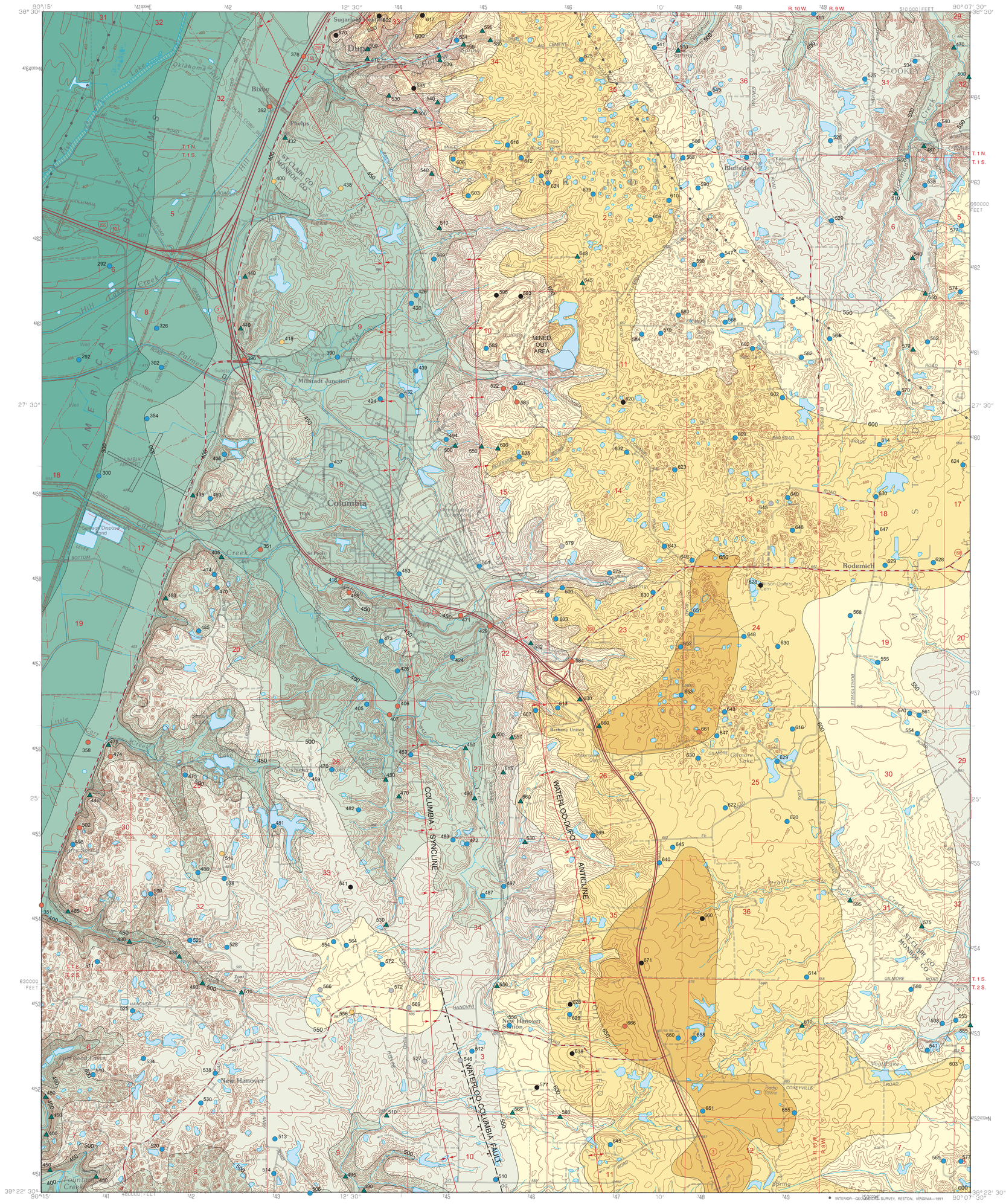
Illinois Department of Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

Bedrock Topography of Columbia Quadrangle

Monroe and St. Clair Counties, Illinois

Samuel V. Panno, Julie C. Angel, David A. Grimley, C. Pius Weibel, and Barbara J. Stiff
2008

Illinois Geologic Quadrangle Map
IGQ Columbia-BT



Introduction

The bedrock topography of the Columbia Quadrangle is part of a series of maps by the Illinois State Geological Survey (ISGS) that interpret (at a scale of 1:24,000) the geology within 7.5-minute quadrangles in the Metro East Illinois area of Greater St. Louis. Data collection and interpretation were funded by the ISGS.

The Columbia Quadrangle is an area presently experiencing rapid population growth and urban and suburban development of primarily rural and agricultural land. Because of increasing environmental concerns with karst and associated groundwater contamination issues, it is important to document the bedrock topography for urban planning, land use planning, and water resource management.

The Columbia Quadrangle lies within the southwestern Illinois sinkhole plain, which is within the Salem Plateau Section (Leighton et al. 1948). The karst topography that dominates the study area is the result of the soluble nature of the underlying bedrock. Mississippian-age carbonate bedrock, particularly St. Louis and Ste. Genevieve Limestones, contain solution-enlarged secondary fractures, and the area is characterized by cover-collapse sinkholes, caves, and large springs.

Map Use

This map is useful for delineating the locations of buried bedrock valleys and for defining flow patterns and recharge and discharge pathways of these aquifers. The map is essential for accurate assessment of the volume and distribution of economically significant shallow deposits of limestone and other construction stone. It is a useful predictive guide for drilling operations, construction and engineering projects, and geophysical surveys and as a base map from which geological units and bedrock structures can be delineated. This bedrock surface is the lower limiting surface that must be integrated into three-dimensional models of the overlying Quaternary sediments. Finally, this bedrock surface is the lower limiting surface that must be integrated into three-dimensional models of the overlying Quaternary sediments.

Mapping Methods

The bedrock topography was mapped using data from 148 well logs from the ISGS wells and borings database. Well locations were verified using plat books. Bedrock exposures were used to identify bedrock surface elevations; such exposures were usually associated with the bottom of sinkholes, cave entrances, springs, bluffs along major stream valleys, and stream bottoms. Additional information was collected from the logs and drill holes used in the exploration for coal and petroleum, and from engineering borings (bridges). The data were plotted and contoured by hand; the resultant map was scanned into raster format and digitized using ESRI ArcMap software. Bedrock elevations were subtracted from standard 30-m digital elevation model data to be sure that the bedrock surface did not extend above the land surface. Because of the low data density, contour lines were not modified in the vicinity of sinkholes.

Bedrock Topography, Geology, and Hydrogeology

The Columbia Quadrangle is on the western margin of the Illinois Basin, and the bedrock dips gently to the east. Much of Monroe County and parts of St. Claire County to the north and Randolph County to the south are referred to as the sinkhole plain because of the area's high density of sinkholes. Approximately 10,000 sinkholes (with densities as high as 230 per square mile), numerous large springs, and the largest caves in the state are found in the Salem Plateau Section (Panno and Weibel 1996, Weibel and Panno 1997, Panno et al. 2004). Glacial drift thickness in this area is relatively thin and typically ranges from 0 to 30 feet (Herzog et al. 1994). Bedrock is covered by a layer of windblown loess that overlies Illinoian glacial deposits and pre-Illinois Episode residuum. This material, especially loess, is easily eroded and forms numerous cover-collapse sinkholes (sinkholes formed in sediment overlying creviced bedrock) and steep-sided gullies. Sinkholes have formed in about 30 feet of loess and glacial sediments over crevices in the bedrock surface that are 6 or more inches wide (Panno et al. 2008). Bedrock exposures in the quadrangle are most often associated with sinkholes, cave entrances, large springs, and along the bluffs overlooking the Mississippi River, large streams, and streambeds. Most sinkholes, caves, and large springs occur in the Mississippian-age St. Louis and Ste. Genevieve Limestones; these fairly soluble rocks and moderate (40 inches/year) precipitation, are responsible for widespread karst terrain in southwestern Illinois (Weibel and Panno 1997), Kentucky, and Indiana.

The bedrock topography of the quadrangle is generally reflected in the surface topography. An upland plateau covers the eastern half of the quadrangle; maximum elevation is 671 feet above mean sea level. In the northwestern corner, the bedrock surface in the Mississippi River valley is less than 300 feet, an elevation difference of 371 feet within the quadrangle, and lies beneath relatively thick fluvial sediments. The upland plateau and the Mississippi River lowlands are separated by the north-south to northwest-southeast–trending bluff of the Mississippi River valley (in this quadrangle), which has a relief of 100 feet to the terrace where the city of Columbia is located and a second bluff with 125 feet of relief. Both the upland plateau and the terrace are dissected by several relatively short tributary streams along the bluff that drain west to the Mississippi River.

St. Clair County is on the western margin of the Illinois Basin, and bedrock dips gently to the east toward the center of the Basin. Bedrock in the sinkhole plain consists of Mississippian limestone; the glacial drift is relatively thin (Willman and Frye 1970, Herzog et al. 1994). Bedrock lithology in the Columbia Quadrangle is composed predominantly of Mississippian-age limestone and Pennsylvanian-age rocks (sandstone, shale, limestone, coal) on the terrace on which the City of Columbia was built and on the far eastern edge of the quadrangle (unpublished mapping by J.A. Devera; Willman et al. 1975). Bedrock is covered by a layer of windblown loess that overlies Illinoian glacial till and/or residuum (Willman and Frye 1970). This material, especially loess, is easily eroded and forms numerous cover-collapse sinkholes and steep-sided gullies. Bedrock exposures in the quadrangle are most often found along the steep bluffs and are associated with sinkholes, cave entrances, and large springs. One of the longest caves in the state (Stemler Cave, Sec. 12, T1S, R10W) is located within the quadrangle and feeds Sparrow Creek Spring, a relatively large spring to the north (Sec. 35, T1N, R10W).

The northwest-southeast–trending Waterloo-Dupo Anticline and the Columbia Syncline (unpublished mapping by J.A. Devera) extend across the western and central part of the quadrangle from the north before entering the Waterloo Quadrangle. Bedrock along the asymmetrical Waterloo-Dupo Anticline dips 45° on the western limb and 2° to 4° on the eastern limb (Nelson 1995). The terrace above the American Bottoms, on which the city of Columbia was built, is the result of Pennsylvanian-age rocks being deposited in the topographic low created by the syncline (unpublished mapping by J.A. Devera). The uplands begin along the crest of the Waterloo-Dupo Anticline and are apparently structurally controlled.

References

Herzog, B.L., B.J. Stiff, C.A. Chenoweth, K.L. Warner, J.B. Sieverling, and C. Avery, 1994, Buried bedrock surface of Illinois: Illinois State Geological Survey, Illinois Map 5, 1:500,000.

Leighton, M.M., G.E. Ekblaw, and C.L. Horberg, 1948, Physiographic divisions of Illinois: Journal of Geology, v. 56: 16–33.

Nelson, J.W., 1995, Structural features in Illinois: Illinois State Geological Survey, Bulletin 100, 144 p.

Panno, S.V., J.C. Angel, D.O. Nelson, C.P. Weibel, and J.A. Devera, 2008, Sinkhole density of Columbia Quadrangle, Monroe County, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ Columbia-SD, 1:24,000; report, 6 p.

Panno, S.V., S.E. Greenberg, C.P. Weibel, and P.K. Gillespie, 2004, Guide to the Illinois Caverns State Natural Area: Illinois State Geological Survey, GeoScience Education Series 19, 106 p.

Panno, S.V., and C.P. Weibel, 1996, Karst regions of Illinois: Illinois State Geological Survey, Open File Series 1997-2, 42 p.

Weibel, C.P., and S.V. Panno, 1997, Karst terrains and carbonate bedrock of Illinois: Illinois State Geological Survey, Illinois Map 8, 1:500,000.

Willman, H.B., E. Atherton, T.C. Buschback, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975, Handbook of Illinois stratigraphy: Illinois State Geological Survey, Bulletin 95, 261 p.

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

Base map compiled by Illinois State Geological Survey from digital data provided by the United States Geological Survey. Topography compiled by photogrammetric methods from aerial photographs taken 1986. PLSS current as of 1991. Planimetry derived from imagery taken 1998.

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 15

Recommended citation:
Panno, S.V., J.C. Angel, D.A. Grimley, C.P. Weibel and B.J. Stiff, 2008, Bedrock Topography of Columbia Quadrangle, Monroe and St. Clair Counties, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ Columbia-BT, 1:24,000.

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 10 FEET
SUPPLEMENTARY CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Released by the authority of the State of Illinois: 2008

Geology based on field work and data compilation by S. Panno, J. Angel, D. Grimley, C.P. Weibel and B. Stiff, 1997–1998.

Digital cartography by J. Domier, B. Stiff, M. Bentley, S. Geegan, A. Schultz, and S. Radil, Illinois State Geological Survey.

The Illinois State Geological Survey, the Illinois Department of Natural Resources, and the State of Illinois make no guarantee, expressed or implied, regarding the correctness of the interpretations presented in this document and accept no liability for the consequences of decisions made by others on the basis of the information presented here. The geologic interpretations are based on data that may vary with respect to accuracy of geographic location, the type and quantity of data available at each location, and the scientific and technical qualifications of the data sources. Maps or cross sections in this document are not meant to be enlarged.

Bedrock Elevation
(feet above mean sea level)

700 650 600 550 500 450 400 350 300 250

Data Type

- Outcrop
- Stratigraphic boring
- Water-well boring
- Engineering boring
- Coal boring
- Oil well
- 426 — Numeric label indicates bedrock elevation in feet above mean sea level
- Fault, bar and ball on downthrown side, inferred
- Syncline
- Anticline

Note: Well and boring records are on file at the ISGS Geological Records Unit and are available from the ISGS Web site.

ILLINOIS DEPARTMENT OF NATURAL RESOURCES
ISGS Illinois State Geological Survey

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

1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Webster Groves, MO
2 Cahokia
3 French Village
4 Oakville
5 Millstadt
6 Valmeyer
7 Waterloo
8 Paderborn

½° MAGNETIC NORTH / TRUE NORTH
APPROXIMATE MEAN DECLINATION, 2008

ROAD CLASSIFICATION

Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route
U.S. Route
State Route