Surficial Geologic Map of the Arrowsmith 7.5 Minute Quadrangle in McLean County, Illinois

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Abstract

A surficial geologic map of the Arrowsmith 7.5' Quadrangle was constructed, spanning from 40° 22' 30" to 40° 30' north latitude and 88° 45' to 88° 37' 30" west longitude. Sediment unit parent materials were identified using McLean County Soil Survey data, they were then grouped together to create formation boundaries. Thickness of major units was determined using water well data, and only considered present at the surface if greater than 2 meters in thickness. Quaternary sediment units deposited during the Woodfordian glacial advance and modern stream alluvium dominate the surficial geology. Quaternary units reach over 100 meters in thickness where they overlie buried bedrock valleys. Major quaternary mapping units include the Wedron Group, the Henry Formation, the Peoria Formation, and the Cahokia Alluvium. The Wedron Group includes the Tiskilwa till and Lemont Formation, which consist of diamicton units that are interbedded with proglacial river and lake sediments. The Lemont Formation is grey in color and exists to the north of the Bloomington Moraine, while the Tiskilwa Till is pink in color and lies to the south of the Bloomington Moraine. The Henry Formation is prominent in the eastern and southwestern portions of the map (up to 10 meters thick) and consists of sand and gravel that was deposited in glacial rivers and outwash fans. The Peoria Formation (up to 3 meters thick) forms the top layer in much of the southern half of the mapping area and consists of fine-grained yellow silt/clay and is interpreted as loess deposits. The Cahokia Alluvium (less than 5 meters thick) is made up of modern river deposits of sand, gravel and silt. A traditional field check was later conducted to ensure that contacts were properly placed. Cross sections were also constructed by subsurface correlation of water well records.

Methodology

Data was collected from the Illinois State Geological Survey upon which various data analysis techniques were used. McLean County soil polygon data was used to separate and group geologic unit boundaries based on parent material identified in the McLean County Soil Survey (figure 1). Well log data from the ISGS was used both in conjunction with soil polygon to obtain surficial geologic unit boundaries, and to develop subsurface interpretations. The geologic unit groupings were placed into GIS to be further analyzed with high resolution Digital Elevation Model (DEM) created from LIDAR data and retrieved from the ISGS. DEM data is useful for visualizing and understanding glacial morphology, and was analyzed in great detail to solidify geologic unit boundaries. The Earth Systems Visualization Laboratory at the University of Illinois in Champaign-Urbana was used to further analyze DEM data with 3-D visualization (figures 4 and 5). Field checks were later completed along various river and stream crossings and cut banks (figure 2). Land surface, subsurface, and aerial perspectives obtained in the VisLab allowed for conclusions to be made for regions that were inaccessible for field checks.

References

- Willman, H.B., and J.C. Frye, 1970, Pleistocene Stratigraphy of Illinois: Illinois State Geological Survey Bulletin 94, 204p.
- Kolata, D. R., and Nimz, C. K., 2010, Geology of Illinois: Illinois State Geological Survey, pgs 216-258.
- Hansel, A. K., Johnson, W. H., 1996, Wedron and Mason Groups: Lithostratigraphic Reclassification of Deposits of the Wisconsin Episode, Lake Michigan Lobe Area.

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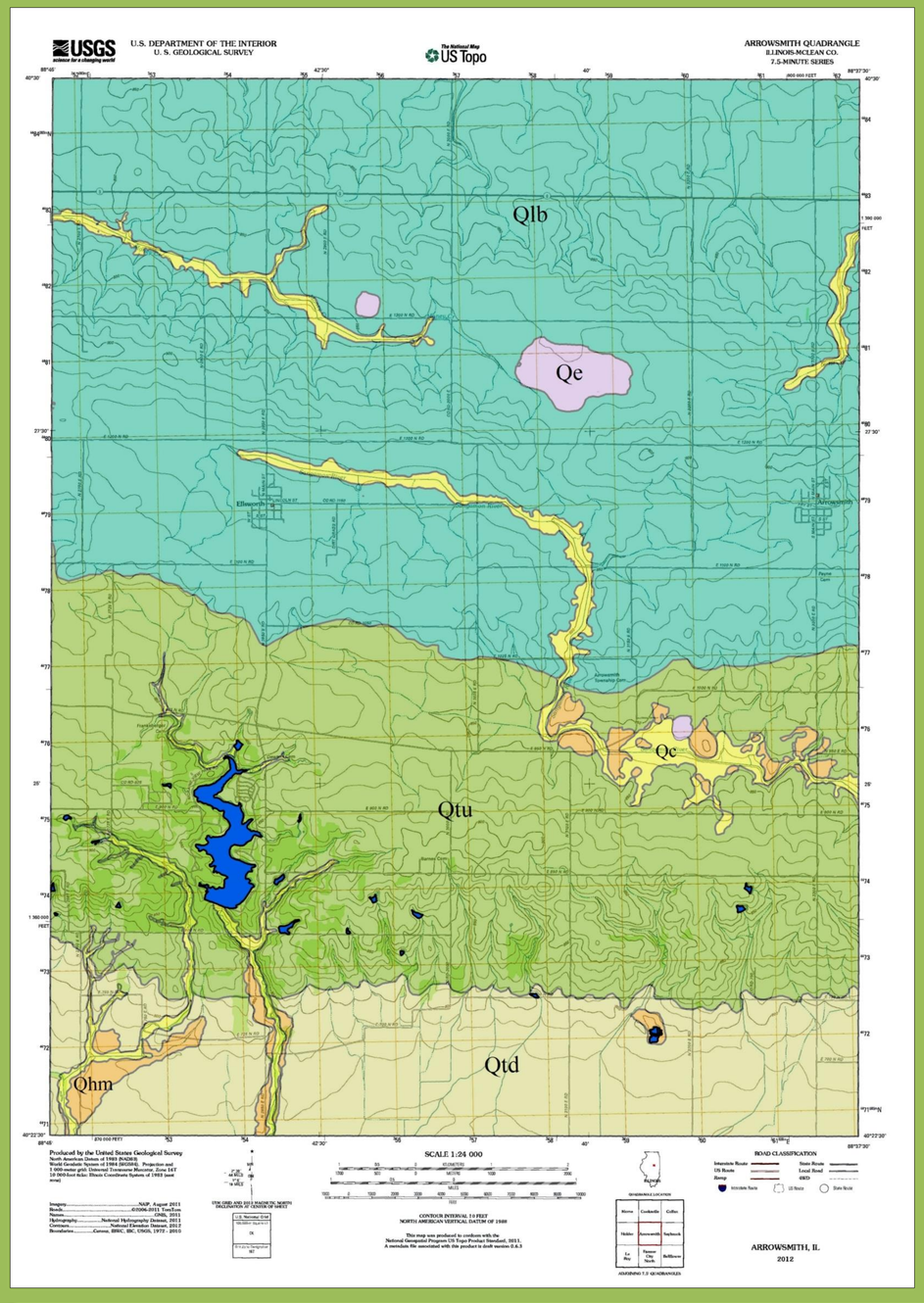

Figure 1: Unit groupings created from soils data before edits (colors different than final map).

Figure 2: Contact between Tiskilwa (Delavan Member) Formation and Peoria Loess above.
*note: loess cover less than two meters and therefore not mappable.

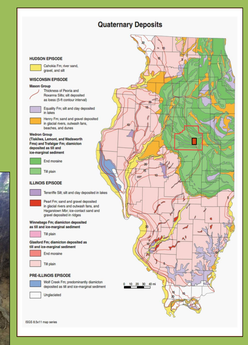

Figure 5: Quaternary deposits throughout Illinois are shown. Extent of the Wisconsin Episode shown in green. McLean County is outlined in red, mapping area shown in solid red.

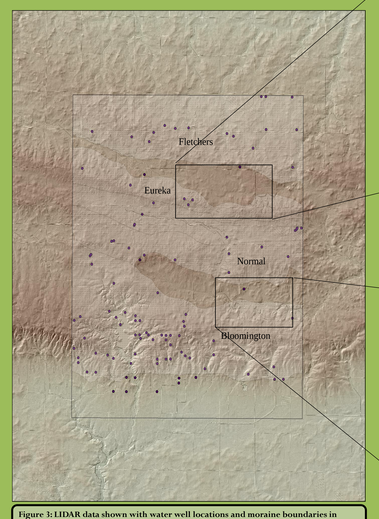

Figure 3: LIDAR data shown with water well locations and moraine boundaries in white.

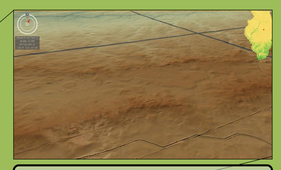

Figure 4: 3-D imagery of ice walled lake deposits (mapped as Equality). Notice flat plateau-like morphology.

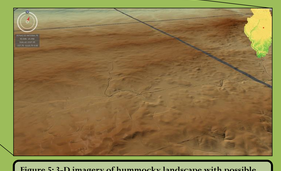

Figure 5: 3-D imagery of hummocky landscape with possible ice walled lake in center view.

Descriptions

Qc — Cahokia Formation: Bedded silts, clays, and sand and gravel deposited in floodplains and channels of modern rivers and streams.

Qe — Equality Formation: Consists predominantly of brown/gray to bedded red silt and clay that is similar in lithology to the silt and clay sized fractions of diamicton units of the Wedron Group. Isolated stones and lenses of gravel, sand, diamicton, organic debris, and wood are locally present in the silt and clay. Bedding ranges from laminae to massive beds that locally contain isolated stones but exhibit little bedding.

Qhm — Henry Formation (Mackinaw facies): Stratified sand and gravel that is similar in lithology to the sand and gravel fractions of the Wedron Group. Lenses of silt, clay, organic debris, wood, and shells exist locally in the sand and gravel. Dominant gravel lithology is Paleozoic carbonate, Paleozoic sandstone, and igneous and metamorphic rock. Lateral and vertical variation is present in grain size, sorting, and bedding of deposits within the formation.

Qlb — Lemont Formation (Batestown Member): Calcareous, gray, medium textured diamicton that contains lenses of gravel, sand, silt, and clay. Oxidizes to brown, olive brown, or yellow brown. In the Peoria and Decatur Sublobe areas, diamicton of the Batestown Member is finer and texturally similar to diamicton of the Yorkville Member to the north.

Qtu — Tiskilwa Formation (Undivided): Calcareous red to gray medium texture (loam) diamicton that contains lenses of gravel, sand, silt, and clay. Oxidizes to red brown, brown, or yellow brown.

Qtd — Tiskilwa Formation (Delavan Member): Calcareous, brown/gray to pink loam diamicton that contains lenses of gravel, sand, silt, and clay. Diamicton oxidizes to brown, tan, yellow brown, or red brown.

Discussion

Based on flat irregular morphological features consisting of fine grained sediments, there are three possible glacial lake deposits that are represented as Equality Formation. These deposits occur in between moraines, where dead ice was trapping meltwater and depositing fine grained clays and silts on top of till and outwash. They are morphologically unique from the other landforms that occur in the mapping area and are seen as plateau-like features in the DEM data (figure 4). Hummocky landscape dominates the areas between moraines, and is most likely caused by sub glacial flow patterns (figure 5). Many of these features have similar morphology as eskers and kames, but have very little relief and the well data does not show enough conclusive evidence to support this hypothesis. The hummocky landscape is therefore interpreted as drained till. Flat step-like features that border stream and river floodplains are interpreted as outwash terraces and are represented by the Mackinaw facies of the Henry Formation. There are prominent outwash deposits in the southwestern portion of the map, where meltwater was flowing off of the retreating ice to the north and depositing outwash. Henry Formation in this region is also commonly deposited as alluvial fan and plain deposits and is represented by the Batavia facies, but these deposits were not identified in the mapping area.

Results

Surficial geology of the Arrowsmith quadrangle consists mainly of Cahokia Formation, Equality Formation, Henry Formation, Lemont Formation, and Tiskilwa Formation; all of which are Quaternary in age. Older Illinoisan glacial units and Pennsylvanian bedrock exist in the subsurface. The Cahokia Formation is Holocene in age and consists of bedded alluvial deposits ranging in grain size from clay to gravel in floodplains and river channels. The Equality Formation (Mason Group) consists of brown-red silt and clay with lenses of gravel, sand, diamicton, organic debris and wood. Equality Formation is interpreted as slack water, glacial, and postglacial lake deposits. The Henry Formation is represented by the Mackinaw facies in the mapping area and consists of stratified sand and gravel with lenses of silt, clay, organic debris, wood and shells. Mackinaw deposits are interpreted as valley train outwash forming terraces. The Lemont Formation (Batestown Member) consists of calcareous gray diamicton with lenses of gravel, sand, silt, and clay and is interpreted as till deposits from the retreating glaciers during the Wisconsinan glacial episode. The Lemont Formation exists on and to the north of the Normal moraine. The Tiskilwa Formation (undivided) consists of calcareous gray diamicton with lenses of gravel, sand, silt and clay, much like the Batestown, and is interpreted as till deposits. Tiskilwa Undivided exists south of the Normal moraine and makes up the adjacent Bloomington moraine. The Delevan Member of the Tiskilwa Formation has similar texture to the above formations but is more pink in color and exists south of the Bloomington moraine.

*Thin Loess cover (Peoria Silt) dominates the landscape, but does not reach thickness of 2 meters in the mapping area and is therefore excluded (see figure 2).