UNIVERSITY OF MINNESOTA

MINNESOTA GEOLOGICAL SURVEY
Harvey Thorleifson, Director

SUPPORTED IN PART BY THE MINERALS DIVERSIFICATION PROGRAM AS ADMINISTERED BY THE MINERALS COORDINATING COMMITTEE FOR THE MINNESOTA LEGISLATURE, THE ITASCA COUNTY BOARD OF COMMISSIONERS, AND THE MINNESOTA DEPARTMENT OF NATURAL RESOURCES, DIVISION OF LANDS AND MINERALS

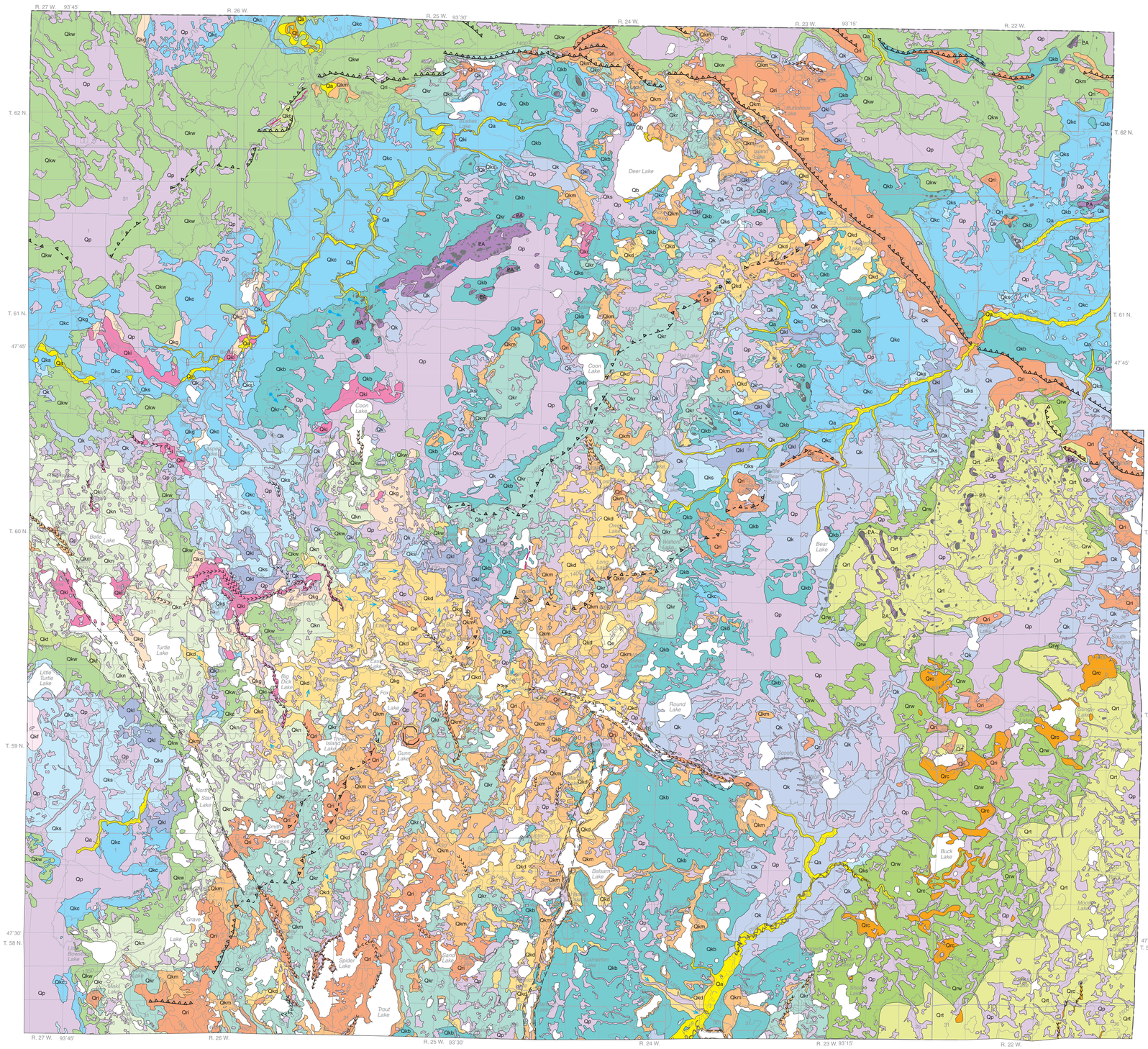
MISCELLANEOUS MAP SERIES
MAP M-131
Plate 3—Surficial Geology, Northeast

SURFICIAL GEOLOGY OF NORTHEAST ITASCA COUNTY

By

Gary N. Meyer 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

SCALE 1:100 000

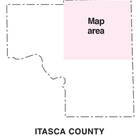
1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 8 KILOMETERS

CONTOUR INTERVAL 50 FEET

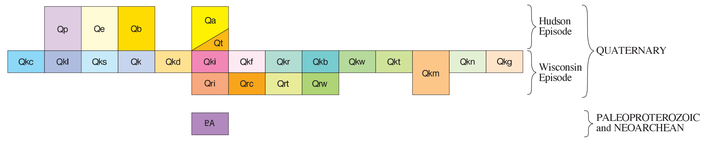
GIS compilation and cartography by
Joyce Meints and R.S. Lively
Edited by Lori Robinson

LOCATION DIAGRAM



ITASCA COUNTY

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.

Former position of glacial ice margin—Barbs on up-ice side. Interpreted from the position of outwash, moraine, and ice-contact landforms.

Inferred

Speculative

Esker or esker-like ridge—Sinuous ridge of interbedded sand, gravel, and silt; interpreted to have been deposited in an ice-walled channel or tunnel of a glacial meltwater stream. Deposited by meltwater of both the Koochiching and Rainy lobes; drainage was generally to the south and east within the lobes. 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.

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. Low areas are commonly filled by lakes.

Ice-walled lake plain—Line marks the rim of an elevated plateau of lake sediment interpreted as the deposits of a former lake once walled by glacial ice.

Glacial striation measurement—Shows direction of ice flow.

Paleoproterozoic and Neoarchean bedrock outcrop.

DESCRIPTION OF MAP UNITS

POSTGLACIAL DEPOSITS (Hudson Episode)

Qe — **Eolian sand**—Fine-grained sand more than 5 feet (1.5 meters) thick that forms low-lying barchan dunes and sheet-sand deposits that display shallow depressions or blowouts. Interpreted to be windblown sand.

Qb — **Beach sediment**—Sand and gravelly sand in low-rising terraces along the shores of modern lakes. Deposits are too narrow to map at this scale except near Deer Lake. 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.

Qt — **Terrace sediment**—Sand and gravelly sand above the modern floodplain of the Big Fork River but located lower than the glacial-lake plain. Interpreted as representing the former level of the floodplain of the Big Fork River. The river has incised more deeply as the local base water level has dropped over time. At this scale, the unit is mapped only in the northern part of the county near T. 62 N., R. 26 W., sec. 1.

DEPOSITS ASSOCIATED WITH THE KOOCHICHING LOBE (Wisconsin Episode)

—Detritus of Cretaceous shale and Paleozoic carbonate is rare to common and is used to distinguish these deposits from those of ice lobes that have a different source area. The flat terrain in the northeast and northwest parts of the map area is part of the former lake bottom of Glacial Lake Koochiching (Hobbs, 1983; Meyer, 1993). The highest level of this lake was about 1,410 feet (430 meters) above mean sea level. The flat terrain in the southwest and elsewhere across the map area is the bottom of former lakes that attained a similar level to, and may have been connected with, Glacial Lake Koochiching.

Qk — **Lacustrine sand and gravelly sand**—Fine-grained sand to sand and gravel; unit is generally near the former lake margin, as identified by the elevation of paleoshoreline, which is interpreted from a variety of geomorphic and textural features within and beyond the current study area; also present are recognizable landforms like beaches and bars. In places, the unit probably originated by wave reworking of coarse-grained, pre-existing deposits, rather than by original deposition by the lake in this setting. Unit generally coarsens upward, with gravel most common at the highest elevations. Mapped where more than 5 feet (1.5 meters) thick over till or intervening finer-grained lake sediment. Gradational with deltaic sediment. Where fine-grained sand is at the surface, the upper few feet may have an eolian origin.

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, 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 snakelike ridges of former subglacial meltwater streams (eskers), fan-shaped landforms 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 clay to loam textured sediment (diamicton) with incorporated pebbles, cobbles, and boulders; mapped in areas where a more hummocky surface 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 clay to clay loam textured; rare to uncommon pebbles, cobbles, and boulders; massive; contains few lenses of bedded sediment. In places, the till is difficult to distinguish from clay because it consists primarily of reworked lake sediment. Deposited by ice of the Koochiching lobe. Generally finer-grained and more massive than the stagnation till (Qkn); the unit also shows less relief and fewer closed depressions.

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 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 clay loam, but in general is more sandy with depth. This unit commonly contains more large clasts and is more compact than till of units Qkt and Qkn. Clasts of Paleozoic carbonate are generally uncommon, especially with depth, and Cretaceous shale is absent to rare.

Qkb — **Water-washed till over Rainy lobe deposits**—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. Sandy lacustrine or fluvial Koochiching-lobe deposits are present at the surface in places.

DEPOSITS ASSOCIATED WITH THE RAINY LOBE (Wisconsin Episode)

—Clasts are primarily derived from Precambrian rock types. Detritus of Cretaceous shale is absent and that of Paleozoic carbonate is rare.

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 and patchy lake sediment and Koochiching-lobe till west of the Bear and Prairie Rivers, and by thin and patchy Rainy-lobe till east of the two rivers.

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.

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 may have 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

PA — **Paleoproterozoic and Neoarchean bedrock**—Complex of Quaternary sediment and bedrock. Thin Quaternary sediment, primarily till, over bedrock.

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AGGREGATE RESOURCE POTENTIAL OF ITASCA COUNTY, MINNESOTA