DIGITAL MAPPING TECHNIQUES 2023

The following was presented at DMT'23
May 21 - 24, 2023

The contents of this document are provisional

See Presentations and Proceedings
from the DMT Meetings (1997-2023)

http://ngmdb.usgs.gov/info/dmt/

A New Statewide Quaternary Map of Illinois: Current Progress and New Findings

David A. Grimley, B. Brandon Curry, Katie M. Mandera, Andrew C. Phillips, Andrew J. Stumpf, Sarah N. Dendy-Metz, Deette M. Lund, McKenzie S. Hamilton

ILLINOIS
Illinois State Geological Survey
PRAIRIE RESEARCH INSTITUTE

Illinois State Geological Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign

ABSTRACT

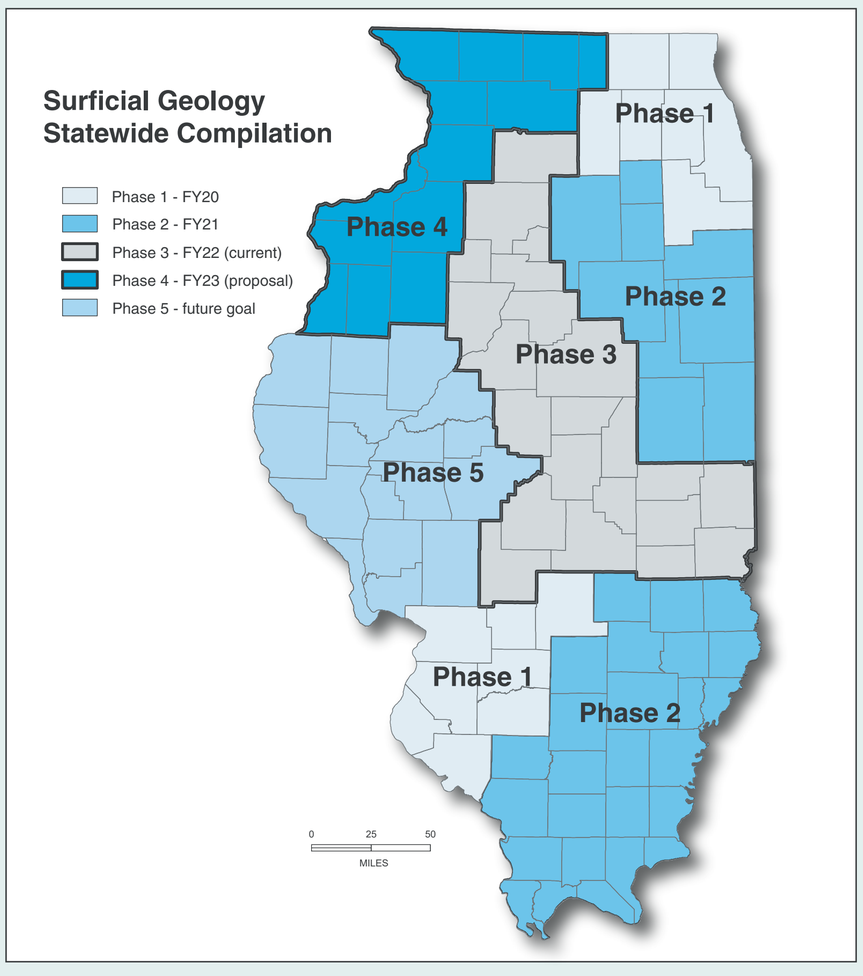
A new Quaternary (surficial geology) map is being developed for Illinois, to update and replace the 1979 Quaternary deposits map (J.A. Lineback). Remapping of Illinois' Quaternary deposits is a 5-year project, currently in its third year. Contact lines are being drawn digitally at 1:80,000 to 1:100,000 scale with the intention of final map publication at 1:250,000 or 1:500,000 scale. To follow current USGS standards, a geological mapping schema (GeMS) is being implemented that tracks data sources used to inform the map, confidences in contact line locations and certainty of polygon unit identification. With four decades of mapping since publication of the Lineback Quaternary map, many updates to map unit boundaries and stratigraphic classifications are being made. Data sources include USDA-NRCS soil survey maps, historical field notes (early- to mid-20th century), aerial photography, digital elevation maps, detailed surficial geology maps, archived sample sets/cores, geophysical data, subsurface boring data, and the 1979 Lineback map.

One significant update from earlier mapping in northeastern Illinois is the addition of previously unrecognized, last glacial, ice-walled lake deposits. Radiocarbon dating of macrofossils within these lake deposits is helping to improve the chronology of glacial moraines and till units. A significant change in south-central Illinois is that many hills, formerly mapped to contain ice-contact deposits, have been found to be bedrock-controlled hills. Based on shallow drillholes and archived samples descriptions, these hills are mainly cored by Pennsylvanian sandstone. Across wide areas of the Illinois Episode till plain in southern Illinois with shallow bedrock and thin loess cover, glacial lineations (from < 0.5 to 8 km long) are notable on digital elevation or LiDAR surface elevation maps. These lineations are indicated on the Quaternary deposit map, along with loess thickness contour lines and moraine crests. Another new addition is a 10-mile buffer zone into surrounding states, thus displaying the full width of the Wabash, Ohio, and Mississippi River valleys. This buffer zone will help to facilitate collaboration with adjacent state geological surveys to resolve lithostratigraphic correlations and to help achieve the long-term goal of a seamless national map.

METHODOLOGY AND DATA SOURCES

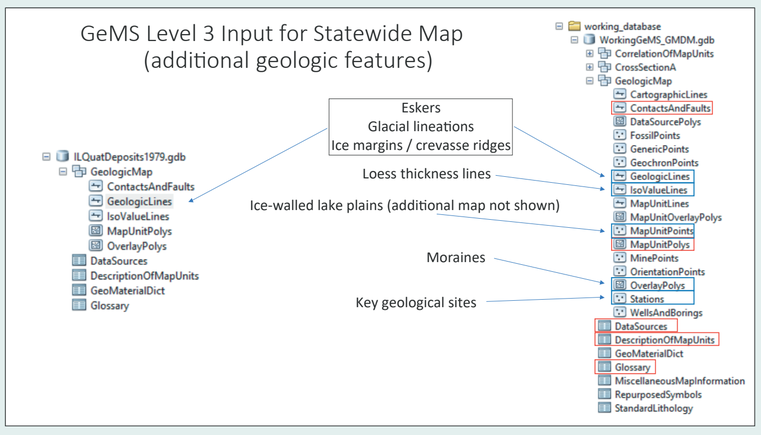
- **Contacts** were drawn at either 1:80,000 or 1:100,000 scale in ArcGIS
- **Polygons** smaller than 400 m x 400 m (160,000 m^2) are generally not mapped, with rare exceptions. Elongate polygons that are more narrow than 250 m (*e.g.*, alluvial valleys) are generally not mapped.
- **Loess contour lines** show thicknesses of 30, 15, 10, & 5 feet (on uneroded uplands); similar in style to Lineback (1979). The loess contours are an *overlay*.
- **Ice margins** (interpreted from moraines, sediment records or other geomorphology) are another *overlay* shapefile
- **Glacial lineations** (areas of areal scour, drumlins, drumlinoids, flutes, or crag and tail) were mapped as an *overlay* at 1:50,000 to 1:150,000 scale from LiDAR or with 10m digital elevation maps. These lineations have not been previously mapped at the statewide scale and indicate ice flow direction.
- Mapping of a **10-mile buffer zone** into adjacent states was made in order to facilitate collaborations with surficial geologists in adjoining states and to show the geologic context and full width of the Wabash, Ohio, and Mississippi River Valleys. Quaternary mapping in Indiana was aided by Gray (1989), among other sources. In Kentucky, digital geological maps were available for all quadrangles, but Quaternary mapping was not always consistent.
- **Data sources** that guided the new mapping include the prior Quaternary map of Illinois [Lineback (1979)], subsurface boring records (water wells, engineering borings, stratigraphic tests), sample sets and cores archived at the ISGS, USDA-NRCS soil mapping, historical field notes of ISGS geologists (~1905 - 1985), newly acquired drillholes and analytical data, geophysical data, prior geologic reports, and detailed geologic mapping of counties (1:62,500 or 1:100,000) or 1:24,000 quadrangles.
- **Geologic notes** are being kept by county or region to document rationale for new mapping, in particular with regards to differences from the Lineback (1979) Quaternary map.

PHASE MAP



Map showing the ISGS plan for 5-year completion of the statewide Quaternary Map of Illinois. Phase 3 is about halfway complete as of March 2023.

GEOLOGIC MAPPING SCHEMA (GeMS)



Confidence Term	Definition	Examples of GeoMaterial Use from Illinois Quaternary Map		
		MapUnit	GeoMaterial	Reasoning
High	*adequately characterizes* the overall lithologic nature of map unit	Cahokia Formation	Alluvial Sediment	accurate
		Parkland facies, Henry Formation	Dune sand	accurate
		Peoria & Roxana Silts	Loess	accurate
Medium	*generally characterizes* the overall lithologic nature of sediments in the map unit, but **one or more** significant but minor lithologies are not adequately described by the selected term	Grayslake Peat	Peat and muck	also includes silt and clay
		Banner Formation	Clastic sediment	include till, outwash, lake sed.
		Teneriffe Silt	Lacustrine sediment, mostly fine-grained	may include loess
		Wadsworth Formation	Glacial till, mostly clayey	may include sand and gravel
		Hagarstown Member. Pearl Fm.	Ice-contact and ice marginal sediment	may include diamicton / silt
Low	Either (1) the overall lithologic nature of sediments in this map unit is not adequately classifiable using the available list of GeoMaterial terms (and their definitions), but **the selected term is the best available**, or (2) this map unit is not sufficiently known enough to confidently assign a GeoMaterial term	No map units classifed as low confidence (as of now)		

Contact Line Location Confidence: solid line contacts (250 m)
dashed line contacts (500 m)

Data Sources Utilized: sources used to guide drawing of contacts and polygons has been tracked in ArcGIS and will be included in the final GeMS database

ILLINOIS QUATERNARY (SURFICIAL GEOLOGY) DRAFT MAP

QUATERNARY DEPOSITS

Description	Unit	Interpretation
HUDSON EPISODE (~12,000 years before present (B.P.) to today)		
anthropogenic fill, mines, pits, or excavations	Disturbed Ground: dg	**anthropogenic sediment or excavations**
organic silt, peat, and muck; may include beds of fine sand, silt, silty clay, and marl	Grayslake Peat: gp	**palustrine sediment** in wetlands, lowlands or depressions
silt loam to silty clay to loamy sand to gravelly silt	Cahokia Formation: c	**alluvium;** generally in modern floodplains; includes overbank, point bar and channel deposits
silt loam to fine sand; moderately well sorted	Cahokia Formation (fan facies): c(f)	**alluvial fan deposits**; typically adjacent to valley bluffs
silt loam to rocky silt loam; may include angular fragments of locally-derived chert, sandstone, limestone or shale	Peyton Formation: py	**colluvium**, may include loess
WISCONSIN EPISODE (~55,000 to ~12,000 years B.P.)		
loamy sand to fine sand to gravelly coarse sand, moderately to well sorted, stratified	Henry Formation (outwash facies): h	**outwash;** proglacial meltwater deposits in fans or valley-trains, may locally include dune sand
fine sand to gravelly sand, with minor beds of silt and clay	Dolton Facies, Henry Formation: h(d)	**beaches, bars, spits, and deltas;** mostly associated with paleo-shorelines of ancestral Lake Michigan
fine to very fine sand, well sorted	Parkland Facies, Henry Formation: h(p)	**eolian sand** in dunes or as cover-sand or sheet-sand
loamy sand to gravelly coarse sand, may contain diamicton or silt beds with folded or faulted bedding (due to collapse during glacial melting)	Wasco Facies, Henry Formation: h(w)	**ice-contact sand** in kames, eskers, or supraglacial environments
silt loam to silty clay loam to fine sand; massive to laminated; may contain aquatic or palustrine fossils or organics	Equality Formation: e	**lake sediments** in proglacial, slackwater, supraglacial or kettle lakes
silt (primarily), fine sand, gravelly sand, and diamicton, fossiliferous in zones	Equality Formation (complex): e(x)	**ice-walled lake sediments** on former stagnant glaciers
silt to silt loam; friable; weak to strong soil structure; may contain paleosols or terrestrial fossils (e.g., gastropods)	Peoria and Roxana Silts: pr	**loess deposits**; may include resedimented loess along slopes
silty clay to silty clay loam diamicton; may contain lenses of silt, clay or sand and gravel; overlain by thin loess	Wadsworth Formation: w	**glacial till and ice-marginal sediment**, Lake Michigan Lobe
pebbly loam diamicton; may contain lenses of sand and gravel	Trafalgar Formation: tf	**glacial till and ice-marginal sediment**, Huron-Erie Lobe
silty clay to silty clay loam to loam to sandy loam diamicton; may contain lenses of silt, clay or sand and gravel; overlain by thin loess	Lemont Formation (undivided): l	**glacial till and ice-marginal sediment**, Lake Michigan Lobe
sandy loam to loam diamicton; dolomite-rich; may contain lenses of sand and gravel; overlain by thin loess	Haeger Member, Lemont Formation: l-h	**glacial till and ice-marginal sediment**, Lake Michigan Lobe
silty clay to silty clay loam diamicton; may contain lenses of silt, clay or sand and gravel; overlain by thin loess	Yorkville Member, Lemont Formation: l-y	**glacial till and ice-marginal sediment**, Lake Michigan Lobe
loam diamicton; may contain lenses of sand and gravel; overlain by thin loess	Yorkville Member, loamy facies, Lemont Formation: l-y(l)	**glacial till and ice-marginal sediment**, Lake Michigan Lobe
silt loam to silty clay loam to loam diamicton; may contain lenses of silt or sand and gravel; overlain by thin loess	Batestown Member, Lemont Formation: l-b	**glacial till and ice-marginal sediment**, Lake Michigan Lobe
pebbly loam diamicton; typically very stiff and dense where thick; has a slight pinkish-brown or reddish brown hue where oxidized; overlain by 1-3 m loess	Tiskilwa Formation: t	**glacial till and ice-marginal sediment**, Lake Michigan Lobe
ILLINOIS EPISODE (~200,000 to130,000 years B.P.)		
fine sand to gravelly coarse sand; moderately to well sorted; contains Sangamon Geosol in upper 2 m; overlain by loess	Pearl Formation (outwash facies): pl	**outwash;** proglacial meltwater deposits in fans or valley-trains
mixture of loam, fine to coarse sand, fine gravel, silt loam, and diamicton; weakly stratified; may contain faults (due to glacial ice collapse); contains Sangamon Geosol in upper 2 m; overlain by loess	Hagarstown Member, mixed facies, Pearl Formation: pl-h(m)	**ice-contact sand** in kames, fans, crevasses, reentrants, or supraglacial environments
sand to gravelly sand, with some fine-grained interbeds; stratified; may locally contain inclusions of diamicton; contains Sangamon Geosol in upper 2 m; overlain by loess	Hagarstown Member, sandy facies, Pearl Formation: pl-h(s)	**ice-contact sand** in kames, eskers, ice-walled channels, or supraglacial
silt loam to silty clay, may contain fine sand or loamy beds; massive to stratified; contains Sangamon Geosol in upper 2 m; overlain by loess	Teneriffe Silt: tr	**proglacial or slackwater lake sediments**; includes redeposited loess in lowlands
diamicton; may contain sand and gravel lenses; Sangamon Geosol locally preserved in upper 2 m; overlain by thin loess	Capron Member, Glasford Formation: g-c	**glacial till and ice-marginal sediment** formerly in Winnebago Fm.; informally reassigned
loam to clay loam to silty clay loam diamicton; may contain sand and gravel lenses; locally contains Sangamon Geosol in upper 2 m; overlain by thin loess	Belvidere Member, Glasford Formation: g-b	**glacial till and ice-marginal sediment**
silt loam diamicton; may contain sand and gravel lenses; contains Sangamon Geosol in upper 2 m; overlain by loess	Radnor Member, Glasford Formation: g-r	**glacial till and ice-marginal sediment** includes former Sterling, Esmond, and Lee Center Members
diamicton; may contain sand and gravel lenses; Sangamon Geosol locally preserved in upper 2 m; overlain by thin loess	Argyle Member, Glasford Formation: g-a	**glacial till and ice-marginal sediment** formerly in Winnebago Formation; informally reassigned; includes Nimtz Member
pebbly loam diamicton (generally > 30 % sand content); typically dense; may contain sand and gravel lenses; contains Sangamon Geosol in upper 2 m; overlain by loess	Vandalia Member, Glasford Formation: g-v	**glacial till and ice-marginal sediment**
silty loam to silty clay loam diamicton (generally < 30 % sand content); moderately stiff (softer than Vandalia Member); contains Sangamon Geosol in upper 2 m; overlain by loess	Glasford Formation, fine-grained facies: g	**glacial till and ice-marginal sediment;** locally with inclusions of proglacial sediment; mapped near ice-margin in Southern Illinois
PRE-ILLINOIS EPISODE (1,200,000 to 430,000 years B.P.)		
includes gravelly sand, sandy silt, silty sand, silt, and diamicton; diamicton portions have a pedogenic origin with clay matrix due to weathering	Metropolis Formation: m	**weathered alluvium,** may be overlain by younger loess units (includes New Columbia sand); may include Illinois Episode deposits
diamicton; may include sand and gravel or fine-grained sediment; Yarmouth Geosol (interglacial paleosol) may be preserved in upper 2 to 3 m; overlain by loess or other sediment	Banner Formation: b	**glacial till and ice-marginal sediment,** proglacial outwash and lake sediment
Pliocene to middle Pleistocene Deposits		
brown chert gravel, rounded; some rounded quartz; includes beds of sand and silty sand; weathered in upper part; overlain by Loveland Silt, Roxana Silt, and Peoria Silt (loess units)	Mounds Gravel: QTm	**alluvium (coarse-grained);** mainly sourced from Tennessee River Valley
Pre-Pliocene Deposits		
typically shale, mudstone, sandstone, limestone, coal, or dolostone; includes some weakly consolidated Cretaceous or Tertiary units in western and southernmost Illinois (Kolata et al., 2005)	Bedrock: R	**Miocene or older bedrock**; dominantly Paleozoic sedimentary rocks; mapped where bedrock occurs within about 5 to 8 feet of the surface

Explanation of Map Symbols

- County seat
- Key geological site
- Interstate highway
- Contact
- Glacial limit
- Ice-margin position
- Crevasse-squeeze ridges
- Eskers
- Glacial lineations
- Loess thickness contour (feet) — 15
  - Loess contours show the combined thickness of Peoria and Roxana Silts on uneroded upland areas. The actual thickness at a given spot may be much less, especially along valley slopes where post-depositional erosion of loess has been significant.
- g-k — Karst (overlay) - Glasford Fm
- g-m — Morainal (overlay) - Glasford Fm

N

SCALE 1:500,000

10 0 10 20 30 MILES

10 0 10 20 30 KILOMETERS

Digital cartography by D. Lund, K. Mandera, E. Bunse, Illinois State Geological Survey.

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program under StateMap award number G21AC10861, 2021. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

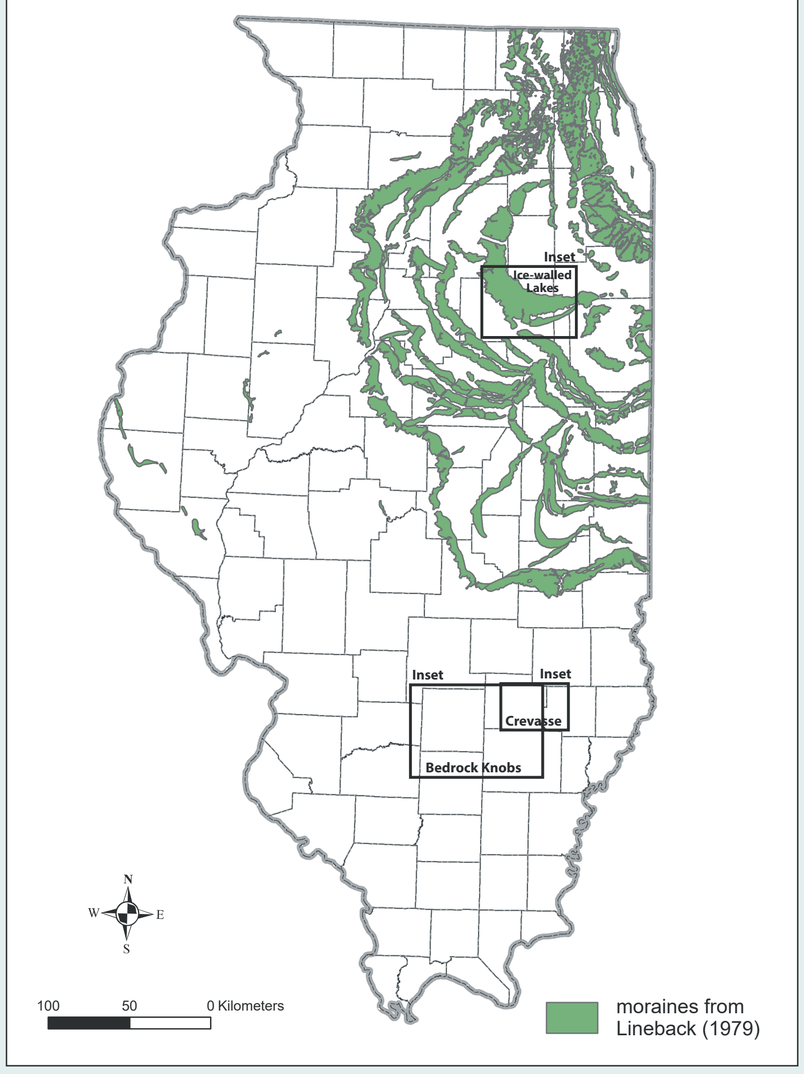
This map is in-progress and has not undergone the formal Illinois Geologic Quadrangle map review process. Whether or when this map will be formally reviewed and published depends on the resources and priorities of the ISGS.

90° 0' 0" W

40° 0' 0" N

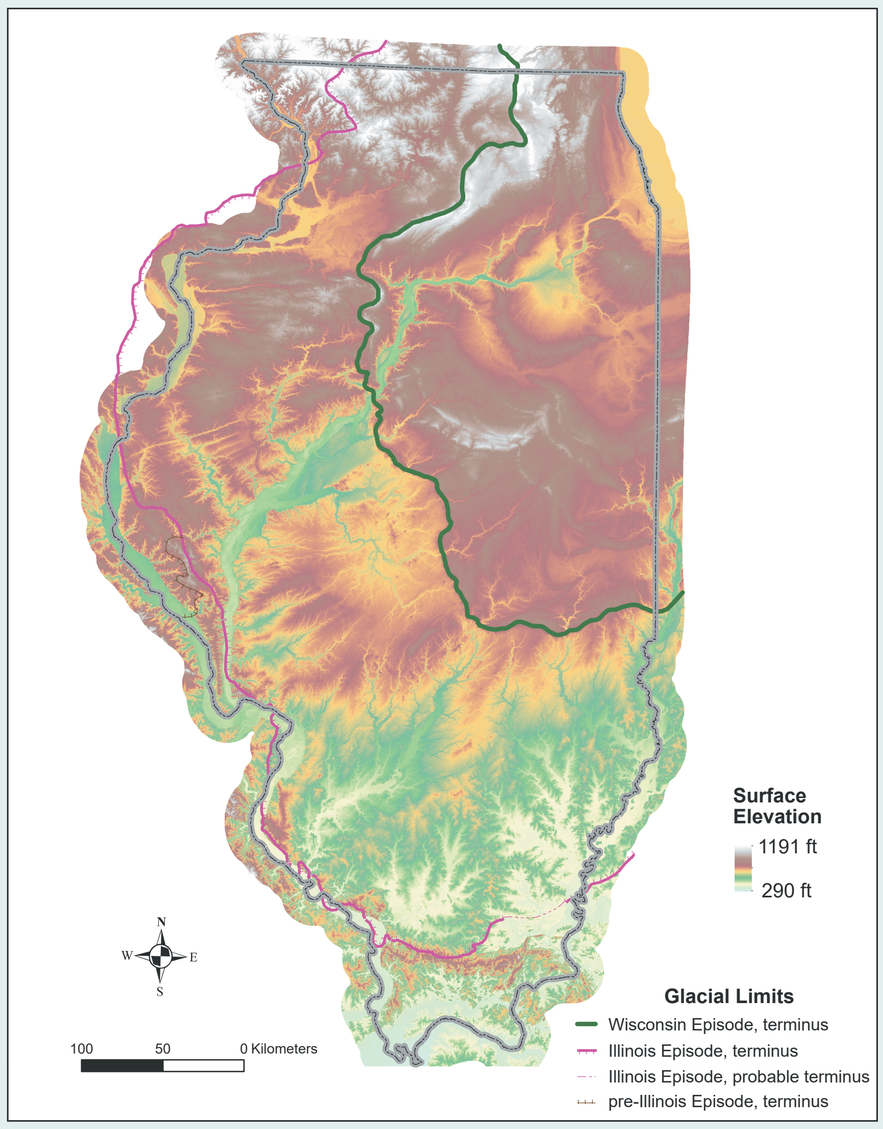
Bordering STATES
1 Wisconsin
2 Indiana
3 Kentucky
4 Missouri
5 Iowa

MORAINES



Wisconsin Episode and Illinois Episode moraines, Lineback (1979), 1:2,500,000 scale

DIGITAL ELEVATION MAP

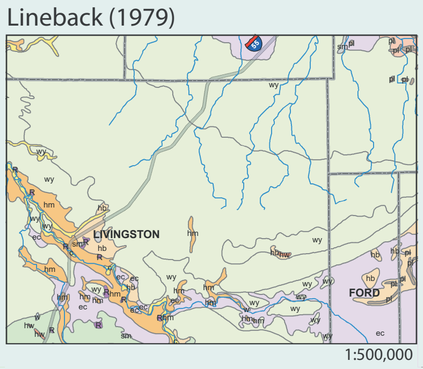


Color shaded 10m DEM, 1:2,500,000 scale

ICE-WALLED LAKES in NE ILLINOIS

(previously unrecognized)

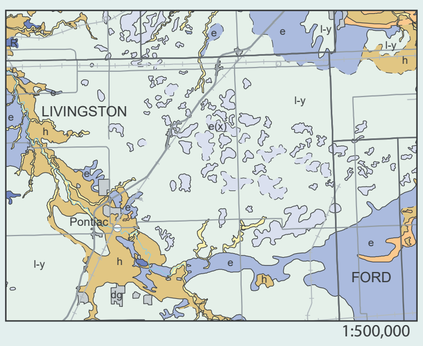
Lineback (1979)



1:500,000

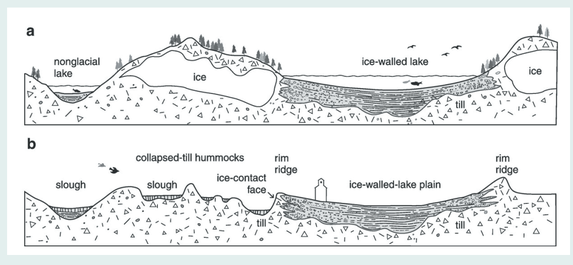
- c — Cahokia alluvium
- ec — Equality Formation - Carmi Member
- hb — Henry Formation - Batavia Member
- hm — Henry Formation - Mackinaw Member
- hw — Henry Formation - Wasco Member
- pl — Parkland Sand
- sm — surface mines
- wy — Wedron Formation - Yorkville Till Member
- R — Bedrock

New compilation



1:500,000

- dg — disturbed ground
- e(x) — Equality Formation - ice-walled lake complex
- e — Equality Formation
- h — Henry Formation
- h(p) — Henry Formation - Parkland facies
- l-y — Lemont Formation - Yorkville Member
- R — Bedrock

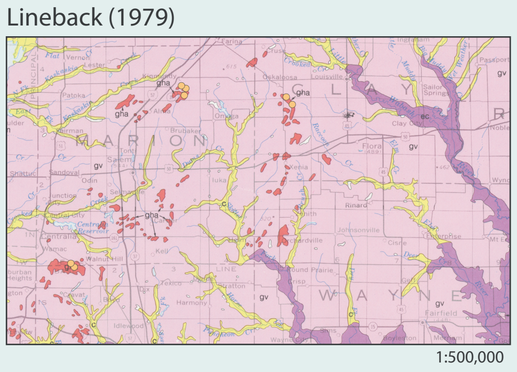


How ice-walled lake plains form (from Clayton et al., 2008, Geomorphology)

BEDROCK KNOBS in SOUTHERN ILLINOIS

(formerly mapped as ice-contact hills)

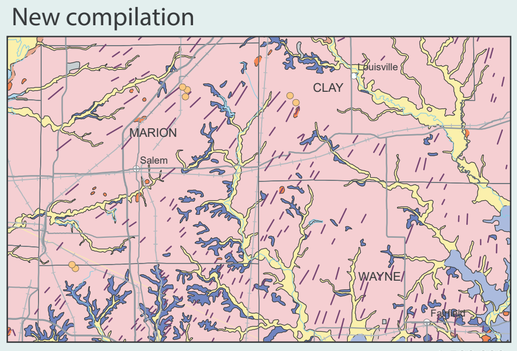
Lineback (1979)



1:500,000

- c — Cahokia Alluvium
- ec — Equality Formation - Carmi Member
- gha — Glasford Formation - Hagarstown Member
- gv — Glasford Formation - Vandalia Till Member
- bedrock (outcrop or near-surface)
- new stratigraphic borings

New compilation

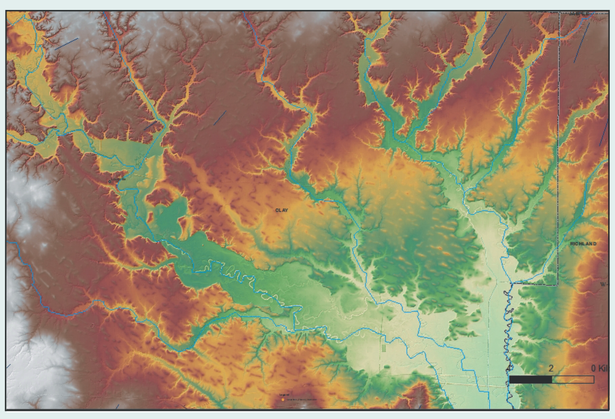


1:500,000

- c — Cahokia Formation
- e — Equality Formation
- pl — Pearl Formation
- pl-h — Pearl Formation - Hagarstown Member
- g-v — Glasford Formation - Vandalia Member
- R — bedrock (near-surface)
- new stratigraphic borings
- glacial lineations

Ten shallow borings drilled in summer 2022, along with geophysical transects, have shown that many hills and ridges in south-central Illinois are underlain by Pennsylvanian bedrock at 7 to 15 feet depth. Previously these were mapped as ice-contact ridges, similar to those found in the Kaskaskia River Basin. The bedrock is mainly fine-grained sandstone and mudstone --- when weathered they can appear as unconsolidated sand in water-well cuttings (sample sets).

CREVASSE-SQUEEZE RIDGES IN SOUTH-CENTRAL IL.



Crevasse-squeeze ridges in Clay County, Illinois, visible with LiDAR elevation map. The ridges likely formed from fast-flowing glacial ice that sqeezed sediment into basal crevasses. The transverse crevasses formed perpendicular to glacial flow; the features help us to reconstruct the shape of glacial sublobes.

ACKNOWLEDGMENTS / REFERENCES

For their helpful comments, suggestions, or provided data sources, we thank Henry Loope (Indiana Geological Survey), Jose Luis Antinao Rojas (Indiana Geological Survey), Ron Counts (University of Mississippi), Matt McCauley (USDA-NRCS), Drew Andrews (Kentucky Geological Survey), John Nelson (ISGS) and Leon Follmer (ISGS). This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program under StateMap award numbers G20AC00371 (2020), G21AC10861 (2021), and G22AC00573 (2022).

Clayton, L., Attig, J.W., Ham, N.R., Johnson, M.D., Jennings, C.E. and Syverson, K.M., 2008, Ice-walled-lake plains: Implications for the origin of hummocky glacial topography in middle North America. Geomorphology, 97, pp.237-248.

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.

Lineback J.A., 1979, compiler, Quaternary Deposits of Illinois, 1:500,000 scale.

U.S. Geological Survey National Cooperative Geologic Mapping Program, 2020, GeMS (Geologic Map Schema)—A standard format for the digital publication of geologic maps: U.S. Geological Survey Techniques and Methods, book 11, chap. B10, 74 p.

Willman, H.B. and J.C. Frye, 1970, Pleistocene Stratigraphy of Illinois, ISGS Bulletin 94, 204 p.