Surficial Geology of the Orangeville 7.5 Minute Quadrangle, Allegan and Barry Counties, Michigan

Michigan Geological Survey - Western Michigan University
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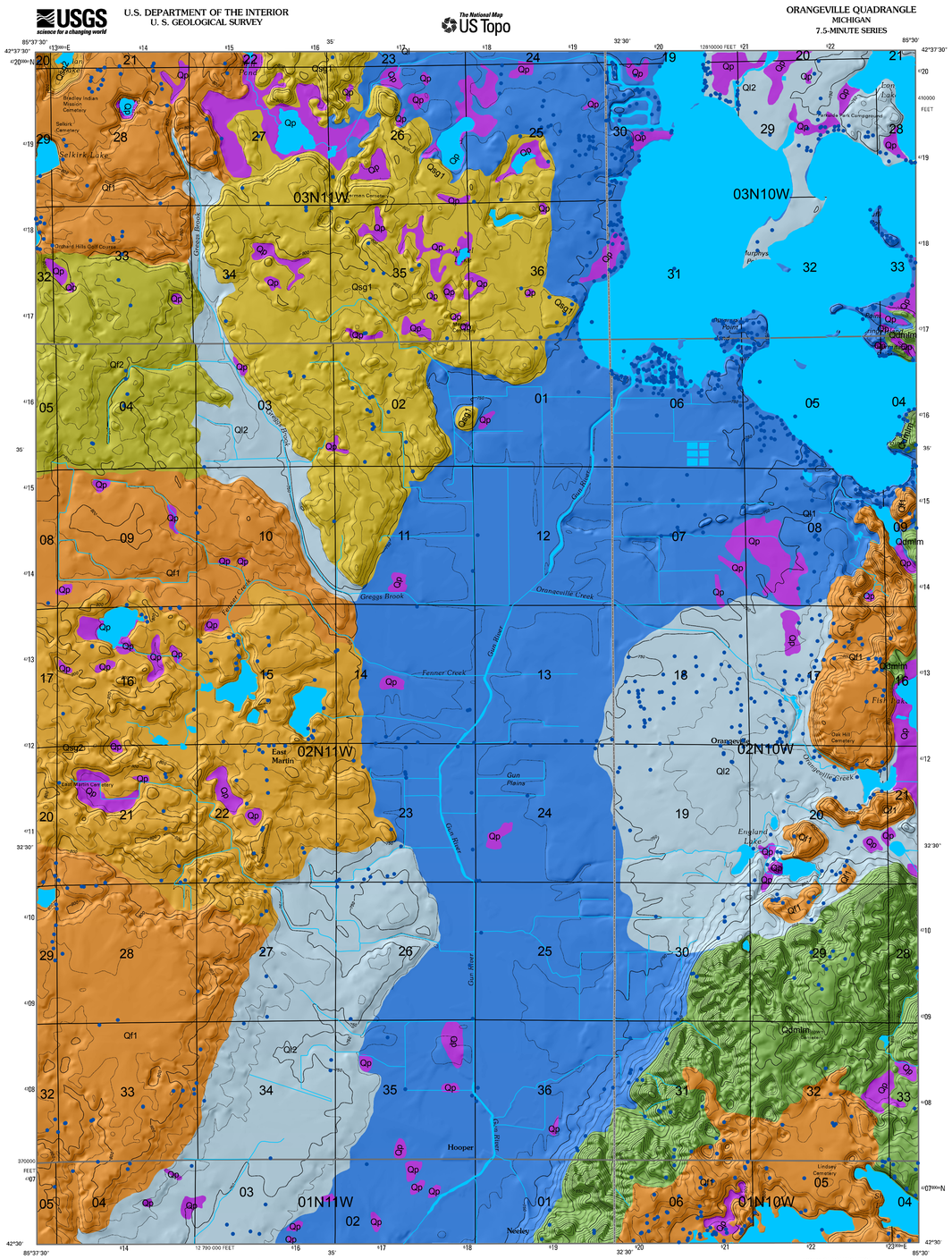

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Topography compiled by United States Geological Survey (USGS). Geology based on field work by Alan E. Kehew and John M. Esch. Map compilation and digital cartography by Sita Karki, Michigan Geological Survey, Western Michigan University.

All map data reprojected to Michigan GeoRef.
North American Datum of 1983 (NAD 83)
Projection: Oblique Mercator in meters

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Description of Map Units

Qdmlm — Hummocky to rolling upland surface, moderate to high relief; Surficial sediment mainly sandy diamicton (till) with boulders but in places may consist of poorly sorted sand and gravel. Low positions on landscape underlain by bedded sand, sand, silt, clay or peat deposited by slopewash or in supraglacial or post-glacial lakes or ponds. Unit is transitional to Ql1 and Qp. End moraine of the Lake Michigan Lobe.

Qf1 — Glaciofluvial fan. Bedded sand and gravel on depositional surface sloping away from moraine. Surface generally smooth and gently sloping. Depositional environment may be subaerial or subaqueous.

Qf2 — Till-capped fan. Bedded sand and gravel on hummocky surface. Mostly capped by several meters of diamicton. Primary depositional surface altered by melting of buried ice.

Ql — Low relief terrain at center of the Gun Plain. Sediment consists of thin (1-2 m) unit of bedded sand and silt overlying glaciofluvial sand and gravel. Glaciolacustrine unit overlying glaciofluvial unit.

Ql1 — Bedded sand and silt occurring in terraces adjacent to Ql1 or in small to medium size, flat-lying lowlands within unit Qdmlm. Sand well sorted. May contain areas of Qal.

Ql2 — Isolated, poorly drained depressions containing peat and muck of Holocene age. May be underlain by bedded sand and gravel or bedded silt and clay.

Qp — Bedded sand gravel, undifferentiated; lacks kettles and collapse features; outwash and/or glaciolacustrine sediment. Not associated with distinct source on moraine. May contain small areas of Qdlm.

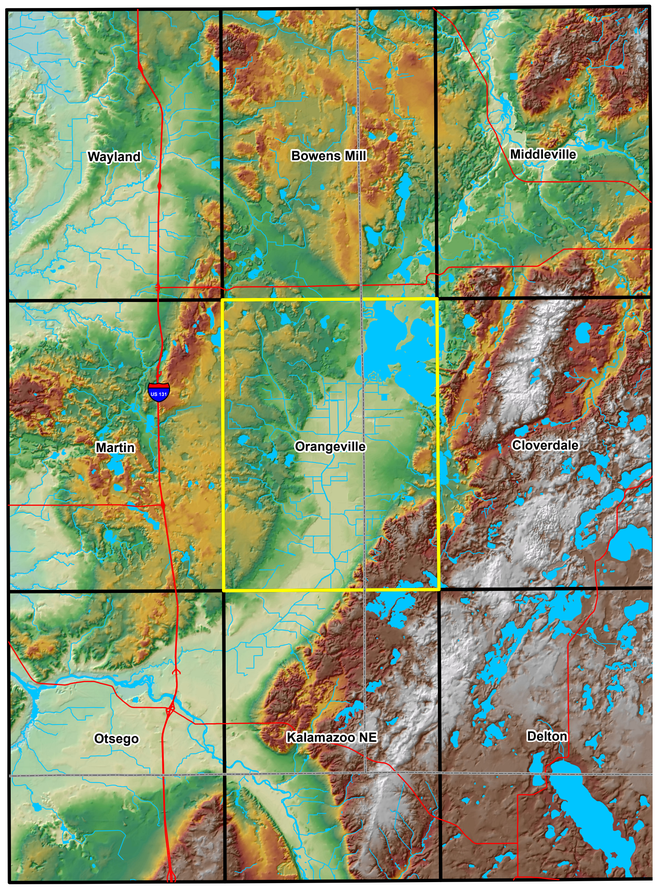
Qsg1 — Bedded sand and gravel with hummocky surface formed by collapse of buried ice blocks or deposition on stagnant ice; outwash.. Not associated with distinct source on moraine.

Qsg2

Legend

- WaterWells
- Counties
- Township Range
- Sections
- Contour Lines
- Lakes
- Streams

Quad Elevation

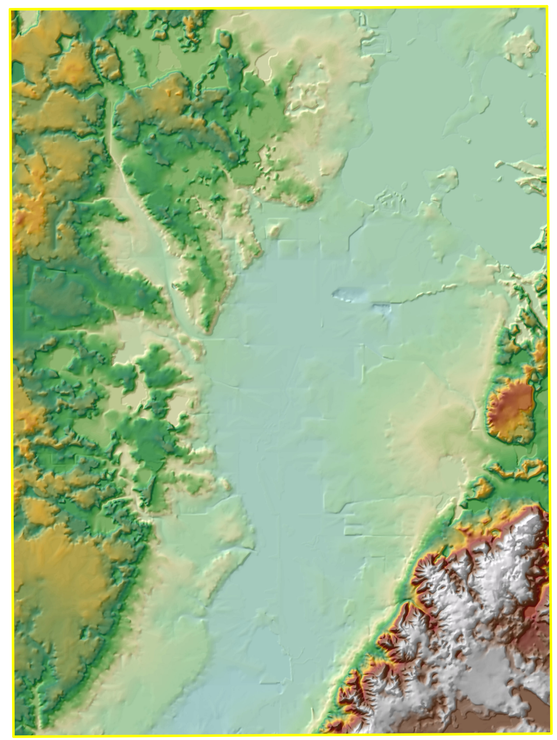


Regional Elevation (Feet-amsl.)
1135
665

0 1 2 4 Miles
0 2 4 8 Kilometers

Orangeville 7.5 Minutes Quadrangle
Regional 7.5 Minutes Quadrangles

Regional Elevation



Elevation (Feet-amsl.)
982
725

0 0.5 1 2 Miles
0 1 2 4 Kilometers

DISCUSSION

The Orangeville Quadrangle, which was mapped as part of the larger Barry County project area, is underlain by unconsolidated deposits of glacial and post-glacial origin from the Lake Michigan Lobe (Leverett and Taylor 1915) of the Laurentide Ice Sheet. The sediments include diamicton (till), sand and gravel and interbedded silt and clay. Till is a characteristic type of glacial deposit that is unsorted and has a range of grain sizes from clay to boulders. The glacial deposits are late Wisconsinan (~30,000 to 10,000 yr before present) in age though some deeply buried deposits may be middle Wisconsinan or older (Winters and Rieck 1982). The thickness of glacial deposits typically ranges between 0-400 ft (0-120 m).

The most prominent glacial landforms in the Orangeville Quadrangle are uplands associated with the Valparaiso Moraine, a broad, north-south trending lowland that experienced glacial meltwater flow and ice-marginal lake conditions, and a broad upland mapped as the Kalamazoo Moraine of the Lake Michigan Lobe (Leverett and Taylor, 1915). Although the Kalamazoo Moraine is traditionally attributed to the Lake Michigan Lobe, the topography in this quadrangle and the Cloverdale Quadrangle to the east, also resemble the topography of the Saginaw Lobe in this region. It is possible that this upland is in fact a composite or interlobate feature formed by the advance of one lobe over the deposits of another lobe.

With the exception of the Kalamazoo Moraine in the eastern part of the quadrangle, most of the other deposits are composed of sand and gravel either at the surface or at depth. In the western part of the quad, the uplands are mostly outwash deposits associated with the Valparaiso Moraine, which continues west of the quad. Some of these deposits occur in fans which contain sand and gravel at the surface or beneath a thin cover of diamicton (till). The broad "Gun Plain" lowland in the center of the quadrangle has a complex glacial history. At some point large quantities of meltwater flowed between the ice margin to the west and the Kalamazoo Moraine to the east. These flows downcut the lowland to its present elevation. The coarser sand and gravel deposits in the lowland are overlain by bedded silt and clay in other place, indicating that water was ponded in a shallow proglacial lake following meltwater drainage.

The upland mapped as the Kalamazoo Moraine is characterized by high-relief, hummocky topography that indicates deposition on stagnant glacial ice covered by thick debris that accumulated on top of the ice. The diamicton that is present at the surface is typically very sandy and may be underlain by sand and gravel. Not much is known about the deeper stratigraphy of the glacial deposits within the moraine in this location.

The exact ages of the glacial deposits have not been determined in the study area but are correlated to dated features elsewhere. The Kalamazoo Moraine was probably formed about 15,000 14C years ago. Studies of tunnel valleys observed in the Saginaw lobe (Kehew et al. 1999, 2005) to the east in Barry County indicate that the Saginaw and Lake Michigan Lobes were not synchronous in the timing of their advances and retreats. The orientation of tunnel valleys is generally perpendicular to the ice margin (Clayton et al. 1999). Kehew et al. (1999, 2005) found morainal deposits and outwash fans within the Lake Michigan Lobe portion of the Kalamazoo Moraine that were deposited across northeast-southwest trending Saginaw Lobe tunnel valleys. This relationship indicates that the Saginaw Lobe tunnel valleys formed first and were filled with ice and debris during retreat of the lobe. The Lake Michigan Lobe then advanced over these buried tunnel valleys and deposited till and outwash. The modern valleys formed by collapse as the buried ice gradually melted out, which could have taken hundreds or even thousands of years. This collapse process produced extremely undulating tunnel valley floors, which is why they often contain chains of lakes rather than streams. Further information about the Saginaw Lobe tunnel valleys is available in Kehew and Kozlowski (2007) and Kehew et al. (2012a, b).

MAP PREPRARATION PROCEDUERES

Surficial geologic maps are produced by field investigation of surficial materials observed in natural exposures, road and stream cuts, building and construction excavations, shallow hand-augered borings, and small pits dug by the investigators. Depth of investigation is generally around 5 feet except in areas of greater exposure like deep cuts and gravel pits. In addition aerial photographs, topographic maps, digital elevation models (DEMs), county soil surveys, existing geologic maps, reports, and the geologic literature for the area are reviewed. Subsurface information concerning the thickness, extent, and stratigraphic position of surficial geologic units was obtained to the extent possible by reviewing digital well log data from the MDEQ Water Bureau Wellogic and historical scanned water-well log databases. Geologic cross-sections are created from the digital water well data and a representative cross-section is shown on the map. For mapping projects in areas of thick glacial drift, logs from oil and gas test well are reviewed.

USES OF SURFICIAL GEOLOGY MAPS

A surficial geology map shows the geological materials such as diamicton or till (commonly called hardpan), sand and gravel, or clay found within 5 feet of the ground surface. In many cases these surface units extend to much greater depths. Most of the surficial materials are deposits formed by glacial and deglacial processes during the last stage of continental glaciation, which began about 30,000 years ago. The remainder of the surficial deposits include the products of postglacial geologic processes, such as river floodplains, swamps or wetlands (Qp), or are attributed to human activity, such as fill or other land-modifying features.

The map shows the areal distribution of the different types of glacial deposits and landforms as described in the map explanation. Features such as drumlins and moraines can be used to reconstruct the movement and position of the glacier and its margin, especially as the ice sheet melted. Other ancient features include shorelines and deposits of glacial lakes, now long gone from the state. This glacial geologic history of the quadrangle is useful to the larger understanding of past earth climates, and how our region of the world underwent recent geologically significant climatic and environmental changes. We may then be able to use this knowledge in anticipation of future similar changes for long-term planning efforts, such as land use planning or waste disposal.

Surficial geology maps can assist anyone wanting to know what lies beneath the land surface. For example, these maps may aid in the search for water supplies, or economically important deposits such as sand and gravel for aggregate or clay for bricks or clay tile. The maps, along with water-well logs can provide and indication as to whether an aquifer at depth is connected to a surface stream. This information is critically important in assessing whether or not a water well near a stream could cause an excessive depletion of surface water. Foundation conditions determined by the surficial geological materials are critical inputs to any type of development. Environmental issues such as the location of a suitable landfill site or the possible spread of contaminants are directly related to surficial geology. Construction projects such as locating new roads, excavating foundations, or siting new homes may be better planned with a good knowledge of the surficial geology of the site. Once a surficial geologic map is constructed, it can be used for a variety of derivative maps, such as aquifer thickness and extent, range of transmissivity values, sensitivity to surface and near surface derived contaminants and reserves of sand and gravel.

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