Institute of Natural Resource Sustainability
William W. Shilts, Executive Director
ILLINOIS STATE GEOLOGICAL SURVEY
E. Donald McKay III, Director

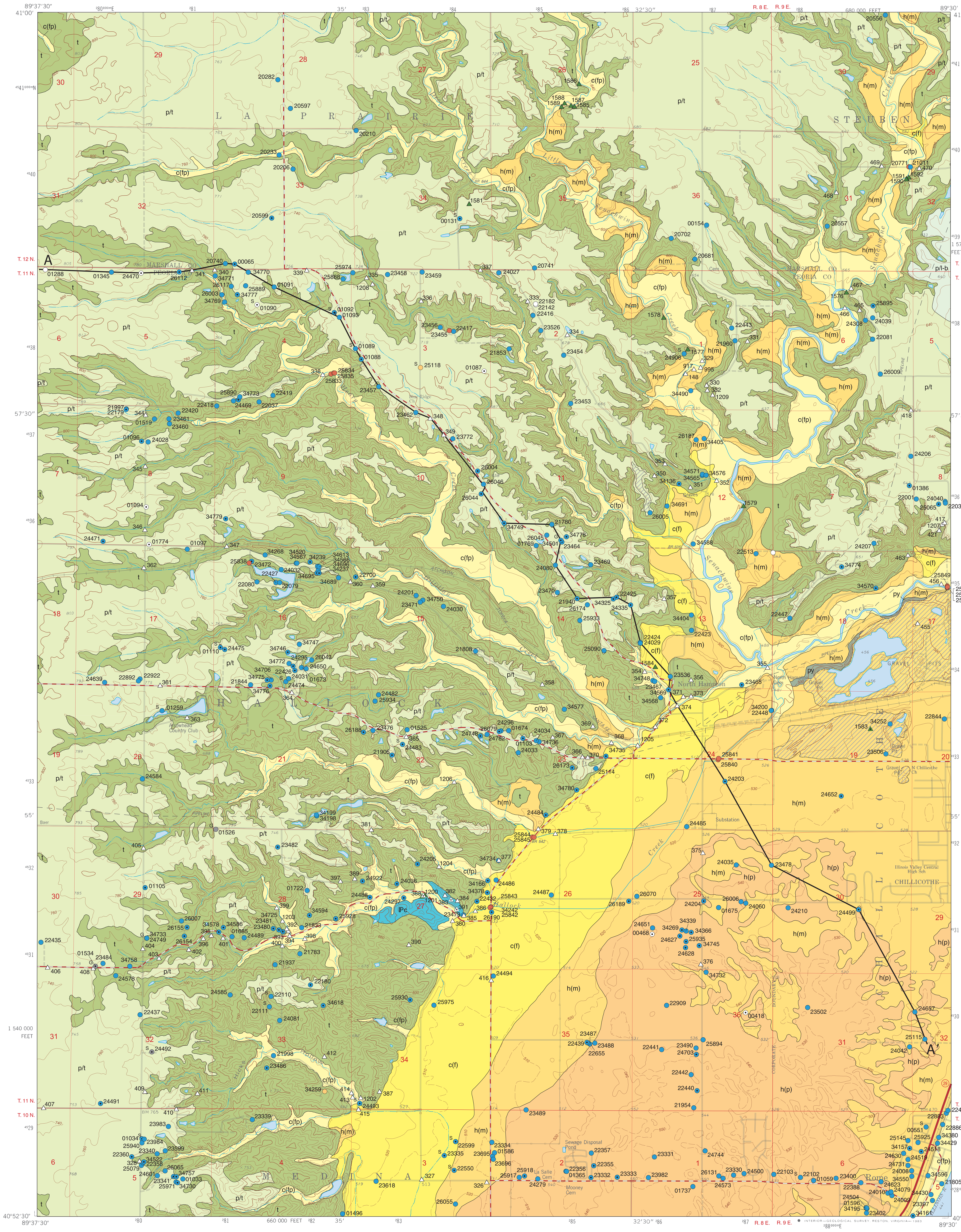
SURFICIAL GEOLOGY OF ROME QUADRANGLE

PEORIA AND MARSHALL COUNTIES, ILLINOIS

Andrew J. Stumpf

2010

Illinois Geologic Quadrangle Map
IGQ Rome-SG



QUATERNARY DEPOSITS

HUDSON EPISODE (~12,000 years before present (B.P.) to today)

Description	Unit	Interpretation
Fill, compacted land, or other disturbed material; highly variable in grain size and could contain construction or mining debris; overlies undisturbed deposits; typical thickness 5 to 15 feet	Disturbed ground	**Human-disturbed deposits** modified during construction of buildings, roads, dams, levees, or landfills; includes excavations in gravel pits, coal mine spoil banks, and other excavations
Sand, silt, and clay with minor gravel; stratified; light brownish gray to gray; typically grades at depth to sand or sand and gravel; typical thickness 5 to 50 feet	Cahokia Formation (floodplain deposits) c(fp)	**Postglacial modern stream sediments** that have been deposited on floodplains of the Illinois River and its tributaries; subject to frequent flooding; may be difficult to differentiate from the Henry Formation
Silt and silty clay interbedded with fine sand; locally contains gravel and redeposited bedrock clasts; brown (soft) to gray (firm); calcareous or non-calcareous; typical thickness 5 to 30 feet	Cahokia Formation (fan deposits) c(f)	**Postglacial modern stream sediments** that form fan-shaped landforms where streams emerge from the uplands onto the lower-gradient valley floors; subject to flooding and sedimentation; commonly overlies the Henry Formation
Sand and gravel; massive to crudely stratified; fine- to coarse-grained; brown to gray; calcareous or noncalcareous; composed of material derived from sands or gravels lying upslope; typical thickness 5 to 20 feet	Peyton Formation py	**Postglacial (modern) sand and gravel slopewash deposits** comprising remobilized floodplain, point bar, and terrace sediments occurring in the Illinois River valley as aprons or fan-shaped deposits at the base of slopes

WISCONSIN (Late) EPISODE (~12,000 – 25,000 years B.P.)

Description	Unit	Interpretation
Silt, fine sand, and clay; silty clay to silty clay loam; crudely stratified to massive; light yellowish brown to grayish brown; lower part calcareous and may contain fossil snails; soft; typical thickness 5 to 15 feet; mapped together with underlying Batestown Member (p/l-b) and Tiskilwa Formation (p/t)	Peoria Silt (cross section only) p	**Proglacial eolian (wind-deposited) silt (loess)** derived from outwash deposits in the Illinois River valley; blankets uplands, decreasing in thickness farther from valleys; generally absent on floodplains, terraces, fans, and steep slopes; conformably overlies Batestown Member, Tiskilwa Formation, or Henry Formation
Silt and clay; stratified to massive; gray to olive green; calcareous; may contain beds of diamicton, sand, or gravel and wood fragments and shells; typical thickness 5 to 40 feet	Equality Formation (cross section only) e	**Proglacial and postglacial lake deposits;** infills channels or depressions on outwash plains; may interfinger or be overlain by alluvial and slopewash deposits
Sand; very fine- to fine-grained; stratified to massive; light yellowish brown to grayish brown; calcareous in lower part; well-sorted and loose; typical thickness 5 to 15 feet	Henry Formation (Parkland facies) h(p)	**Proglacial and postglacial wind-deposited sand** composing dunes and low-relief sheet deposits in the Illinois River valley and locally on uplands; conformably overlies the Mackinaw facies
Sand and gravel with cobbles and boulders; stratified; light yellowish brown to grayish brown; calcareous; usually clean and moderately well sorted; typical thickness 10 to 80 feet	Henry Formation (Mackinaw facies) h(m)	**Proglacial fluvial (outwash) sediments** deposited by meltwater from distant glaciers; composes a series of terraces in channels and tributaries of the Illinois River; unconformably overlies older outwash, diamictons, or bedrock; difficult to differentiate from older fluvial deposits unless intervening glacial deposits and palesols are present
Diamicton; massive; pebbly silty clay loam; light olive brown (oxidized) to grayish brown (unoxidized); calcareous; firm to hard; locally jointed; contains some cobbles, scattered boulders, and discontinuous beds of sand, gravel, or silt; typical thickness 5 to 35 feet	Batestown Member, Lemont Formation; >5 feet of Peoria Silt over Batestown p/l-b	**Subglacial and ice-marginal sediments (till)** deposited directly from Batestown glacial ice; in some areas overlain by a veneer (<5 feet) of loess; absent in the Illinois River valley and tributary valleys, where removed by postglacial erosion; unconformably overlies the Tiskilwa Formation or older deposits
Diamicton; massive; pebbly loam; light reddish brown to very dark gray; calcareous; firm to hard; jointed; contains some cobbles, scattered boulders, and discontinuous beds of stratified sand, silt, or clay; the lower part of the unit usually is not red in color, but dark gray, and may contain dispersed wood fragments and gastropod shells; typical thickness 10 to 120 feet	Tiskilwa Formation t; >5 feet of Peoria Silt over Tiskilwa p/t; Delavan Member (cross section only) t-d	**Subglacial and ice-marginal sediments (till)** deposited directly from Tiskilwa glacial ice; exposed where Peoria Silt and Batestown diamicton have been eroded; found throughout the uplands; on steep slopes may be overlain by slopewash (colluvium); absent in the Illinois River valley and tributary valleys, where removed by postglacial erosion; the lower part, the Delavan Member, is differentiated by color or presence of oxidation; unconformably overlies Ashmore Tongue, Roxana Silt, and older deposits; present as a discontinous veneer on bedrock (areas too small to be mapped)
Sand and gravel; sand is fine- to coarse-grained; light yellowish brown to grayish brown; calcareous; contains some cobbles and scattered boulders; water saturated; locally contains intraclasts of diamicton in the upper part; calcite cemented in places; typical thickness 5 to 50 feet	Ashmore Tongue, Henry Formation (cross section only) h-a	**Proglacial fluvial (outwash) sediments** deposited by meltwater from advancing Wisconsin Episode glaciers; overlies Pearl Formation, Glasford diamicton, or bedrock; present as sheets and channels fills beneath the Tiskilwa Formation; widespread in subsurface, but difficult to differentiate from the Mackinaw facies or older deposits

WISCONSIN and SANGAMON EPISODES (~25,000 – 130,000 years B.P.)

Description	Unit	Interpretation
Silt, silt loam, sandy silt, and peat; massive to crudely stratified; reddish brown (oxidized) to dark gray or greenish gray (mottled); leached to weakly calcareous; contains humus, wood, peat, and gastropod shells (Robein Member); typical thickness 3 to 40 feet	Robein Member, Roxana Silt (cross section only) r-r	**Proglacial eolian (wind-deposited) silt (loess)** containing a cool-climate paleosol (Farmdale Geosol) deposited on a former land surface that was well to poorly drained; conformably overlies Pearl Formation or Glasford diamicton; distinctive mapping unit, but only locally preserved in the subsurface

ILLINOIS EPISODE (~130,000 – 200,000 years B.P.)

Description	Unit	Interpretation
Diamicton; massive; pebbly loam to silty clay loam; light yellowish brown (oxidized) to dark grayish brown (unoxidized); calcareous; firm to hard; contains some cobbles, boulders, and discontinuous beds of gravel, sand, or silt; contains many coal clasts and occasional wood fragments; upper part weathered in profile of Sangamon Geosol; typical thickness 5 to 20 feet	Glasford Formation (till) undivided (cross section only) g	**Subglacial and ice-marginal sediments (till)** deposited sediment directly from Illinois Episode glacial ice; mapped throughout the area, but only isolated remnants are preserved, having been largely removed by subsequent fluvial and glacial erosion; where present, it unconformably overlies older deposits or bedrock
Sand and gravel; sand is fine- to coarse-grained; light yellowish brown to grayish brown; contains some cobbles; calcite cemented in some places; typical thickness 5 to 20 feet	Pearl Formation (outwash) undivided (cross section only) pl	**Proglacial fluvial sediments** deposited in former river channels or on uplands by meltwater from Illinois Episode glaciers; underlies Glasford diamicton; unconformably overlies bedrock
Fine-grained sand, silt, and clay; stratified; silt loam to clay; light pinkish gray to brown; firm to stiff; typical thickness 5 to 20 feet	Glasford Formation (lacustrine) undivided (cross section only) g(l)	**Proglacial lacustrine sediments** deposited in lakes ponded in some tributary valleys beyond Illinois Episode glaciers; locally preserved in the subsurface

PRE-QUATERNARY

Description	Unit	Interpretation
Rock; shale, clay, sandstone, limestone, and coal; includes a variably thick weathered profile on the bedrock surface	Near-surface bedrock Carbondale Formation Pc	**Bedrock or where rock is within 10 feet of land surface;** includes strata of marine, estuarine, deltaic, fluvial, and swamp deposits; forms a very undulating surface that has been shaped by multiple cycles of fluvial and glacial erosion

Data Type

- Outcrop
- Outcrop in field notes (ISGS archives)
- Stratigraphic boring
- Water boring
- Engineering boring
- Coal boring
- Other boring, includes oil and gas

- Contact
- A — A′ Line of cross section

SG 31500 Labels indicate samples (S) or geophysical log (G). Numeric labels indicate the county number. Outcrop labels indicate geologist's field number. Dot indicates boring is to bedrock.

Note: The county number is a portion of the 12-digit API number on file at the ISGS Geological Records Unit. Online well and boring records are available at the ISGS Web site.

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Digital Line Graph data from 1982.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, west zone (Transverse Mercator)
1,000-meter ticks: Universal Transverse Mercator grid system, zone 16

SCALE 1:24,000

1 – 1/2 – 0 – 1 MILE
1000 – 0 – 1000 – 2000 – 3000 – 4000 – 5000 – 6000 – 7000 FEET
1 – .5 – 0 – 1 KILOMETER

BASE MAP CONTOUR INTERVAL 20 FEET
SUPPLEMENTARY CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology based on field work by Andrew J. Stumpf, C. Pius Weibel, Ardith K. Hansel, and Lisa R. Smith, 2002–2005.

Digital cartography by Jennifer E. Carrell, Zahra Golshani, and Jane E.J. Domier, Illinois State Geological Survey.

Recommended citation:
Stumpf, A.J., 2010, Surficial geology of Rome Quadrangle, Peoria and Marshall Counties, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ Rome-SG, 2 sheets, 1:24,000.

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

For more information contact:
Institute of Natural Resource Sustainability
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Castleton
2 La Prairie Center
3 Lacon
4 Edelstein
5 Chillicothe
6 Dunlap
7 Spring Bay
8 Germantown Hills

2° TRUE NORTH / MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2010

ROAD CLASSIFICATION

- Primary highway, hard surface
- Secondary highway, hard surface
- Light-duty road, hard or improved surface
- Unimproved road
- State Route

Purpose

Detailed geologic mapping of the Rome 7.5-minute Quadrangle was completed as part of a multi-year mapping program by the Illinois State Geological Survey (ISGS) to provide the Illinois Department of Transportation (IDOT) with updated geologic information to aid decisions regarding upgrade, route selection, and an environmental impact assessment for State Highway Route 29 between Chillicothe and its junction with U.S. Interstate 180. This work also supports the ISGS geologic mapping program to produce 1:24,000-scale three-dimensional maps of the glacial geology from land surface to the top of bedrock for the entire state. This information will be accessible to decision makers to address a wide variety of local and countywide issues that include protecting groundwater, locating new municipal water wells, designing and constructing foundations and structures, identifying potential aggregate resources, and preserving natural areas.

The geologic materials displayed on the land surface and in cross section are the source of important earth and water resources. Some materials may present hazards, while others favor highway construction and development.This map and cross section provide the information necessary to identify opportunities and limitations for future development as well as to determine the likely consequences of past and future land-use decisions. This mapping serves as a basis for the production of derivative maps such as assessment of groundwater resource potential, mineral resources, and geologic hazards.

Introduction

The Rome Quadrangle is located along the middle part of the Illinois River valley in central Illinois and encompasses parts of northeastern Peoria County and southern Marshall County that include the Town of Chillicothe, the Villages of Rome and North Hampton, and other unincorporated areas (fig. 1). The map area is located entirely within the watershed of the Illinois River and is drained by the Senachwine Creek, Hallock Creek, and Dickson Run. The land surface ranges in elevation (above sea level) from a minimum of approximately 440 feet at the Illinois River to greater than 820 feet just north of the Peoria-Marshall county line in the western part of the quadrangle. The map area contains a variety of landforms including morainal uplands, steeply sloping bluffs, and flat to undulating floodplains and terraces.

Throughout the last 1.8 million years during the Quaternary Period, the landscape in the map area was extensively modified by the combined action of glaciers, water, and wind. Preglacial rivers shaped the uppermost surface of the relatively soft shale bedrock into gently rolling uplands cut by a deep and wide bedrock valley. An extensive preglacial drainage system that included the Ancient Mississippi River was formed in central Illinois (fig. 2). A portion of this drainage system flowed through the Wyoming Bedrock Valley (fig. 3), and this area was repeatedly overridden by glaciers flowing from the east and northeast into Illinois through the Lake Michigan basin and areas farther east. Deposits of the Wisconsin and Illinois Episodes and intervening interglacial periods compose the landforms observed at land surface and those now buried in the subsurface (shown on cross section A–A′).

The present landscape was shaped by glaciers and meltwater associated with the latest (Wisconsin Episode) glaciation. When the last of several glaciers flowed into the valley about 24,800 calendar years before present (cal yr B.P.) (McKay and Berg 2008), drainage along the the Ancient Mississippi River was blocked and diverted to western Illinois where it occupied and enlarged the valley of the present Mississippi River (fig. 2). During subsequent glaciations, the river sediments deposited by the Ancient Mississippi River were nearly completely buried by glacial deposits.

During the Wisconsin Episode glaciation, the Lake Michigan Lobe of the Laurentide Ice Sheet reached its maximum extent, which is delineated by the Buda Moraine approximately 5 miles west of the Rome Quadrangle (fig. 1). As the ice margin retreated to the northeast, drainage from the melting ice sheet flowed southward following the course of the modern Illinois River and cut the present valley, depositing thick deposits of sand and gravel that are preserved in outwash plains and terraces. These deposits were the source of fine sand and silt that was picked up by winds and transported downwind, blanketing the local uplands with loess. As the river downcut into the new valley fill, tributary streams were lengthened and incised. With the disappearance of glaciers and the return of warmer climate and reduced discharge and sediment load, the Illinois River began meandering in its oversized valley, creating its modern channel, point bars, natural levees, backwater lakes, and floodplain. Gradually, glacial sand and gravel were reworked and covered with overbank silt and clay, while tributary streams built alluvial fans into the valley.

The uplands bordering the Illinois River valley have an undulating to rolling topography crossed by several arcuate ridges (moraines) that delineate margins of the Lake Michigan Lobe as it melted and the ice margin retreated (fig.1). In the Rome Quadrangle, till and other sediments composing these moraines are classified to the Tiskilwa Formation (Hansel and Johnson 1996).

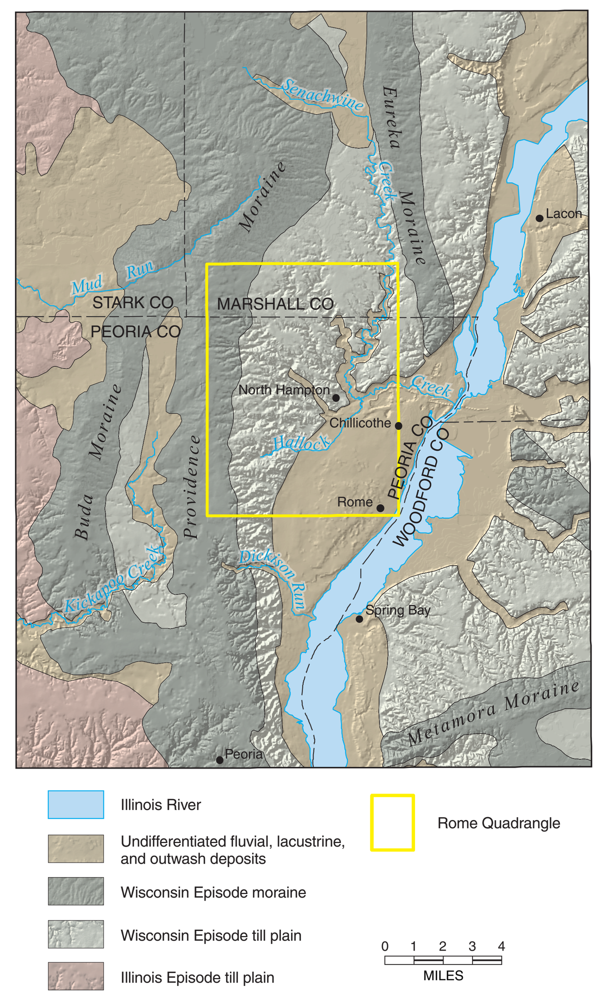


Figure 1 Surficial geology over shaded relief map (derived from a digital elevation model) of the Illinois River valley and adjacent areas of central Illinois. Map modified from Illinois State Geological Survey (2000) and Luman et al. (2003).

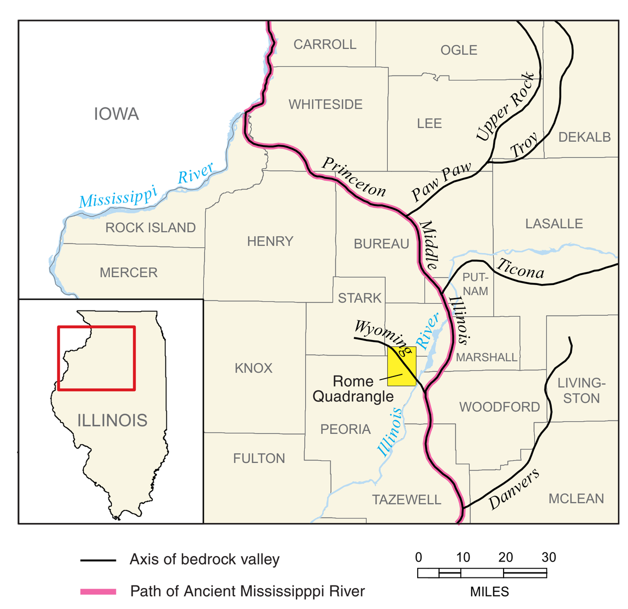


Figure 2 Axes of major bedrock valleys and routes of ancient and modern rivers in west-central Illinois (after Horberg 1950). The Rome quadrangle is shown in yellow.

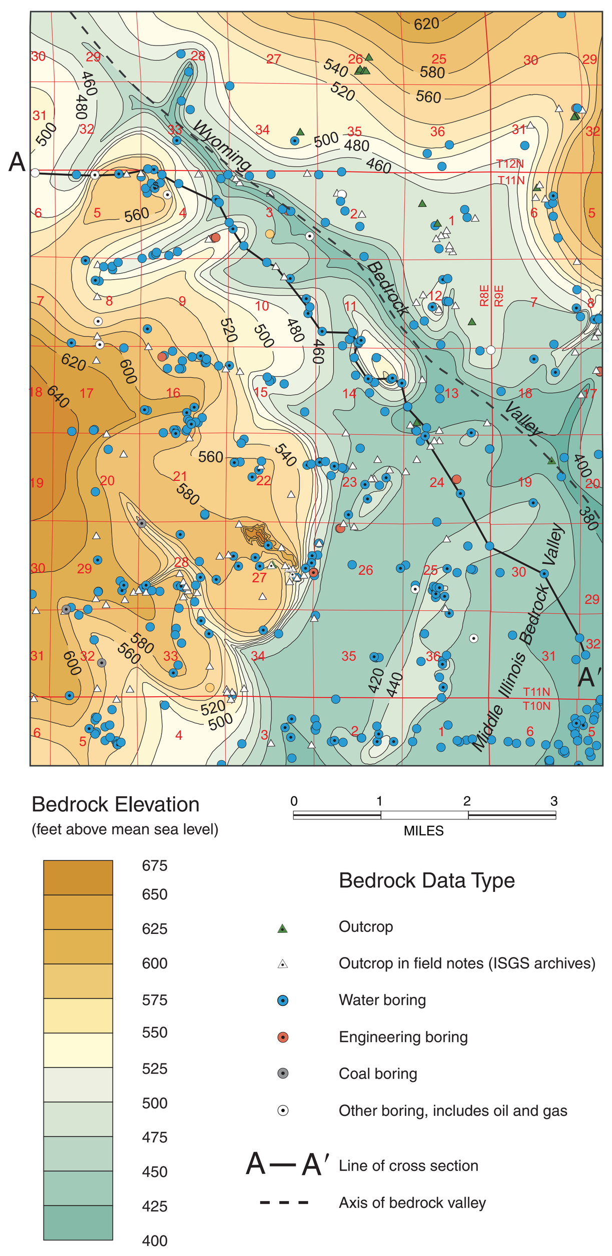


Figure 3 Bedrock topography of the Rome Quadrangle. Modified from Berg et al. (2009).

Mapping Techniques

This surficial geology map and associated cross section were developed from existing surface and subsurface geologic information available from the ISGS Geological Records Unit. The interpretations made from this data were verified by the geology observed at selected field sites in the quadrangle and from inferences made from geologic maps of the adjoining Spring Bay and Dunlap quadrangles (Stumpf and Weibel 2005, Hardy and Weibel 2008) that were based upon descriptions of continuous core to bedrock.

Digital soils data compiled by the United States Department of Agriculture, Natural Resources Conservation Service (NRCS), were the basis of a preliminary surficial geologic map. The data were provided to the ISGS by the NRCS for this project and cover portions of Peoria County and Marshall County. The soils data were digitized from maps published in county reports by Walker (1992) and Teeter and Walker (2002).

These county maps of soil series were combined and generalized into soil parent material classes by Berg et al (2004). This information provides the following unit boundaries: thick loess, thin loess, and alluvium. Previous geomorphic mapping in the Illinois River valley by Hajic (2000), and new mapping by the author from aerial photographs, were used to modify parent material boundaries.

Geologic information from field descriptions of natural and man-made exposures, engineering borehole and water-well drillers' logs, downhole geophysical logs, archived maps, and topographic maps were used to better define geologic map unit boundaries. Software was used to compile and analyze field data, to prepare the map, and publish in digital format one northwest-southeast cross section labeled A–A′. The cross section was constructed to portray the sequence of Quaternary deposits in the subsurface above bedrock. A record of geologic materials encountered at each site is available from the ISGS Geological Records Unit and http://www.isgs.illinois.edu/maps-data-pub/isgs-quads/r/rome.shtml.

For the surficial geology maps of the Rome Quadrangle and Middle Illinois River valley (McKay et al. 2010), some geologic map units include materials that were mapped as separate polygons on maps of adjoining quadrangles. For example, on the surficial geology map of the Spring Bay Quadrangle (Stumpf and Weibel 2005), the Tiskilwa till is mapped separately from colluvial slopewash and gravity-flow deposits classified to the Peyton Formation that are found on and at the base of hillslopes. In the Rome Quadrangle, Peyton Formation deposits are also found in the same topographic position, but are mapped as part of the Tiskilwa till unit.

Map Unit Characterization and Stratigraphic Relationships

The surficial geology map and accompanying cross section delineate geologic materials (formally called lithostratigraphic units) that are classified by their lithology (sediment type or rock type) and stratigraphic position. The stratigraphic nomenclature used here is from Willman and Frye (1970) and Hansel and Johnson (1996). Lithostratigraphic units in the Illinois River valley area have a complex but mappable pattern of occurrence.

In the Rome Quadrangle, the sediments deposited during glacial and nonglacial times of the Quaternary Period range in thickness from less than 5 feet to 330 feet above bedrock. Multiple diamicton units from the Illinois and Wisconsin Episode glaciations have been differentiated. At the surface, the Tiskilwa till comprises the steep bluffs along the Illinois River valley and its tributary valleys, the moraines, and some lower areas between moraines. Windblown sand and silt (dunes) are found primarily on the Illinois River floodplain, but locally are present as small hills on the uplands. Deposits of modern river and overbank sediment and of organic-rich silt and sand are also present on the floodplain. Organic-rich sediments also occur in deposits that infill depressions on the uplands.

In the subsurface, meltwater stream and river sediments infill the Middle Illinois Bedrock Valley and its tributary valleys (fig. 2). Glacial lake sediment is also present in the subsurface, especially the lower part of the bedrock valley fill, where glaciers advancing into the area locally blocked drainage. Organic-rich silt classified to the Robein Member of the Roxana Silt was encountered in the uplands and is a key stratigraphic marker bed. Silt classified to the Robein Member was deposited about 29,964 cal yr B.P. (26,180 ± 230 radiocarbon years before present; ISGS-6553) on an older landscape in small water bodies or depressions during the nonglacial period prior to the advance of Wisconsin Episode glaciers into the area. Locally in the subsurface below the Robein Member, remnants of a paleosol (Sangamon Geosol) developed in deposits classified to the Glasford Formation are preserved. This soil formed prior to the deposition of the organic silt during a nonglacial period (Sangamon Episode) between 60,000 and 130,000 years ago.

Acknowledgments

This mapping was partially funded by IDOT as part of the Preliminary Environmental Assessment for the "IL Route 29 Study in Peoria, Marshall, Putnam, and Bureau Counties." Funding was obtained to conduct detailed geologic mapping and geophysical surveys along the road corridor. General Revenue Funds from the State of Illinois were used to support geologic mapping outside the corridor study area and to cover costs associated with geophysical logging of water wells, laboratory analyses, and field logistics.

The author thanks ISGS staff C. Pius Weibel, Richard Berg, Donald McKay, Jane Domier, Jennifer Carrell, Lisa Smith, Jane Duncan, Donald Keefer, and Christopher Stohr for support in the field, management of project databases, processing of digital data and compilation of basemaps, data entry, and technical review. The Peoria GIS Consortium through the Tri-County Planning Commission provided access to planimetric data and digital orthophotographs. The USDA-NRCS provided soils data digitized from paper maps. Water well drillers shared propriety data and access to drill sites to collect drill cutting samples and logs of downhole geophysical data. Private landowners provided access to outcrops and drill sites.

References

Berg, R.C., P.D. Johnstone, and A.J. Stumpf, 2004, Soil parent materials map of the Middle Illinois River valley region: Illinois State Geological Survey, Illinois Geology Map, IDOT contract report, 1:48,000.

Berg, R.C., C.P. Weibel, A.J. Stumpf, and E.D. McKay III, 2009, Bedrock topography of the Middle Illinois River valley, Bureau, Putnam, Peoria, Putnam, and Woodford Counties: Illinois State Geological Survey, Illinois Map 15, 1:62,500. http://www.isgs.illinois.edu/maps-data-pub/regional-maps/mid-il-riv-val.shtml.

Hajic, E.R., 2000, Landform sediment assemblage (LSA) units in the Illinois River valley and the Lower Des Plaines River Valley: Illinois State Museum, Quaternary Studies Program, Technical Report No. 99-1255-16, 45 p.

Hansel, A.K., and W.H. Johnson, 1996, Wedron and Mason Groups: Lithostratigraphic reclassification of deposits of the Wisconsin Episode, Lake Michigan Lobe area: Illinois State Geological Survey, Bulletin 104, 116 p.

Horberg, C.L., 1950, Bedrock topography of Illinois: Illinois State Geological Survey, Bulletin 73, 111 p.

Illinois State Geological Survey, 2000, Surficial deposits of Illinois: Illinois State Geological Survey, Open File 2000-7, 1:500,000.

Luman, D.E., L.R. Smith, and C.C. Goldsmith, 2003, Illinois surface topography: Illinois State Geological Survey, Illinois Map 11, 1:500,000.

McKay, E.D., III, and R.C. Berg, 2008, Optical ages spanning two glacial-interglacial cycles from deposits of the Ancient Mississippi River [abs.]: Geological Society of America, North-Central Section, Abstracts with Programs, v. 40, no. 5, p. 78.

McKay, E.D., III, R.C. Berg, A.J. Stumpf, and C.P. Weibel, 2010, Surficial geology of the Middle Illinois River valley, Bureau, Marshall, Peoria, Putnam, and Woodford Counties, Illinois: Illinois State Geological Survey, Illinois Map 16, 1:48,000. http://www.isgs.illinois.edu/maps-data-pub/regional-maps/mid-il-riv-val-sg.shtml.

Stumpf, A.J., and C.P. Weibel, 2005, Surficial geology of Spring Bay Quadrangle, Peoria and Woodford Counties, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ Spring Bay-SG, 1:24,000. http://www.isgs.illinois.edu/maps-data-pub/isgs-quads/s/spring-bay.shtml.

Teeter, W.M., and M.B. Walker, 2002, Soil survey of Marshall County, Illinois: United States Department of Agriculture, Natural Resources Conservation Service, 301 p. http://soildatamart.nrcs.usda.gov/manuscripts/IL123/0/marshall_IL.pdf.

Walker, M.B., 1992, Soil survey of Peoria County, Illinois: United States Department of Agriculture, Natural Resources Conservation Service, 139 p. http://soildatamart.nrcs.usda.gov/manuscripts/IL143/0/peoria.pdf.

Willman, H.B., and J.C. Frye, 1970, Pleistocene stratigraphy of Illinois: Illinois State Geological Survey, Bulletin 94, 204 p.