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Harvey Thorleifson, Director

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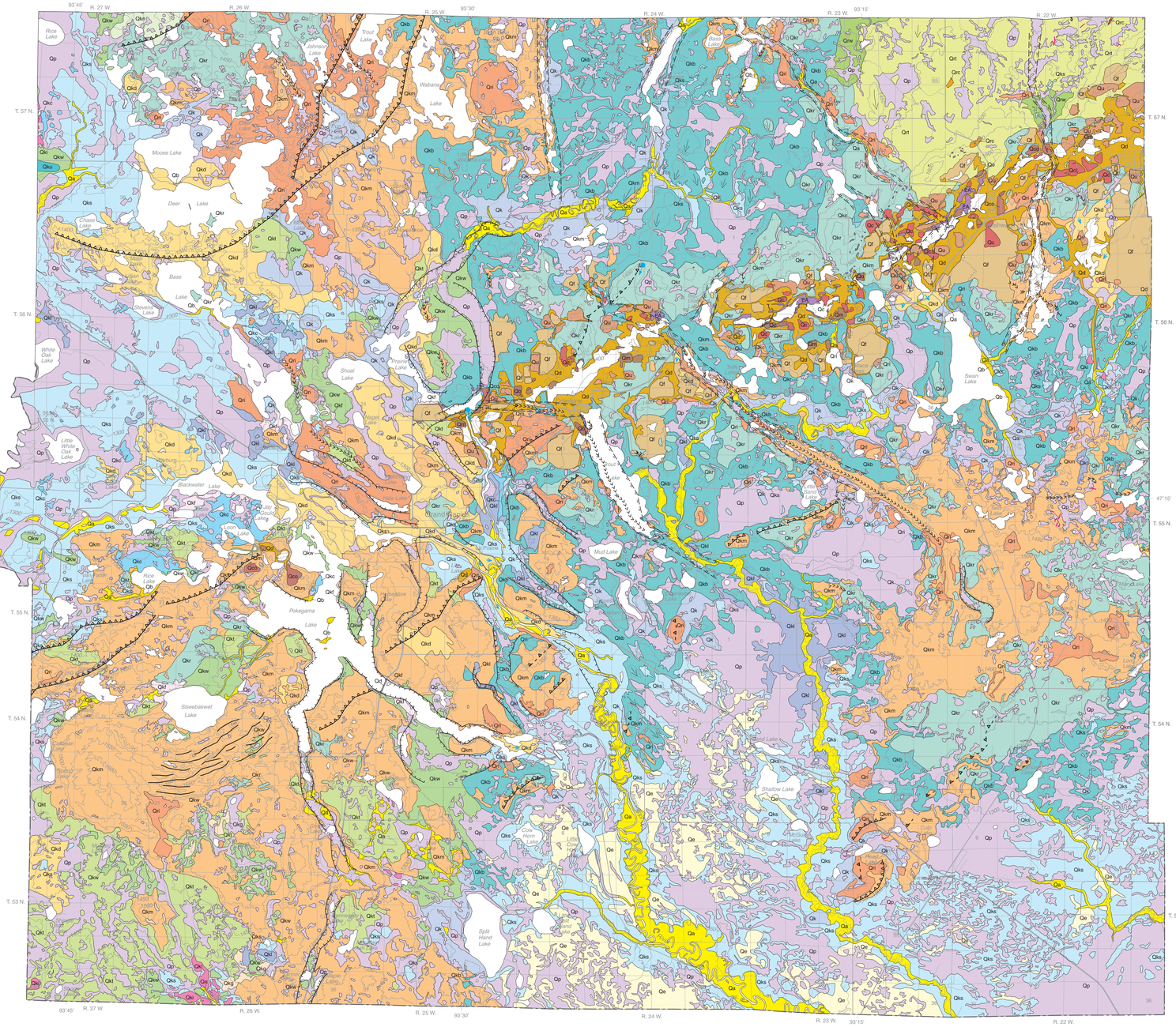
MISCELLANEOUS MAP SERIES
MAP M-131
Plate 5—Surficial Geology, Southeast

SURFICIAL GEOLOGY OF SOUTHEAST ITASCA COUNTY

By

Gary N. Meyer, Carrie E. Jennings, and Mark A. Jirsa

2005



Digital base modified from the Minnesota Department of Transportation BaseMap data; digital base annotation by the Minnesota Geological Survey.

Elevation contours were derived from the U.S. Geological Survey 30-meter Digital Elevation Model (DEM) by the Minnesota Geological Survey.

Universal Transverse Mercator Projection, grid zone 15
1983 North American Datum

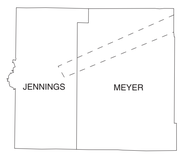
GIS compilation and cartography by
Joyce Meints and R.S. Lively
Edited by Lori Robinson

SCALE 1:100 000

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

CONTOUR INTERVAL 50 FEET

ITASCA COUNTY



INDEX TO MAPPING

Note: Jirsa mapped outcrop and disturbed areas in the portion of the county with the dashed outline.

LOCATION DIAGRAM

Every reasonable effort has been made to ensure the accuracy of the factual data on which this map interpretation is based; however, the Minnesota Geological Survey does not warrant or guarantee that there are no errors. Users may wish to verify critical information; sources include both the references listed here and information on file at the offices of the Minnesota Geological Survey in St. Paul. In addition, effort has been made to ensure that the interpretation conforms to sound geologic and cartographic principles. No claim is made that the interpretation shown is rigorously correct, however, and it is not to be used to guide engineering-scale decisions without site-specific verification.

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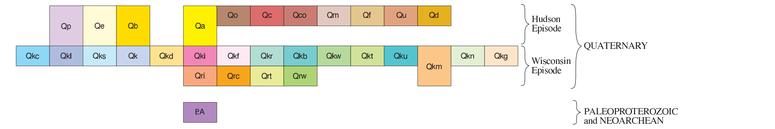
CORRELATION OF MAP UNITS



MAP SYMBOLS

Geologic contact—Approximately located. Determined by examination of outcrops, topography, black-and-white aerial photographs, vegetation type, and through interpretation of drill-hole data and soil-survey maps. Where known, gradational contacts are indicated in the map-unit descriptions.

Meltwater channel—Drainage channel cut by meltwater. May represent former subglacial or surface streams.

Former position of glacial ice margin—Interpreted from position of outwash, moraine, and ice-contact landforms.
- **Inferred**
- **Speculative**

Esker or esker-like ridge—Sinuous ridge interpreted to have been deposited in an ice-walled channel or tunnel of a glacial meltwater stream, and if so, comprised of interbedded sand, gravel, and silt. Deposited by meltwater of the Rainy lobe. Overlying glacial and/or lacustrine sediment ranges in thickness from less than one foot to tens of feet.

General flow direction of meltwater that deposited surficial sand and gravel—Arrow points downstream. Interpreted from the surface slope and flow indicators in unit bedding, such as foresets and imbrication.

Drumlin—Streamlined hill or ridge shaped by moving ice, typically of glacial till, with arrow showing the inferred direction of ice movement and central axis of streamlined form.

Minor linear ridge—Narrow, discontinuous ridges (generally less than 20 feet [6 meters] high) composed of glacial till; commonly interbedded with silt, sand, and gravel; interpreted to have been deposited in fissures in the disintegrating ice surface.

Tunnel valley—Broad, linear lowland with an irregular bottom elevation. Commonly has a sinuous ridge (esker) within it and a fan-shaped deposit at its southern termination. Interpreted to be a former subglacial drainageway partially filled with glacial-age and younger sediment. The low areas are commonly filled by lakes.

Proglacial ridges—Linear to arcuate sets of ridges, commonly associated with a depression on the up-ice side, interpreted to be the result of glaciotectonic disturbance or thrusting of proglacial sediment and soft sedimentary rock by the movement of the ice.

Glacial striation measurement—Shows direction of ice flow as determined from striations on bedrock outcrops.

Paleoproterozoic and Neoarchean bedrock outcrop.

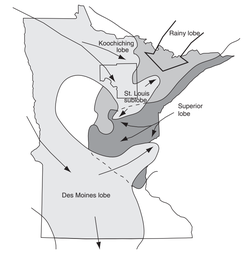


Figure 1. During the last glaciation, the Late Wisconsinan, southeast Itasca County was covered by ice of the Rainy lobe, which moved into the county from the northeast. Following the retreat of the Rainy lobe, ice of the Koochiching lobe and St. Louis sublobe entered Itasca County from the northwest.

DESCRIPTION OF MAP UNITS

POSTGLACIAL DEPOSITS (Hudson Episode)

Qo **Overburden dump mound**—Unconsolidated sediment that has been stripped from iron mines, including a mixture of sand, silt, clay, gravel, cobbles, and boulders of glacial origin, together with smaller amounts of peat and other postglacial sediment.

Qc **Coarse-grained rock dump mound**—Waste or stockpiled broken rock from iron mining, typically in sizes from about one inch to three feet (3 centimeters to 1 meter) in diameter.

Qco **Coarse-grained rock and overburden dump mound**—Mixture of unconsolidated materials and broken rock stripped from mineable iron-ore zones.

Qm **Medium-grained rock dump mound**—Iron-bearing rock crushed to a size range from coarse-grained sand to about 2 inches (5 centimeters) in diameter.

Qf **Fine-grained rock tailings basins**—Iron-poor rock crushed to fine- to coarse-grained sand size that has been slurried into basins. Basins typically are enclosed within containment dikes of coarser-grained rock or unconsolidated sediment.

Qu **Dump mound of unknown content**—No field data; identified largely from soil maps and air photographs. Most are described as "stripping dumps" on mining company maps (Great Northern Iron Ore Properties, 1959).

Qd **Disturbed land**—Surface is generally and variably disturbed by mining or other human activity. May contain a wide variety of materials including any of the above units, together with small areas of undisturbed surface material and bedrock outcrop.

Qe **Eolian sand**—Very fine- to medium-grained sand more than 5 feet (1.5 meters) thick that forms parabolic or longitudinal dunes and sheet-sand deposits that display shallow depressions or blow-outs. Interpreted to be windblown sand.

Qb **Beach sediment**—Sand and gravelly sand along the shores of modern lakes. Deposits are too narrow to map at this scale along many lakeshores. Interpreted as modern beach sediment; unit may include some ice-push or ice-jam sediment (Zumberge, 1952).

Qa **Alluvium**—Interbedded fine-grained sand, fine-grained sandy loam, and silt loam; shells, wood, and other organic debris are typically present. Interpreted as the deposits of modern rivers during high-water stages.

Qp **Peat**—Organic material in various stages of decomposition; some deposits include small bodies of open water. Near streams, unit is interbedded in places with alluvium. Interpreted as swamp deposits and deposits of freshwater lakes that have filled with vegetation.

DEPOSITS ASSOCIATED WITH THE KOOCHICHING LOBE AND THE ST. LOUIS SUBLOBE (Wisconsin Episode)

Qk—Detritus of Cretaceous shale and Paleozoic carbonate eroded from bedrock to the northwest is rare to common and is used to distinguish these deposits from those of the Rainy lobe, which had a source area to the northeast (Fig. 1). Deposits of the Koochiching lobe and the St. Louis sublobe (Martin and others, 1989) are in many places covered by sediment deposited in lakes that fronted the retreating glacial ice. Where these lake sediments were sandy, they were later affected by wind. The flat terrain north and west of Grand Rapids is the bottom of a former lake. Its maximum elevation (about 1,410 feet [430 meters] above mean sea level) was similar to that of a larger lake that existed further north, Glacial Lake Koochiching (Hobbs, 1983; Meyer, 1993), which may have been contiguous. A third lake lying south of the bedrock high formed by the Mesabi Iron Range, called Glacial Lake Aitkin-Upham (about 1,350 feet [411 meters] above mean sea level at its maximum extent), appeared to receive water from lakes to the north. Channels in the Grand Rapids area were scoured as water moved from the northern lake basins to the south (Wright, 1972; Hobbs, 1983; Marlow and others, 2004).

Qks **Lacustrine sand and silt**—Interbedded very fine- to medium-grained sand to silt; beds of fine-grained gravel are found at depth in places. Unit has a flat and unpitted surface expression. Unit grades laterally and vertically with deltaic sand and gravel at the margins; the upper few feet commonly have been reworked by wind.

Qkl **Lacustrine silt**—Predominantly sandy to clayey silt; interbeds of very fine-grained sand to silty clay. Unit is gradational with other lacustrine units and has a flat, unpitted surface expression. The silt retains water in the upper soil horizon, resulting in a different vegetation assemblage, which includes more hardwood trees than typically found on unit Qks.

Qkc **Lacustrine clay**—Primarily massive silty clay to clay; contains varying amounts of dropstones; at depth, unit is rhythmically laminated with silt and interbedded with coarser-grained sediment, and in places, with flow till. Unit has a flat, unpitted surface expression. Contacts with other lacustrine units are gradational. Commonly overlain by several feet of lacustrine or eolian sand near coarser-grained deposits.

Qkd **Deltaic sediment**—Interbedded fine-grained sand to sand and gravel, commonly grading to and interbedded with silt and clay at depth and laterally. As interpreted from paleoshoreline elevations and landforms, the deposits are located where former meltwater streams entered glacial lakes. Includes sediment deposited by streams flowing across filled or drained lake basins. Bedding has collapsed in places where the unit was deposited over glacial ice.

Qki **Ice-contact sediment**—Sand, gravelly sand, and gravel; in places, the unit is covered by and interbedded with glacial till. May also be covered in places by lacustrine fine-grained sand and silt. Deposited by meltwater within or in proximity to glacial ice, as shown by faulted and convoluted bedding and landforms that include fan-shaped hills with a steep, ice-contact face, or conical hills (kames).

Qkf **Fluvial sediment**—Sand, gravelly sand, and gravel deposited in sinuous or straight-channel form, or in planar areas. Bedding is commonly flat-lying. Interpreted to have been deposited by streams flowing from melting ice, possibly over stagnant ice.

Qkw **Water-washed till**—Unsorted sediment (diamicton) mapped in areas where the more hummocky surface of unit Qkt has been smoothed by the action of water; in some places (primarily near sand deposits), it is thinly mantled by silt, sand, or gravel. Where the unit lies below a former paleoshoreline, smoothing of the land surface is due to the wave action in former glacial lakes. In places, smoothing was the result of fluvial activity, as interpreted by the position of the unit along a former stream course. The sand mantle has an eolian origin in places.

Qkt **Till**—Unsorted sediment, chiefly clayey textured in the northern part of the map area, but generally sandy textured to the south; incorporated pebbles, cobbles, and boulders; massive; few lenses of bedded sediment. Deposited directly by glacial ice.

Qku **Drumlinized till**—Material as above, but the surface is streamlined into low, smooth, drumlin-like landforms. Shaping beneath active, moving ice produced a more consolidated unit than generally found in unit Qkt. The till is difficult to distinguish from underlying lake clay.

Qkn **Stagnation till**—Chiefly clay loam to loam textured, unsorted sediment; some pebbles, cobbles, and boulders; texture ranges in places to sandy loam, especially where it overlies or is interbedded with sand; contains lenses of silt, sand, and gravel in places, particularly near sandy deposits or minor linear ridges. Unit is mainly distinguished by its irregular hummocky topography.

Qkg **Complex of glacial, fluvial, and lacustrine deposits**—Till texture is variable but generally sandier with depth; unit thickness over silt, sand, or gravel is generally less than 20 feet (6 meters). In places, bedded sediment may be present in one or more positions relative to the till, or it may be absent.

Qkr **Till over Rainy-lobe deposits**—Till generally less than 20 feet (6 meters) thick over Rainy-lobe silt, sand, gravel, or till. Includes small areas where Precambrian bedrock is within 20 feet (6 meters) of the surface. Texture varies from clay to sandy loam, but in general is more sandy with depth. This unit commonly contains more large clasts and is more compact than till of unit Qkt. Clasts of Paleozoic carbonate are generally uncommon, especially with depth, but increase along with the content of Cretaceous shale to the south and west.

Qkb **Water-washed till over Rainy-lobe deposits**—Unsorted sediment mapped where the hummocky surface of unit Qkr has been smoothed by the action of water; in some places (primarily near sand deposits), it is thinly mantled by silt, sand, or gravel. Where the unit lies below a former paleoshoreline, smoothing of the land surface is due to the wave action in former glacial lakes. In places, smoothing was the result of fluvial activity, as interpreted by the position of the unit along a former stream course. The sand mantle has an eolian origin in places.

Qkm **Complex of till and Rainy-lobe ice-contact deposits**—Till less than 20 feet (6 meters) thick over Rainy-lobe sand to cobbly gravel, with patches of Rainy-lobe sand and gravel at the surface in many places. Till characteristics are similar to unit Qkr. The underlying Rainy-lobe deposits include till and silt in places. Sandy lacustrine or fluvial Koochiching-lobe deposits are present at the surface in places.

DEPOSITS ASSOCIATED WITH THE RAINY LOBE (Wisconsin Episode)

Qri **Ice-contact sediment**—Sand, gravelly sand, and cobbly gravel deposited by meltwater beneath or surrounded by glacial ice, as indicated by esker, kame, and ice-walled landforms, or in large fans immediately in front of glacial ice; large cobbles and boulders are common in places; overlain by thin Koochiching-lobe sediment in places.

Qrt **Till**—Chiefly clay to loam textured, unsorted sediment; pebbles, cobbles, and boulders are generally uncommon; texture ranges in places to sandy loam, especially where the till overlies sand. Although fairly loose in the upper few feet in some places, the unit is primarily a very dense, subglacial till. The high clay and silt content, atypical of Rainy-lobe till, was derived as the Rainy lobe advanced over proglacial lake sediment in a basin to the northeast. Rainy-lobe till exposed in the walls of deep iron mines and present as lenses in ice-contact sediment is generally much coarser textured.

Qrw **Water-washed till**—Unsorted sediment mapped where the hummocky surface of unit Qrt has been smoothed by the action of water; in some places (primarily near sand deposits), it is thinly mantled by silt, sand, or gravel. Where the unit lies below a former paleoshoreline, smoothing of the land surface is due to the wave action in former glacial lakes. In places, smoothing was the result of fluvial activity, as interpreted by the position of the unit along a former stream course. The sand mantle has an eolian origin in places.

Qrc **Complex of till and ice-contact deposits**—Till less than 20 feet (6 meters) thick over sand to cobbly gravel, with patches of sand and gravel at the surface in many places. Till characteristics are similar to unit Qrt.

PREGLACIAL DEPOSITS

EA **Paleoproterozoic and Neoarchean bedrock**—Area of numerous bedrock outcrops.

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AGGREGATE RESOURCE POTENTIAL OF ITASCA COUNTY, MINNESOTA