, Iron County, Michigan: U.S. Geological Survey Bulletin 1044, 88 p.

### 14. Marquette sheet

- Cannon, W.F., 1974, Bedrock geologic map of the Greenwood quadrangle, Marquette County, Michigan: U.S. Geological Survey Geologic Quadrangle Map GQ-1168, scale 1:24,000.
- , 1975, Bedrock geologic map of the Republic quadrangle, Marquette County, Michigan: U.S. Geological Survey Miscellaneous Investigations Series Map I-862, scale 1:24,000.
- Case, J.E., and Gair, J.E., 1965, Aeromagnetic map of parts of Marquette, Dickinson, Baraga, Alger, and Schoolcraft Counties, Michigan, and its geologic interpretation: U.S. Geological Survey Geophysical Investigations Map GP-467, scale 1:62,500.
- Gair, J.E., 1975, Bedrock geology and ore deposits of the Palmer quadrangle, Marquette County, Michigan: U.S. Geological Survey Professional Paper 769, 159 p.

Gair, J.E., and Thaden, R.E., 1968, Geology of the Marquette and Sands quadrangles, Marquette County, Michigan: U.S. Geological Survey Professional Paper 397, 77 p.

Puffett, W.P., 1974, Geology of the Negaunee quadrangle, Marquette County, Michigan: U.S. Geological Survey Professional Paper 788, 53 p.

Simmons, G.C., 1974, Bedrock geologic map of the Ishpeming quadrangle, Marquette County, Michigan: U.S. Geological Survey Geologic Quadrangle Map GQ-1130, scale 1:24,000.

### 15. Sault Sainte Marie sheet

Kelley, R.W., 1968, Bedrock of Michigan: Michigan Geological Survey Small Scale Map 2, scale 1:2,500,000.

### 16. Milbank sheet

Oak Ridge Gaseous Diffusion Plant, 1981, Hydrogeochemical and stream sediment reconnaissance basic data for Milbank NTMS Quadrangle, Minnesota, North Dakota, South Dakota: U.S. Department of Energy Open-File Report GJBX-271(81), plate 8, scale 1:250,000.

### 17. St. Cloud sheet

Morey, G.B., Olsen, B.M., and Southwick, D.L., 1981, Geologic map of Minnesota—east-central Minnesota, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

Morey, G.B., Southwick, D.L., Lively, R.S., and Beltrame, R.J., 1980, Uranium resource evaluation, St. Cloud Quadrangle, Minnesota: U.S. Department of Energy Open-File Report PGJ-048(81), plate 9, scale 1:250,000.

### 18. Stillwater sheet

Dutton, C.E., and Bradley, R.E., 1970, Lithologic, geophysical, and mineral commodity maps of Precambrian rocks in Wisconsin: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-631, scale 1:500,000.

Morey, G.B., Olsen, B.M., and Southwick, D.L., 1981, Geologic map of Minnesota—east-central Minnesota, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

### 19. Rice Lake sheet

Hotchkiss, W.O., 1915, Mineral land classification: Wisconsin Geological and Natural History Survey Bulletin 44, Economic Series 19, 377 p.

Hotchkiss, W.O., and Bean, E.F., 1929, Mineral lands of part of northern Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 46, Economic Series 21, 212 p.

Sims, P.K., 1980, Boundary between Archean greenstone and gneiss terranes in northern Wisconsin and Michigan, *in* Morey, G.B., and Hanson, G.N., eds., Selected studies of Archean gneisses and lower Proterozoic rocks, southern Canadian Shield: Geological Society of America Special Paper 182, p. 113-124.

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

Sims, P.K., and Peterman, Z.E., 1980, Geology and Rb-Sr age of lower Proterozoic granitic rocks, northern Wisconsin, *in* Morey, G.B., and Hanson, G.N., eds., Selected studies of Archean gneisses and lower Proterozoic rocks, southern Canadian Shield: Geological Society of America Special Paper 182, p. 139-146.

Wisconsin Geological and Natural History Survey, 1981, Geologic map of Wisconsin—bedrock geology: File map, scale 1:500,000.

#### 20. Iron Mountain and Escanaba sheets

Banks, P.O., and Cain, J.A., 1969, Zircon age of Precambrian granite rocks, northeastern Wisconsin: *Journal of Geology*, v. 77, p. 208-220.

Banks, P.O., and Rebello, D.P., 1969, Zircon age of a Precambrian rhyolite, northeastern Wisconsin: *Geological Society of America Bulletin*, v. 80, p. 907-910.

Dutton, C.E., 1971, Geology of the Florence area, Wisconsin and Michigan: U.S. Geological Survey Professional Paper 633, 54 p.

Dutton, C.E., and Linebaugh, R.E., 1967, Map showing Precambrian geology of the Menominee iron-bearing district and vicinity, Michigan and Wisconsin: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-466, scale 1:125,000.

James, H.L., Clark, L.D., Lamey, C.L., and Pettijohn, F.J., 1961, Geology of central Dickinson County, Michigan: U.S. Geological Survey Professional Paper 310, 176 p.

James, H.L., Dutton, C.E., Pettijohn, F.J., and Wier, K.L., 1968, Geology and ore deposits of the Iron River-Crystal Falls district, Iron County, Michigan: U.S. Geological Survey Professional Paper 570, 134 p.

Medaris, L.G., Jr., and Anderson, J.L., 1973, Preliminary geologic map of the Iron Mountain sheet, Wisconsin-Michigan: Institute on Lake Superior Geology, 19th Annual, Madison, Wisconsin, Guidebook to the Precambrian geology of northeastern and northcentral Wisconsin, plate 2, scale 1:250,000.

#### 21. Watertown sheet

Oak Ridge Gaseous Diffusion Plant, 1981, Hydrogeochemical and stream sediment reconnaissance basic data for Watertown NTMS Quadrangle, South Dakota, Minnesota: U.S. Department of Energy Open-File Report GJBX-219(81), plate 8, scale 1:250,000.

#### 22. New Ulm sheet

Goldich, S.S., Hedge, C.E., and Stern, T.W., 1970, Age of the Morton and Montevideo gneisses and related rocks, southwestern Minnesota: *Geological Society of America Bulletin*, v. 81, p. 3671-3696.

Mossler, J.H., 1981, Regional study of Paleozoic aquifers in Minnesota: Minnesota Geological Survey, file maps, scale 1:500,000.

Sims, P.K., Austin, G.S., Grant, J.A., and Ikola, R.J., 1970, Geologic map of Minnesota—New Ulm sheet, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

Southwick, D.L., Morey, G.B., Lively, R.S., and Beltrame, R.J., 1981, Uranium resource evaluation, New Ulm Quadrangle, Minnesota: U.S. Department of Energy Open-File Report PGJ-052(81), plate 9, scale 1:250,000.

#### 23. St. Paul sheet

Mossler, J.H., 1981, Regional study of Paleozoic aquifers in Minnesota: Minnesota Geological Survey, file maps, scale 1:250,000.

Sloan, R.E., and Austin, G.S., 1966, Geologic map of Minnesota—St. Paul sheet, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

#### 24. Eau Claire sheet

Maass, R.S., and Van Schmus, W.R., 1980, Precambrian tectonic history of the Black River Valley: Institute on Lake Superior Geology, 26th Annual, Eau Claire, Wisconsin, Field Guide, 43 p.

Meyers, P.E., Cummings, M.L., and Wurdinger, S.R., 1980, Precambrian geology of the Chippewa Valley: Institute on Lake Superior Geology, 26th Annual, Eau Claire, Wisconsin, Field Guide, 103 p.

Mossler, J.H., 1981, Regional study of Paleozoic aquifers in Minnesota: Minnesota Geological Survey, file maps, scale 1:500,000.

Sloan, R.E., and Austin, G.S., 1966, Geologic map of Minnesota—St. Paul sheet, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

Wisconsin Geological and Natural History Survey, 1981, Geologic map of Wisconsin—bedrock geology: File map, scale 1:500,000.

#### 25. Green Bay and Manitowoc sheets

LaBerge, G.L., and Myers, P.E., 1977, Geological map of Marathon County, Wisconsin: Wisconsin Geological and Natural History Survey, open-file report, scale 1:250,000.

LaBerge, G.L., and Palmer, Elizabeth, 1980, The Middle Precambrian geology of Marathon County: Institute on Lake Superior Geology, 26th Annual, Eau Claire, Wisconsin, Field Guide, 50 p.

Maass, R.S., Medaris, L.G., Jr., and Van Schmus, W.R., 1980, Penoquean deformation in central Wisconsin, in Morey, G.B., and Hanson, G.N., eds., Selected studies of Archean gneisses and lower Proterozoic rocks, southern Canadian Shield: *Geological Society of America Special Paper* 182, p. 147-157.

Medaris, L.G., Jr., and Anderson, J.L., 1973, Preliminary geologic map of the Green Bay sheet, Wisconsin: Institute on Lake Superior Geology, 19th Annual, Madison, Wisconsin, Guidebook to the Precambrian geology of northeastern and northcentral Wisconsin, plate 3, scale 1:250,000.

Sood, M.K., Myers, P.E., and Berlin, L.A., 1980, The petrology, geochemistry, and contact relations of the Stettin and Wausau syenite plutons, central Wisconsin: Institute on Lake Superior Geology, 26th Annual, Eau Claire, Wisconsin, Field Guide, 59 p.

Van Schmus, W.R., 1976, Early and middle Proterozoic history of the Great Lakes area, North America, in *Global tectonics in Proterozoic times*: Royal Society of London Philosophical Transactions, ser. A, v. 280, p. 605-628.

——— 1978, Geochronology of the southern Wisconsin rhyolites and granites: *Geoscience Wisconsin*, v. 2, p. 19-24.

Van Schmus, W.R., and Anderson, J.L., 1977, Gneiss and migmatite of Archean age in the Precambrian basement of central Wisconsin: *Geology*, v. 5, p. 45-48.

Van Schmus, W.R., Thurman, E.M., and Peterman, Z.E., 1975, Geology and Rb-Sr chronology of Middle Precambrian rocks in eastern and central Wisconsin: *Geological Society of America Bulletin*, v. 86, p. 1255-1265.

Weidman, S., 1907, The geology of north-central Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 16, 697 p.

Wisconsin Geological and Natural History Survey, 1981, Geologic map of Wisconsin—bedrock geology: File map, scale 1:500,000.

## 26. Sioux Falls and Fairmont sheets

Sims, P.K., Austin, G.S., Grant, J.A., and Ikola, R.J., 1970, Geologic map of Minnesota—New Ulm sheet, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

## 27. Mason City and La Crosse sheets

Mossler, J.H., 1981, Regional study of Paleozoic aquifers in Minnesota: Minnesota Geological Survey, file maps, scale 1:500,000.

Sloan, R.E., and Austin, G.S., 1966, Geologic map of Minnesota—St. Paul sheet, bedrock geology: Minnesota Geological Survey, scale 1:250,000.

Wisconsin Geological and Natural History Survey, 1981, Geologic map of Wisconsin—bedrock geology: File map, scale 1:500,000.

## 28. Madison and Milwaukee sheets

Smith, E.I., 1978, Precambrian rhyolites and granites in south-central Wisconsin: Field relations and geochemistry: Geological Society of America Bulletin, v. 89, p. 875-890.

Wisconsin Geological and Natural History Survey, 1981, Geologic map of Wisconsin—bedrock geology: File map, scale 1:500,000.

## GENERAL REFERENCES

- Austin, G.S., 1972, Paleozoic lithostratigraphy of southeastern Minnesota, *in* Sims, P.K., and Morey, G.B., eds., *Geology of Minnesota: A centennial volume*: Minnesota Geological Survey, p. 459-473.
- Dunlavy, H.R., Pavlik, C.E., and Morey, G.B., 1979, Geologic map index of Minnesota: Minnesota Geological Survey, unpagged.
- Dutton, C.E., and Bradley, R.E., 1970, Lithologic, geophysical, and mineral commodity maps of Precambrian rocks in Wisconsin: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-631, scale 1:500,000.
- Ervin, C.P., and Hammer, S.H., 1974, Bouguer anomaly gravity map of Wisconsin: Wisconsin Geological and Natural History Survey, scale 1:500,000.
- Merewether, E.A., and Cobban, W.A., 1981, Mid-Cretaceous formations in eastern South Dakota and adjoining areas—Stratigraphic, paleontologic, and structural interpretations, *in* Brenner, R.L. and others, eds., *Cretaceous stratigraphy and sedimentation in northwest Iowa, northeast Nebraska, and southeast South Dakota*: Iowa Geological Survey Guidebook Series 4, p. 43-56.
- Morey, G.B., 1978, Metamorphism in the Lake Superior region, U.S.A., and its relation to crustal evolution, *in* Fraser, J.A., and Heywood, W.W., eds., *Metamorphism in the Canadian Shield*: Geological Survey of Canada Paper 78-10, p. 283-314.
- 1978, Lower and Middle Precambrian stratigraphic nomenclature for east-central Minnesota: Minnesota Geological Survey Report of Investigations 21, 52 p.
- Ostrom, M.E., 1978, Stratigraphic relationships of Lower Paleozoic rocks of Wisconsin, *in* *Lithostratigraphy, petrology and sedimentology of Late Cambrian-Early Ordovician rocks near Madison, Wisconsin*: Wisconsin Geological and Natural History Survey Field Trip Guide Book 3, p. 3-22.
- Sims, P.K., 1976, Precambrian tectonics and mineral deposits, Lake Superior region: *Economic Geology*, v. 71, p. 1092-1127.
- Sloan, R.E., 1964, The Cretaceous System in Minnesota: Minnesota Geological Survey Report of Investigations 5, 64 p.
- Van Schmus, W.R., 1976, Early and middle Proterozoic history of the Great Lakes area, North America, *in* *Global tectonics in Proterozoic times*: Royal Society of London Philosophical Transactions, ser. A, v. 280, p. 605-628.
- 1980, Chronology of igneous rocks associated with the Penokean orogeny in Wisconsin: *in* Morey, G.B., and Hanson, G.N., eds., *Selected studies of Archean gneisses and lower Proterozoic rocks, southern Canadian Shield*: Geological Society of America Special Paper 182, p. 159-168.
- Webers, G.F., 1972, Paleogeology of the Cambrian and Ordovician strata of Minnesota, *in* Sims, P.K., and Morey, G.B., eds., *Geology of Minnesota: A centennial volume*: Minnesota Geological Survey, p. 474-484.
- Weiblen, P.W., and Morey, G.B., 1980, A summary of the stratigraphy, petrology and structure of the Duluth Complex: *American Journal of Science*, v. 280-A, p. 16-66; fig. 2, scale 1:3,168,000.
- Zietz, I., Karl, J.H., and Ostrom, M.E., 1977, Preliminary aeromagnetic map covering most of the exposed Precambrian terrane in Wisconsin: U.S. Geological Survey Miscellaneous Field Studies Map MF-888, scale 1:250,000.

Quaternary geology of Wisconsin and contiguous Upper Michigan. In Mahaney, W.C. (Ed.), Quaternary Stratigraphy of North America. Dowden, Hutchinson, and Ross, Stroudsburg, Pennsylvania, pp. 93-117. Google Scholar. Late Wisconsin and Holocene history of the Lake Superior basin. In Karrow, P.K., Calkin, P.E. (Eds.), Quaternary Evolution of the Great Lakes. Geological Association of Canada, Special Paper 30, pp. 17-32. Google Scholar. Geologic map of the Lake Superior region, Minnesota, Wisconsin, and northern Michigan. Minnesota Geological Survey, University of Minnesota. Google Scholar. Mothersill, J.S. 1988. Geology of the Upper Narrows. Bedrock Geology of Copper Falls State Park. Bedrock Geologic Map of Paulding, MI. Bedrock Geologic Map of Fern Creek Area, Michigan. Bedrock Geologic Map of the McClure Basin, MI. Bedrock Map of the Precambrian Kona Formation Type Section. Surficial Geology of Matthiessen State Park, IL. Bedrock Cambrian exposure of the Wonewoc and Lone Rock Formations. The Transition between the Lorraine and Gordon Lake Formations, ON. Precambrian Jacobsville/Lorraine Horst. Precambrian BIF of the Negaunee Formation along US-41/M28, MI. Contact between the Michigamme and Jacobsville Formations on Lake Superior, MI. Precambrian Jacobsville Formation, Shelter Bay and Deer Lake, MI. Bedrock geologic map of the US area bordering Lake Superior in Minnesota, Wisconsin, and Michigan. The Minnesota Geological Survey has placed this image in the public domain with the request that credit be given to the Minnesota Geological Survey, University of Minnesota, and to the author(s) of the specific work. These images are available through the Minnesota Digital Library, "Minnesota Reflections". More information on the Minnesota Geological Survey map and report scanning project can be found here. Basis of this page is in Wikipedia. Text is available under the CC BY-SA 3.0 Unported License. Michigan Geological Survey at Western Michigan University houses the biggest collection of geologic maps available for the State of Michigan at the MGS Store. The extent, coverage and type of the maps available can be viewed using the MGS Geoplatform application. Most of the surficial geologic maps are available for the southern part of the lower peninsula while county scale bedrock geologic and bedrock topographic maps are available for northern part of lower peninsula. There are limited mappings done in the upper peninsula of Michigan. Most of the surficial geological mapping in Michigan have 2 GEOLOGIC ATLAS OF CHISAGO COUNTY, MINNESOTA Glauconite Microbial domes; stromatolites/thrombolites 800 1 mile Approximate scale EXPLANATION 200 St Peter Sandstone Jordan Sandstone 5 miles Wisconsin Figure 1. Schematic illustration of the depositional conditions about 490 million years ago in the area known today as Taylors Falls, Minnesota, and St. Croix Falls, Wisconsin. The depiction of uppermost bedrock units in the northern approximately one-half of the county is more tenuous than in the southern half. northwestern Wisconsin, and eastern Minnesota: Geological Society of America Special Paper 312, p. 47-72. Berg, R.R., 1954, Franconia Formation of Minnesota and Wisconsin: Geological Society of America Bulletin, v. 66, p. 857-882.