Illinois Geologic Quadrangle Map
IGQ Welge-SG

Surficial Geology of Welge Quadrangle

Randolph and Jackson Counties, Illinois

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Location and Topography

The Welge 7.5-minute Quadrangle is in southwestern Illinois near the Mississippi River. The quadrangle is about 4 miles east of Chester, 30 miles northwest of Carbondale, and 60 miles southeast of St. Louis, Missouri (fig. 1).

The Welge Quadrangle contains parts of three regional physiographic provinces (Horberg 1950). On the southwest is the Salem Plateau Section of the Ozark Plateaus Province. This area is underlain by sandstone, shale, and limestone of Mississippian age. The southeastern and central parts of the Welge Quadrangle are in the Shawnee Hills Section of the Interior Low Plateaus Province, having resistant, scarp-forming sandstone bedrock of Pennsylvanian age. The northeastern part of the quadrangle is in the Mt. Vernon Hill Country of the Central Lowland Province, where isolated bedrock hills rise above a plain of glacial drift. The map area lies

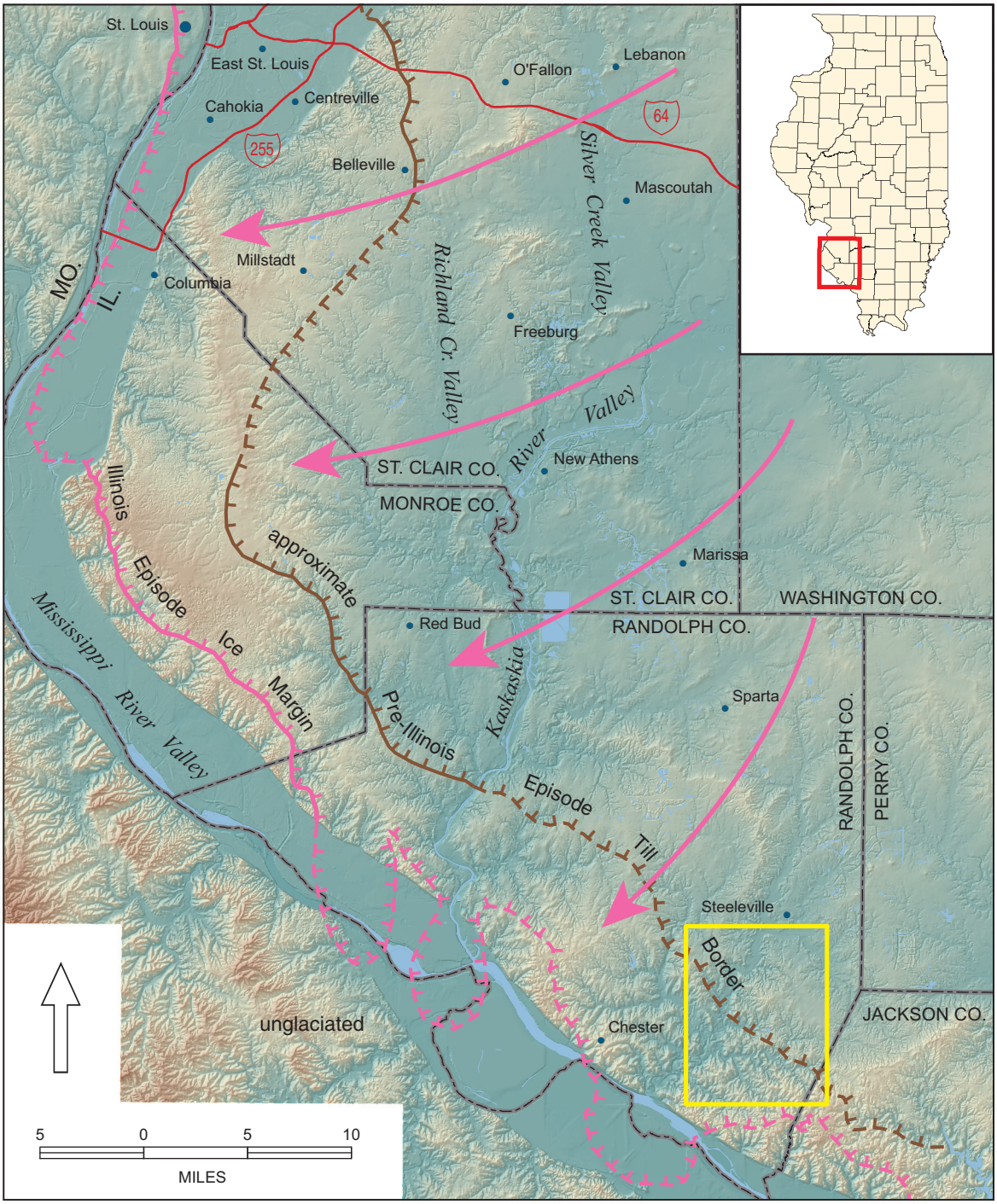

Figure 1 Shaded relief map of the St. Louis Metro East area (southern portion). The Welge Quadrangle is outlined in yellow. Pink arrows indicate approximate ice flow direction during the Illinois Episode. Till borders and ice margins are based in part on recent mapping and observations by D.A. Grimley and A.C. Phillips.

entirely in the drainage basin of Mary's River; its confluence with the Mississippi River is about two miles southwest of the quadrangle border. Mary's River has a broad floodplain and exhibits terraces, as do several of its tributaries (Mill Creek, Dry Creek, Cox Creek, and Little Mary's River). The bedrock geology of the Welge Quadrangle was previously mapped in detail by Nelson (2007).

The Welge Quadrangle straddles the limit of continental glaciation that occurred during the Illinois Episode and pre-Illinois Episode glaciations in southwestern Illinois (Willman and Frye 1970, Lineback 1979, Grimley et al. 2001); glacial ice likely advanced from the northeast. Deposits of the Illinois Episode glaciation have been mapped just southwest of this quadrangle (Lineback 1979), suggesting that glacial ice at one time crossed this entire quadrangle. The basis for mapping this boundary is, in part, the observations near Ste. Genevieve, Missouri, of scattered erratic boulders and small bodies of till (at elevations of ~500 to 520 feet) as reported by E.W. Shaw and F. Leverett in the publication by Weller and St. Clair (1928). Because of the quadrangle's location near the margin, the ice sheet was likely thin. It is not clear whether the ice sheet was continuous or if the highest uplands near the ice terminus remained ice free. A recently mapped area that includes the terminus of the Illinois Episode and pre-Illinois Episode glaciations is the Ames Quadrangle (Grimley and Shofner 2008), about 40 km northwest of this quadrangle. Additionally, MacClintock (1926) noted till deposits from both glaciations at the Schuline section, 7.5 miles northwest.

Methods

During the winter of 2005–2006, John Nelson conducted outcrop mapping in the Welge Quadrangle. Bedrock geology was the primary focus (Nelson 2007), but surficial deposits and landforms were also observed. Observations were supplemented by those of previous Illinois State Geological Survey (ISGS) geologists, filed in the ISGS library. Also utilized were the descriptive boring logs from water wells, engineering boreholes, and test holes for oil, gas, and coal. All water well and engineering records are on public file at the Geologic Records Unit of the ISGS. David Grimley assisted with delineation of the Equality Formation terraces and the distribution of Cahokia Formation in floodplains. Such delineations in the valleys were based on soil parent materials from the Randolph County soil report (Leeper 1999) and topographic control to help define landform-sediment assemblages.

This is a preliminary map. We did not excavate exposures of Quaternary sediments or conduct test drilling. Many outcrops of Quaternary sediment are difficult to examine along vertical banks or muddy slopes that are heavily slumped and vegetated. Many outcrops along Mary's River are accessible only by boat. Most well record descriptions (such as "yellow clay" and "brown silty clay") are difficult to use in interpreting geologic mapping units, although they are useful in providing a depth to bedrock (shown as red contours on the surficial map). Soil boring logs of bridge borings made by the Illinois Department of Transportation (IDOT) provide important descriptive detail and engineering data, albeit confined to valley bottoms.

This map presents (1) locations of bedrock outcrops (where bedrock is mapped), (2) the distribution of near-surface Quaternary sediments, and (3) contour lines showing the elevation of the Paleozoic bedrock surface (below Quaternary deposits). The bedrock topographic surface was hand-contoured, based on field observations and subsurface data.

Bedrock Topography and Preglacial Drainage

Contour lines on the geologic map depict the configuration of the bedrock surface. The topography of the bedrock surface is probably fairly similar to the landscape prior to Pleistocene glaciations, although some modifications have resulted from glacial erosion and modern fluvial erosion. The present course of Mary's River closely, but not exactly, follows its preglacial channel. The bedrock valley, buried by Quaternary sediments, is narrow, sinuous, and incised 100 feet or more beneath the present river bed. At Welge the valley floor is at an elevation of ~285 feet and presumably cuts to a lower elevation downstream (southwest). Where constrained by borehole data, the buried bedrock gorge varies from less than 1,000 feet to about 2,000 feet wide and has about 100 feet of relief.

As shown by cross-section A–A′ (fig. 2), a possible preglacial valley of Mary's River is buried beneath the uplands east of the present valley at Welge. Following deposition of glacial sediments, Mary's River evidently eroded a new valley west of the original one. An alternative explanation is that both eastern and western courses are preglacial and were occupied at different times.

In the northeastern part of the map area, a buried preglacial valley lies south of Cox Creek. The bed of the buried valley lies 100 feet lower in elevation than that of the modern stream.

Creeks in the southern part of the quadrangle were not buried deeply by glacial deposits and were only slightly altered from their preglacial courses. Most notably, Piney Branch (in the southeast area) appears to have been shifted southward by glaciation. The original course was likely in the southern parts of Sec. 22 and 23, T7S, R5W. This area today carries a northern tributary. The main stream, displaced southward, became superimposed onto bedrock and incised a series of tight meanders into Pennsylvanian sandstone. The resulting gorge, one of the most scenic areas in southern Illinois, is maintained by the State of Illinois as Piney Creek Ravine

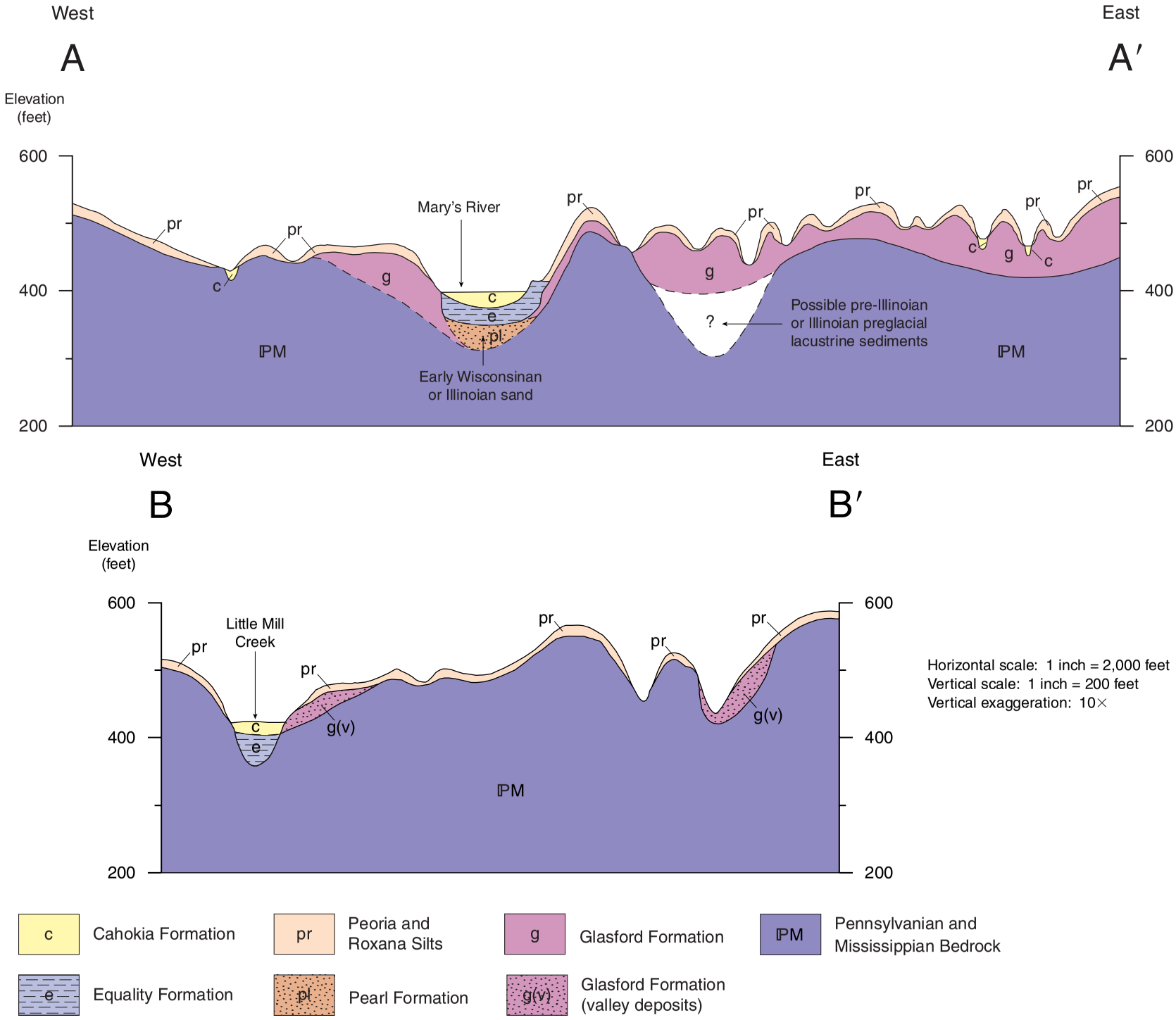

Figure 2 Cross sections A–A′ and B–B′ of Welge Quadrangle, Randolph and Jackson Counties, Illinois.

Nature Preserve. More entrenched bedrock meanders that formed in the same manner occur along Mill Creek in the western part of Sec. 27, T7S, R5W.

Quaternary Deposits

Quaternary sediments in the map area include direct glacial and ice-marginal deposits, eolian silts (loess), alluvial deposits in floodplains, lacustrine and alluvial deposits in terraces and in the subsurface, and colluvial deposits along slopes.

Direct glacial deposits (till) and ice-marginal sediments in the map area are mapped as the Glasford Formation of Illinois Episode age. The Glasford is overlain only by Wisconsin Episode loess deposits, the Peoria and Roxana Silts. A strongly developed interglacial soil profile (the Sangamon Geosol) is developed into the upper part of the Glasford Formation and below the loess. Patchy pre-Illinois Episode till or other Quaternary deposits possibly underlie the Glasford Formation; however, their existence cannot be demonstrated using existing data. In the northeastern part of the quadrangle, loess-covered glacial and ice-marginal deposits form a nearly continuous blanket (mapped as Peoria and Roxana Silt over Glasford Formation). In the southwestern part, the Glasford Formation is thin and patchy on upland ridges; such upland areas are mostly loess deposits over bedrock. Deposits of Glasford Formation in the southwestern area are confined to valley slopes and are mapped specifically as Glasford valley deposits. These deposits are similar to the upland Glasford sediments but contain larger and more numerous blocks of locally derived bedrock, mostly sandstone.

Numerous valley floodplains and broad terraces are also found throughout the quadrangle. All are part of the Mary's River drainage network. Floodplain and channel deposits in stream valleys are Holocene in age (Hudson Episode) and are mapped as Cahokia Formation. Lacustrine deposits, with perhaps some alluvium, are mapped in terraces of the Mary's River as the Equality Formation.

Northeastern Uplands
(Semi-continuous Quaternary Deposits)
Quaternary deposits typically range from 30 to 100 feet thick in the northeastern part of the map area and locally are as much as 150 feet thick, according to water well log descriptions. Bedrock exposures are confined to the banks of active streams; the only large area of rocky bluffs occurrs along Rockcastle Creek. The dissected till plain in this area slopes gently toward the northeast, reflecting the dip of underlying bedrock. Otherwise, the influence of bedrock structure on topography has been masked. This northeastern area appears to have been blanketed deeply enough to completely bury a stretch of preglacial Cox Creek valley a few miles long. The largest level area of till plain is east of Wine Hill (Sec. 5, T7S, R5W). North of this area, relief is low, and the landscape is gently rolling. Relief increases southeast of Wine Hill, where the drainage pattern is highly intricate. On steep slopes, the loess and till deposits are eroded to a stabilized "badland" topography that features a multitude of narrow ridges separated by deep V-shaped gullies.

Quaternary deposits on uplands consist predominantly of Wisconsin Episode loess (Peoria and Roxana Silts) underlain by various thicknesses of Illinois Episode till and ice-marginal sediment (Glasford Formation). In areas where thick Quaternary sediment has filled preglacial bedrock valleys, early Illinois Episode lacustrine deposits or pre-Illinois Episode till, alluvium, or lacustrine deposits may be present. Periodic infilling of bedrock valleys occurred elsewhere in the vicinity during each major glaciation in response to aggradation in the Mississippi River valley (Willman and Frye 1970, Grimley et al. 2001, Grimley 2010). As the Mississippi River aggraded, tributary valleys were impounded and filled with slackwater lacustrine deposits. The Schuline section, located in the Walsh Quadrangle about 7.5 miles northwest of the northwestern corner of the Welge Quadrangle, contains both Illinois Episode till (16 feet thick) and pre-Illinois Episode till (>14 feet thick) with intervening loess deposits and well-developed paleosols developed into the upper portions of both tills (MacClintock 1926). Thin pre-Illinois Episode till (~5 feet thick) and Illinois Episode lacustrine deposits (~8 feet thick) were recently observed below about 30 feet of Illinois Episode till at Kinkaid Quarry (southeast Sec. 36, T7S, R5W, Jackson County, Illinois) about 1.5 miles east of the southeast corner of the Welge Quadrangle. Thus, it appears likely that thin pre-Illinois Episode deposits and Illinois Episode lacustrine deposits (Petersburg Silt) are present below the Glasford Formation in the Welge Quadrangle, although probably confined to tributary bedrock valleys in areas protected from subsequent erosion.

Southwestern Uplands and Valley Slopes
(Thin, Patchy, Glacial Deposits)
Quaternary deposits are relatively thin (typically 5 to 30 feet) on the uplands in the southwestern third of the quadrangle. Glacial till and ice-marginal deposits here are uniformly blanketed by loess, although well-exposed outcrops of Quaternary deposits are rare. Water well logs indicate depth to bedrock, but do not provide enough detail to differentiate loess from fine-grained till or lake sediment. Upland glacial landforms are not evident; bedrock structure provides the dominant influence on topography. Resistant, ledge-forming sandstones, especially the Caseyville (Pennsylvanian) and Degonia (Mississippian) Formations, underlie extensive, level to gently rolling plateaus (Nelson 2007).

Extensive diamicton (till and debris flow) deposits along all the large streams in the southern third of the map area are interpreted to have been deposited possibly by valley glaciers. These deposits are most evident along the upper reaches of Mill and Little Mill Creeks and along the unnamed tributary stream valley near the southwest corner of the map. Deeply dissected by recent erosion, glacial deposits commonly form distinctive flat-topped terraces. Good places

to view the terraces are where County Route 5 crosses Little Mill Creek (Sec. 32, T7S, R5W) and where Springvale Road crosses the unnamed stream (Sec. 36, T7S, R6W). Terrace surfaces in both areas lie north of the respective streams and are being farmed and used for home sites. A curious feature of these terraces is that in most cases they lie north of the present streams. The creeks cut against rock bluffs on the southwestern valley walls. Although valley glaciers provide a possible explanation for these deposits, an alternative is that these deposits are erosional remnants of a formerly more extensive blanket of till deposits. Regional ice flow is thought to have been generally from the northeast, so preservation of till on southwest-facing slopes would be expected due to more limited glacial erosion in the lee of bedrock highs. Thin till deposits on the bedrock highs themselves may have since eroded during the Sangamon Episode interglacial or subsequent time. Furthermore, thicker loess cover in the southwestern areas (due to closer proximity to the Mississippi Valley source) conceals any underlying thin till deposits. More drilling would be required to determine whether Glasford Formation valley deposits are related to valley glaciers, selective preservation or some combination with thicker, sediment-rich glacial ice in valleys and thinner, cleaner ice on the bedrock highs followed by subsequent erosional processes.

Intriguing lobate landforms occur along the stream near the southwest corner of the map. Note the palm-shaped area of glacial sediment that straddles the border of Sec. 26 and 27 (T7S, R6W); this area is a possible candidate for a debris flow or paleo-landslide that postdates Illinois Episode glaciation. Another lobe partially crosses the valley bottom from the south in the SW¼ of Sec. 26. Where the stream is eroding the latter lobe, it is exhuming many giant, jumbled boulders of locally derived sandstone embedded in fine-grained matrix. The form of these lobes suggests mud flows related to former mass wasting processes; a lack of loess cover indicates that some may be Holocene (Hudson Episode) features. The southern lobe plausibly came out of the ravine from the south, but the northern palm-shaped lobe does not connect to a side valley. Mapped areas of Glasford valley deposits thus may include younger colluvium and landslide materials.

Floodplains and Terraces, Mary's River Drainage Basin
Fine-grained, stratified deposits, identified as Equality Formation (Hansel and Johnson 1996) and capped by thin loess (Peoria Silt only), are mapped along Mary's River valley and the lower reaches of its tributary valleys. These deposits, of Wisconsin Episode age, occur within a distinct, level to very gently rolling terrace along Mary's River valley at elevations of about 400 to 410 feet. The village of Welge is built upon such a terrace in Sec. 36, T6S, R6W. The terrace also is easily seen from County Farm Road on both sides of Mary's River in Sec. 14, T7S, R6W. The Equality is interpreted as sediment of slackwater lakes that formed when tributaries of the Mississippi became impounded by glacial meltwater and aggradation. The sediment is largely redeposited loess (silt), mixed with some sand and gravel supplied by streams that flowed into the lakes. Similar glacial slackwater lake terraces are common in the Kaskaskia River valley (~15 miles northwest) at slightly higher terrace elevations of ~410 to 420 feet above sea level (Grimley 2010) and extensively along many other tributary valleys in southeastern Illinois (Frye et al. 1972). Ages for the Equality Formation in the region, based mostly on radiocarbon (^{14}C) ages for wood and plant macrofossils, range from about 45,000 to 13,000 ^{14}C years before present (Curry and Grimley 2006, Hansel and Johnson 1996).

Lithologic information on the Equality Formation is based on limited outcrop studies, boring logs, and soil survey reports. A cutbank of Mary's River examined south of the center of Sec. 14, T7S, R6W revealed alternating layers (mostly a few inches thick) of gray silt and yellowish brown, fine sand. At a construction site west of the Welge Quadrangle, workers described layered fine sand encountered in a cellar hole on the terrace. County soil series maps indicate that material underlying the terraces is dominantly fine-grained silty clay loam to silt loam in the upper portions (within 5 to 10 feet of land surface) and has a cap of about 3 to 6 feet of late Wisconsin Episode loess (Leeper 1999). Two IDOT bridge borings in the Mary's River floodplain penetrate material at depth (below ~10 to 20 feet of Cahokia Formation) that consists of mainly silty clay. This material has soft to medium consistency (0.5 to 1.5 tons per square foot) and high moisture content (25 to 40%), consistent with the Equality Formation (Grimley 2010). Thin zones with wood or fine sand are also noted to be intermixed within the predominantly silty to clayey deposits. In the bridge borings of County Farm Road over Mary's River (Sec. 14, T7S, R6W), ~50 feet of silty clay, interbedded with some fine sand, is found below ~11 feet of silty to silty clay Cahokia Formation (probable). Much of the older silty clay deposits are reddish brown below 338 feet elevation and are stiffer; these deposits may be middle Wisconsin Episode slackwater lake deposits (Curry and Grimley 2006) or perhaps Illinois Episode or older lake deposits, which in some places have a reddish hue.

Sand and gravel locally underlie Cahokia and/or Equality Formation, particularly in the deeper portions of preglacial valleys. One of the bridge borings where County Farm Road crosses Mary's River recorded 6 feet of medium to coarse sand and gravel underlying reddish brown clay at the base of the Quaternary. This basal coarse material might belong to the Pearl Formation of Illinois Episode age (Willman and Frye 1970). Another bridge boring log, where Ballpark Road crosses Cox Creek overflow (Sec. 21, T6S, R5W), reports about 17 feet of fine sand with a 2- to 3-foot interbed of silty clay, underlying gray silty clay at a depth of 40 feet. This fine sand may represent fluvial sediments deposited in a channel of Cox Creek during early to middle Wisconsin Episode, but prior to being inundated by the last glacial slackwater lake.

Stratigraphically, the fine sand may correlate to the Henry Formation, which commonly intertongues with the Equality Formation (Hansel and Johnson 1996).

Following the last glaciation, during the past several thousand years, large and small stream valleys have been inset into pre-existing lake deposits (Equality Formation), depositing younger alluvium (Cahokia Formation) on the low floodplain levels overlying the older lake deposits. This postglacial erosion carved out the terraces of today, which are preserved remnants of the original last glacial lake plain. The Cahokia Formation in the Welge Quadrangle has predominantly silt loam textures (Leeper 1999), reflecting erosion and redeposition of loess and lake sediment into the drainage network. The Cahokia Formation along the smaller tributaries in southern areas of the quadrangle can contain more gravelly and sandy areas in channels, at depth, and in areas where bedrock is more continuously exposed, such as along Little Mill Creek.

Recommendations

Further study is recommended:

- Examine terrace deposits in the banks of Mary's River and its larger tributaries. This examination might be best accomplished from a boat and should be done during relatively dry soil conditions when the banks can be scaled.
- Drill test holes along upland ridges in the southern part of the map area to determine the presence or absence of glacial till (to help refine the glacial border and test the valley glacier hypothesis).
- Drill one or more continuous core test holes into the Equality Formation lacustrine terraces in the southern part of map area.
- Drill one or more deep stratigraphic test holes (to bedrock) along the Mary's River and Cox Creek preglacial drainages or tributaries to these drainages. Where deep bedrock valleys underlie present-day uplands, there is potential for finding pre-Illinois Episode deposits of glacial or lacustrine origin.

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