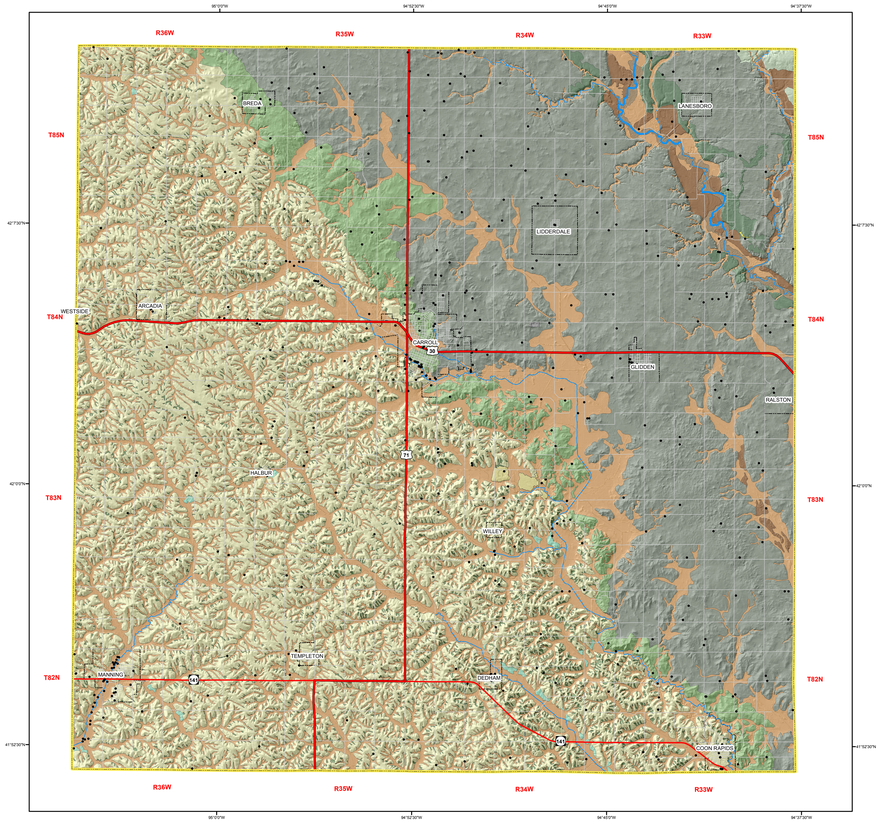
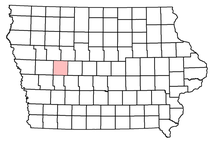
Surficial Geology of Carroll County, Iowa



Map Location



1:100,000

0 1 2 4 6 8 Miles

0 1 2 4 6 8 Kilometers

Base map from Iowa DOT Road Map Layers 2009. Shaded relief from Iowa Lidar Project 2007-2011.

Carroll_SFGeology.mxd, version 9/24/13 (ArcGIS 10.1)
Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15, datum NAD83.

The map is based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site specific studies.

LEGEND

CENOZOIC

QUATERNARY SYSYTEM

HUDSON EPISODE

Qc - Depressions (DeForest Formation-Woden Mbr.) - Generally 2.5 to 6 m (8-20 ft) of black to very dark gray, calcareous, muck, peat and silty clay loam colluvium and organic sediments in drained and undrained closed and semi-closed depressions. Overlies gray, calcareous, loam diamicton (Dows Fm.-Morgan/Alden Mbr.) or Noah Creek Fm. sand and gravel. Associated with low relief features that occupy depressions and low sags on the landscape. Supports wetland vegetation and can be permanently covered by water. High water table.

Qal - Alluvium (DeForest Formation-Undifferentiated) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous to calcareous, stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hill slopes and in closed depressions. May overlie Prelllinois glacial till of the Wolf Creek or Alburnett formations or Pre-Holocene fine-grained alluvium. On the Des Moines Lobe may overlie Dows Formation (Morgan or Alden Mbrs.) or Noah Creek Fm. sand and gravel. Associated with low-relief modern floodplain, closed depressions, modern drainageways or toeslope positions on the landscape. Unit also includes colluvial deposits derived from adjacent map units. Seasonal high water table and potential for frequent flooding.

Qalt – River Channel Belt – Low Terrace (DeForest Formation-Camp Creek Mbr. and Roberts Creek Mbr.). Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous, stratified silty clay loam, loam, or clay loam, associated with the modern channel belt of the North Raccoon River Valley. May overlie Dows Formation (Morgan or Alden Mbrs.) or Noah Creek Fm. sand and gravel. Occupies lowest position on the floodplain ie modern and historic channel belts. Ox-bow lakes and meander scars are common features associated with this terrace level. Mapped primarily using aerial imagery and county soil survey data. Seasonal high water table and frequent flooding potential.

HUDSON AND WISCONSIN EPISODE

Qc - Sand Dunes and Sand Sheets (Peoria Formation-sand facies) - Generally less than 3 m (10 ft) of yellowish brown, massive,calcareous loamy sand to fine sand. It may overlie yellowish-brown coarse-grained sand and gravel (Noah Creek Fm.), or it may overlie yellowish to grayish brown, usually calcareous, stratified loam to silt loam to sandy loam diamicton (Dows Fm.-Morgan Mbr.). Usually restricted to a narrow belt along major river valley bottoms or adjacent uplands on the Des Moines Lobe.

WISCONSIN EPISODE

Qpt- Loess Mantled Terrace (Peoria Formation –silt and/or sand facies) 2 to 9 m (7-30 ft) of yellowish brown to gray, massive, jointed, calcareous or noncalcareous, silt loam and intercalated fine to medium, well sorted, sand. May grade downward to poorly to moderately well sorted, moderately to well stratified, coarse to fine feldspathic quartz sand, loam, or silt loam alluvium (Late Phase High Terrace) or may overlie a Farmdale Geosol developed in Roxanna Silt which in turn overlies a well-expressed Sangamon Geosol developed in poorly to moderately well sorted, moderately to well stratified, coarse to fine sand, loam, or silt loam alluvium (Early Phase High Terrace)

Qps – Loess (Peoria Formation—silt facies) Generally 3 to 9 m (10-30 ft) of yellowish to grayish brown, massive, jointed calcareous or noncalcareous silt loam to silty clay loam. Deposits are thickest in the western portion of the county and thin to the east. Limited areas of fine eolian sand may be present near major river valleys. Overlies a grayish brown to olive gray silty clay loam to silty clay (Pisgah Formation—eroded Farmdale Geosol) which is less than 1.5 m (5 ft) thick. The Farmdale may be welded to an older Sangamon Geosol developed in loamy glacial till of the Wolf Creek or Alburnett formations. This mapping unit encompasses upland divides, ridgetops and convex sideslopes. Well to somewhat poorly drained landscape.

Qoch - Valley train outwash (Noah Creek Formation) Generally 3 to 9 m (10-30 ft) of dark gray, dark grayish brown, dark brown to dark yellowish brown medium to coarse sand, gravelly sand to pebbly gravel. Overlies gray, calcareous, massive, dense loam diamicton (Dows Fm-Alden Mbr.). In valley positions, it is at the land surface of older terraces. On the modern floodplain it is buried by DeForest Fm. alluvium. Low-relief landforms expressed as broad terraces; long, narrow longitudinal terraces or cuspate-shaped point terraces. Terraces associated with the major valleys are benched on a gray, calcareous, massive, dense loam diamicton (Dows Fm-Alden Mbr.). **Qow- In** areas of the county, beyond the extent of the Des Moines Lobe landform this unit is benched on Pre-Illinoian glacial till of the Wolf Creek or Alburnett formations diamicton. This unit encompasses deposits that accumulated in stream valleys during the Wisconsin Episode. No flooding potential.

Qsgc- Supraglacial complex (Dows Formation-Pilot Knob Mbr./ Morgan Mbr.) Generally 3 to 9 m (10-30 ft) of yellowish brown, often calcareous and fractured, stratified sand and gravel with interbedded stratified loam diamicton. Collapse features are usually evident. In depressions and sags on upland surfaces, the sand and gravel may be buried by DeForest Fm.-Woden Mbr. Overlies gray, calcareous, massive, dense loam diamicton (Dows Fm.– Alden Mbr.) Moderate to high relief (3 to 9 m) hummocks, beaded ridges, elongated hummocks, kames and associated linked drainages on upland surfaces.

Qtr_am1 - Till ridge (Dows Formation-Morgan Mbr. or Pilot Knob Mbr.) Generally 9 to 15 meters (27 to 49 ft) of yellowish to grayish brown, usually calcareous and fractured, stratified loam to silt loam; stratified sands and gravels to sandy loam diamicton; textures can be quite variable. Overlies gray, calcareous, massive, dense loam diamicton (Dows Fm.-Alden Mbr.) The Alden Mbr. in this mapping unit can extend to depths in excess of 25 meters (85 ft). This sediment package overlies Prelllinois glacial till of the Wolf Creek or Alburnett formations. Moderate to high relief hummocky landform features exceed 3 to 10 meters (10 to 33 ft) of local relief. This landform is characterized by moderate to high relief hummocks, esker and kame features, and ice-walled lakes; and is associated with the Altamont Moraine Complex. Seasonal high water table.

Qtr_bm - Till ridge (Dows Formation-Morgan Mbr.) Generally 3 to 5 meters (10-16 ft) of yellowish to grayish brown, usually calcareous and fractured, stratified loam to silt loam; stratified sands and gravels to sandy loam diamicton; textures can be quite variable. Overlies gray, calcareous, massive, dense loam diamicton (Dows Fm.-Alden Mbr.) The Alden Mbr. in this mapping unit rarely extends to depths greater than 12 to 25 meters (40-85 ft); and overlies the Prelllinois glacial till of the Wolf Creek or Alburnett formation diamictons. At the DML margin, this landform may be mantled with a thin layer of Peoria Formation silt. Low to moderate relief hummocky landform features exceed 3 to 5 meters of local relief. This landform is associated with the Bemis Moraine. The surface pattern is irregularly shaped patterns. Seasonal high water table.

Qtp_bm- Till plain (Dows Formation-Morgan Mbr.) Less than 9 m (30 ft) of yellowish brown, often calcareous and fractured, stratified loam to silt loam to sandy loam diamicton; textures can be quite variable. Overlies gray, calcareous, massive, dense loam diamicton (Dows Fm.- Alden Mbr.). Low to moderate relief (3 to 8 m), undulating plains with irregular surface patterns. **Qsgclp-Aligned hummocky ridge forms** (Dows Formation-Pilot Knob Mbr./ Morgan Mbr.) These ridge forms are commonly found on the Bemis till plain. Ridge forms are greater than 4 m(13 ft) and less than 10 m (33 ft) of yellowish brown, often calcareous and fractured, stratified sand and gravel with interbedded stratified loam diamicton or yellowish to grayish brown, often calcareous and fractured, stratified loam to silt loam to sandy loam diamicton; textures can be quite variable. In depressions and sags on upland surfaces, the sand and gravel may be buried by DeForest Fm.-Woden Mbr. Overlies gray, calcareous, massive, dense loam diamicton (Dows Fm.- Alden Mbr.). Faint to well-defined aligned or elongated hummocks oriented transverse to glacier flow are inset on till plain. Hummocky ridges are moderate to high relief features (3 to 8+ m). Occasionally, these hummocks consist primarily of sand and gravel and exhibit evidence of syndepositional collapse (Pilot Knob Mbr.). Overall landform can be hummocky or swell and swale topography. Seasonal high water table.

PRE-ILLINOIS EPISODE

Qwa3 – Till (Wolf Creek or Alburnett Formations) Generally 15 to 152 m (50-500 ft) of very dense, massive, fractured, loamy glacial till of the Wolf Creek or Alburnett formations with or without a thin loess mantle (Peoria Formation—less than 2 m) and intervening clayey Farmdale/Sangamon Geosol. This mapping unit encompasses narrowly dissected interfluves and side slopes, and side valley slopes. Drainage is variable from well drained to poorly drained.

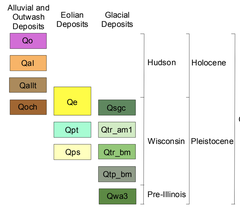
Other Mapping Units

Qpq - Pits and Quarries Sand and gravel pits and rock quarries. Extent mapped as shown in county soil surveys and as identified on aerial imagery.

Water Features Rivers, lakes and small ponds formed by blockage of drainageways and river channels. Extent mapped as shown in county soil surveys and as identified on aerial imagery.

Water Wells

Correlation of Map Units



SURFICIAL GEOLOGY OF CARROLL COUNTY, IOWA

Iowa Geological and Water Survey
Open File Map OFM-13-12
September 2013

prepared by

Deborah Quade[1], Stephanie Tassier-Surine[1], James Giglierano[1], and E. Arthur Bettis, III[2]

Iowa Geological and Water Survey, Iowa City, Iowa

Iowa Department of Natural Resources, Chuck Gipp, Director
Iowa Geological and Water Survey, Robert D. Libra, State Geologist

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Introduction to the Surficial Geology of Carroll County, Iowa

Carroll County lies in west-central Iowa and straddles the western margin of the Late Wisconsinage Des Moines Lobe (DML) landform, the most recently glaciated region of the state and the much older Southern Iowa Drift Plain Landform Region (Prior and Kohrt, 2006). Surficial materials consist of a mix of eolian deposits (loess), glacial till, and alluvium. Multiple periods of Quaternary glaciation and subaerial erosion have led to the landscape we see today.

Previous surficial geologic mapping of the area is limited to the Des Moines 4° x 6° Quadrangle at a scale of 1:1,000,000 (Hallberg et al., 1991). Compilation mapping was completed near the project area in 2011 and 2012 for Adams County (Tassier-Surine et al., 2011), Mills County (Tassier-Surine et al., 2012a), and Montgomery County (Tassier-Surine et al., 2012b). New mapping was completed near the project area in 2002 for Dallas County (Quade et al., 2002) and in 2003 for Polk County (Quade et al., 2003). Statewide bedrock geologic maps by Hershey (1969), and more recently, by Witzke, Anderson, and Pope (2010), depict the increased understanding of the distribution of geologic units at the bedrock surface across this region, including Carroll County.

Early researchers believed there were only two episodes of Pre0Illinois glaciation in Iowa: Kansan and Nebraskan (Chamberlin, 1894, 1895; Bain, 1896; Shimek, 1909; Kay and Apfel, 1928; Ruhe, 1969). Later regional studies determined that the original concept of Kansan-Aftonian-Nebraskan was grossly oversimplified and flawed. It is now recognized that there were at least seven episodes of Pre-Illinois glaciation that occurred in this region from approximately 2.2 to 0.5 million years ago (Boellstorff, 1978a, 1978b; Hallberg, 1980a, 1986). Episodic erosion during the last 500,000 years has led to the destruction of pre-existing glacial landforms associated with these glaciations. Boellstorff (1978a, 1978b) and Hallberg (1980a, 1980b, 1986) undertook regional-scale projects that involved detailed outcrop and subsurface investigations including extensive laboratory work and synthesis of previous studies. These studies led to the abandonment of the classic glacial and interglacial terminology: Kansan, Aftonian, and Nebraskan. This study marked a shift from the use of time-stratigraphic terms to lithostratigraphic classification. The result of Boellestorff's and Hallberg's studies was the development of a lithostratigraphic framework for Pre-Illinois till. They developed a general stratigraphic framework for Iowa and eastern Nebraska based on physical stratigraphy, mineralogic criteria as well magnetostratigraphy and tephrochronology. In western Iowa and eastern Nebraska three lithologically distinctive till assemblages were identified, the 'A,' 'B,' and 'C' tills with paleosols sometimes delimiting multiple till units within the A and B till assemblages. Recent work by Balco and Rovey (2010) suggests that a single ice advance around 2.4 Ma deposited the C till and that the A and B till assemblages accumulated between about 1.3 and 0.5*Ma.

The Loveland Loess (Daniels and Handy, 1959; Ruhe, 1969; Bettis, 1990) is the only Illinois or late middle Pleistocene deposit that is currently recognized in western Iowa. Where observed in outcrop, the Sangamon Geosol is developed in the upper part of the Loveland. The Loveland Loess thins away from the Missouri River and the Sangamon Geosol merges with the thick and more weathered Yarmouth-Sangamon Geosol in southern Iowa (Ruhe, 1967).

In Carroll County, the highly eroded and dissected Pre-Illinois upland and older terraces are mantled by Wisconsin loessers of variable thickness (Ruhe, 1969; Prior, 1976). The Wisconsin loesses are the youngest regionally extensive Quaternary materials and were deposited between 30,000 and 12,000 years ago. Two loess units were deposited across Iowa during Wisconsin time, the older Pisgah Formation and the younger Peoria Formation. The Pisgah is thin and includes loess and related slope sediments that have been altered by colluvial hillslope processes, pedogenic and periglacial processes. The upper part of the unit is modified by development of the Farmdale Geosol. It is not uncommon to see the Farmdale developed throughout the Pisgah and incorporated into the underlying older Sangamon Geosol.The Pisgah Formation loess was deposited on the western Iowa landscape from about 55,000 to 26,000 years ago (Bettis et al., 2003) and is typically buried by Peoria Formation loess. The Peoria Formation loess accumulated on stable landsurfaces inwestern Iowa from 25,000 to 12,000 years ago.

In the eastern portion of the map area, the younger DML region consists of a complex suite of depositional landforms and sediment sequences related to supraglacial, subglacial, and proglacial sedimentation. The DML is characterized by hummocky terrain that forms arcuate belts of moraine complexes and undulating plains with thick increments of supraglacial sediment (>3 m). In the map area, the most notable features of the DML are the Bemis Moraine, the terminal moraine of the DML which is dated at approximately 14,500 to 14,000 years before present and the slightly younger Altamont Moraine I which is dated at approximately 13,500 years before present. Supraglacial and proglacial sediments associated with hummocky terrain, elongated and aligned hummocks, and outwash channel deposits, which encompass the western flank of the DML, are mapped in Carroll County. Extensive outwash deposits are mapped along the North Raccoon River and Purgatory Creek valleys, as well as the western flank of the sliver of Altamont Moraine I that is mapped in theextreme northeast corner of Carroll County.

Surficial deposits of the map area are composed of five formations: DeForest, Noah Creek, Peoria, Dows and undifferentiated Pre-Illinois tills. Hudson age deposits associated with fine-grained alluvial and colluvial sediments include the DeForest Formation which is subdivided into the Camp Creek, Roberts Creek, Gunder and Corrington members. The Noah Creek Formation includes coarser grained deposits associated with large valleys which are overlain by finer-grained alluvial material or eolian silt and sand. Peoria Formation eolian materials consist of windblown silt that may be up to 9 m (30 ft) in thickness. Limited areas of eolian sand may be present adjacent to river valleys. Additional eolian materials may be intermittently present mantling Wisconsin Episode terraces. The Dows Formation consists of upland glacial deposits and is subdivided into the Alden, Lake Mills, Morgan and Pilot Knob members. Pre-Illinois glacial deposits are exposed in the map area along drainages and where loess cover is thin. Based on existing well data, Pre-Illinois deposits may be as thick as 152 m (500 ft) in bedrock valleys.

Soils series units from the Soil Survey of Carroll County, Iowa (Sherwood, 1982) were categorized into surficial geologic units based on soil data and available subsurface geologic data from the Iowa Geological and Water Survey's GEOSAM database (water well log database) as well as other existing subsurface data for this compilation map project Modeling and mapping of the glacial till outcrops was completed using ArcGIS 10.0, geSKi open source GIS program and the Sextante landscape classification subprogram.

* We disagree with the younger 0.2Ma age estimate for Pre-Illinois glaciations presented by Balco and Rovey (2010) and suggest 0.5Ma is more consistent with regional data and stratigraphicrelationships.

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