Glacial (and related) deposits; with focus on Illinois

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glacier (definition)

-- a large mass of ice formed, at least in part, on land by the compaction and recrystallization of snow, moving slowly by creep [gravity] downslope or outward in all directions due to the stress of its own weight, and surviving from year to year. Included are small mountain glaciers as well as ice sheets continental in size, and ice shelves which float on the ocean but are fed in part by ice on land.

[Glossary of Geology, 4th edition, 1997]

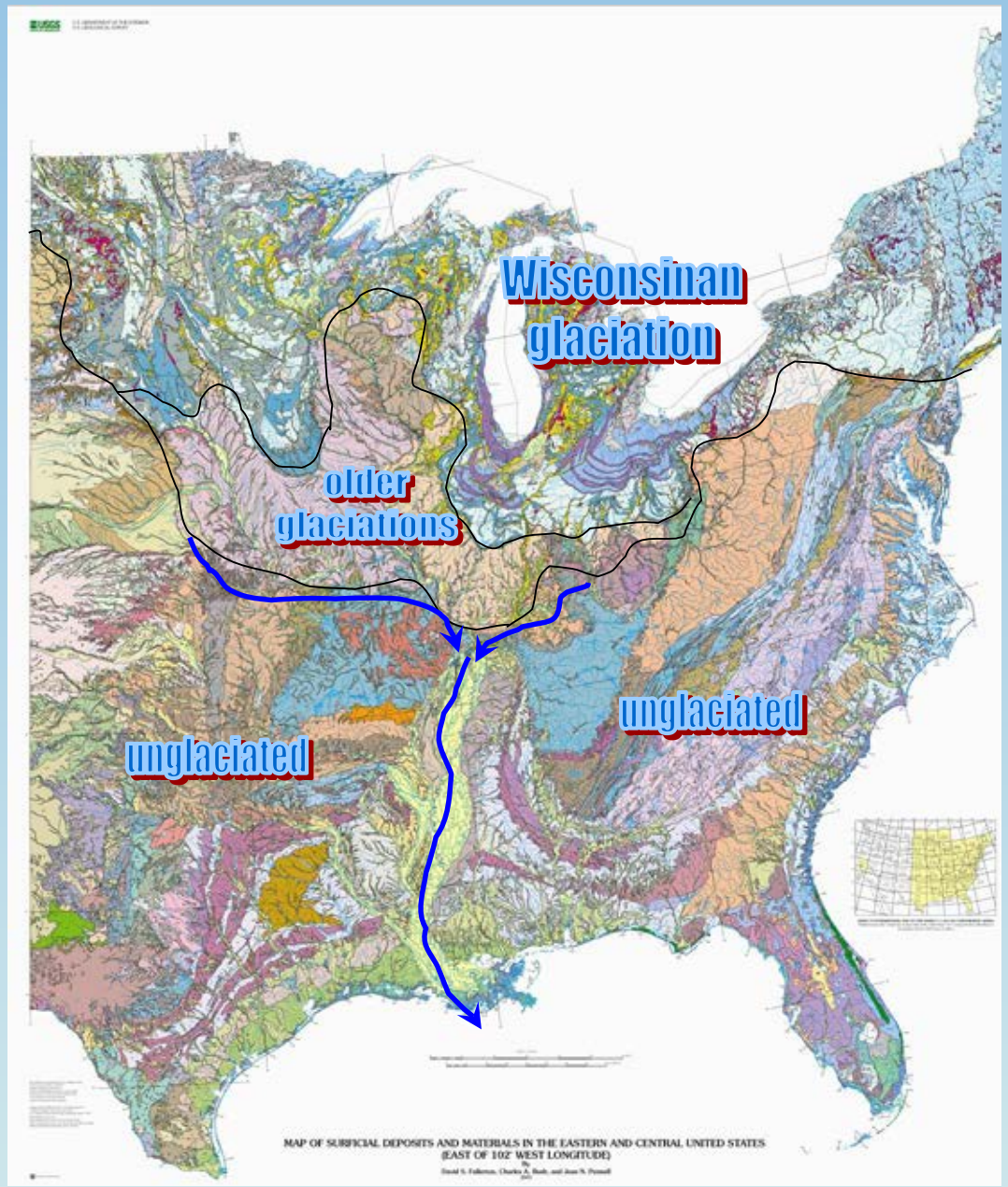
(ice on your roof doesn't qualify now...)

ice on roof (not a glacier)

glaciers

Antarctica (on way to McMurdo)

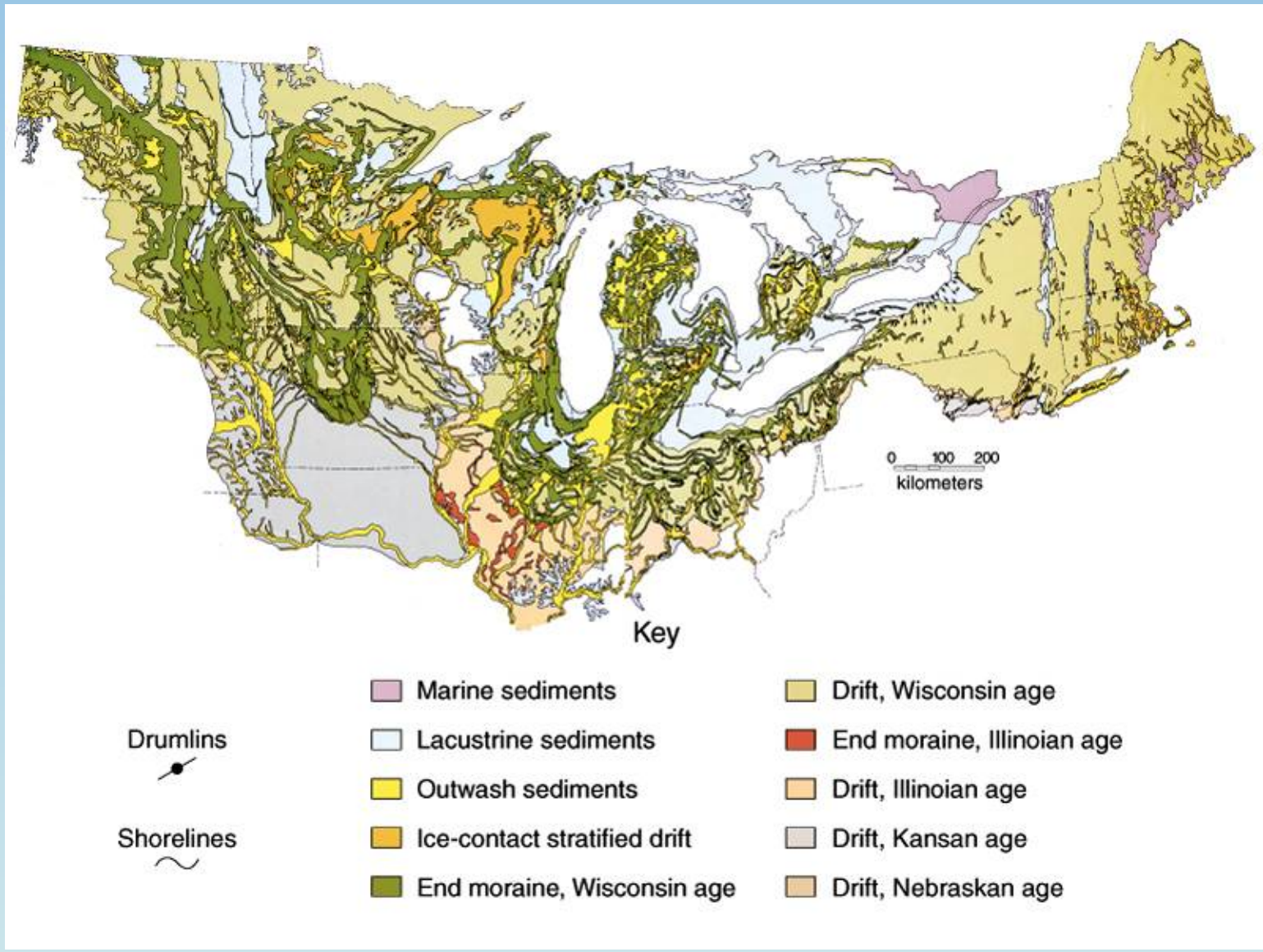
edge of Greenland ice sheet near Kangerlussuaq

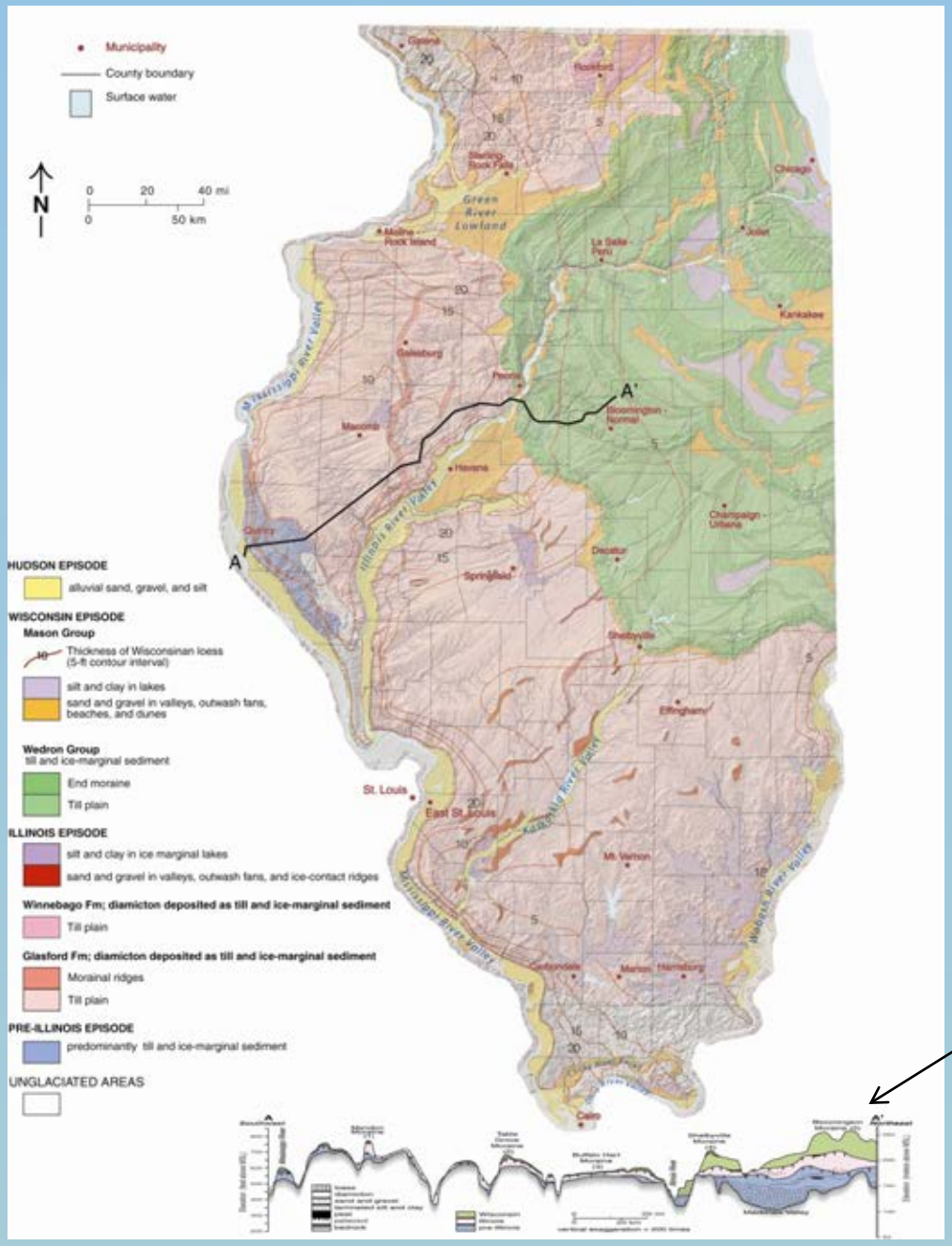


Quaternary / Surficial Deposits in Eastern USA

- http://www.youtube.com/watch?v=wbsURVgoRD0
- http://www.nature.com/nature/journal/v500/n7461/extref/nature12374-sv1.mov

(video of glacial retreat)

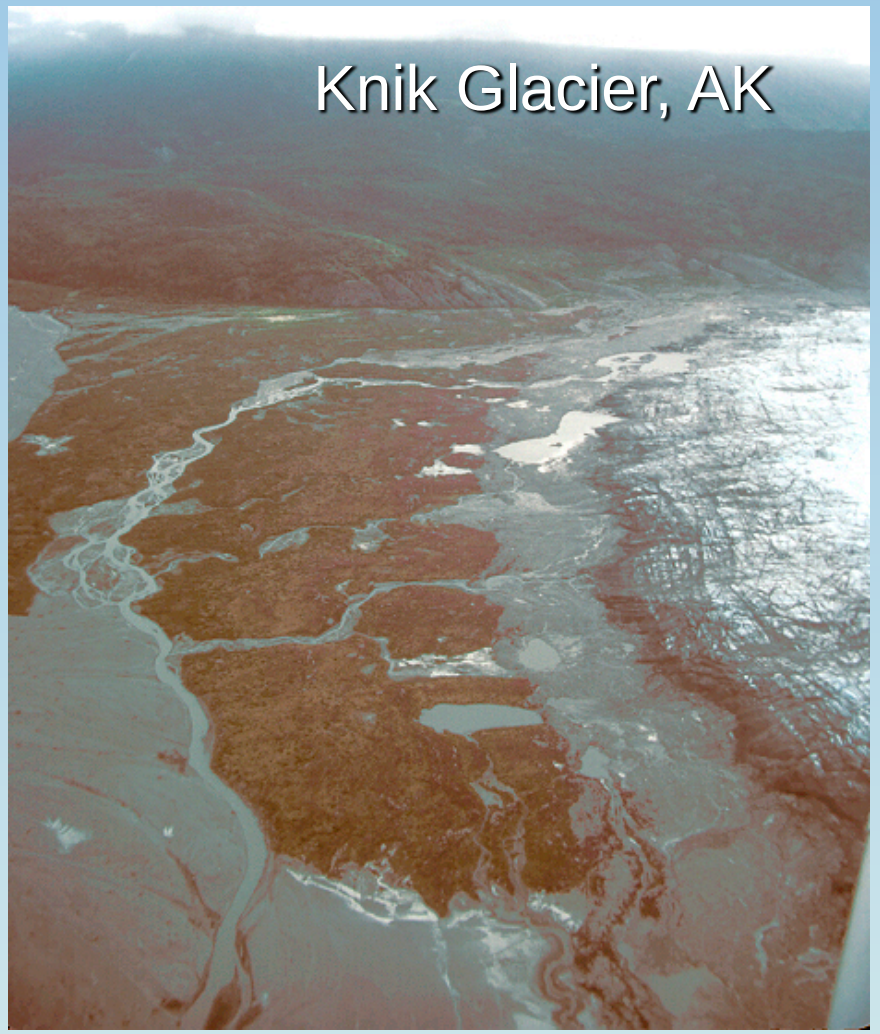

0 100 200
kilometers
Key
Marine sediments
Lacustrine sediments
Outwash sediments
Ice-contact stratified drift
End moraine, Wisconsin age
Drift, Wisconsin age
End moraine, Illinoian age
Drift, Illinoian age
Drift, Kansan age
Drift, Nebraskan age
Drumlins
Shorelines



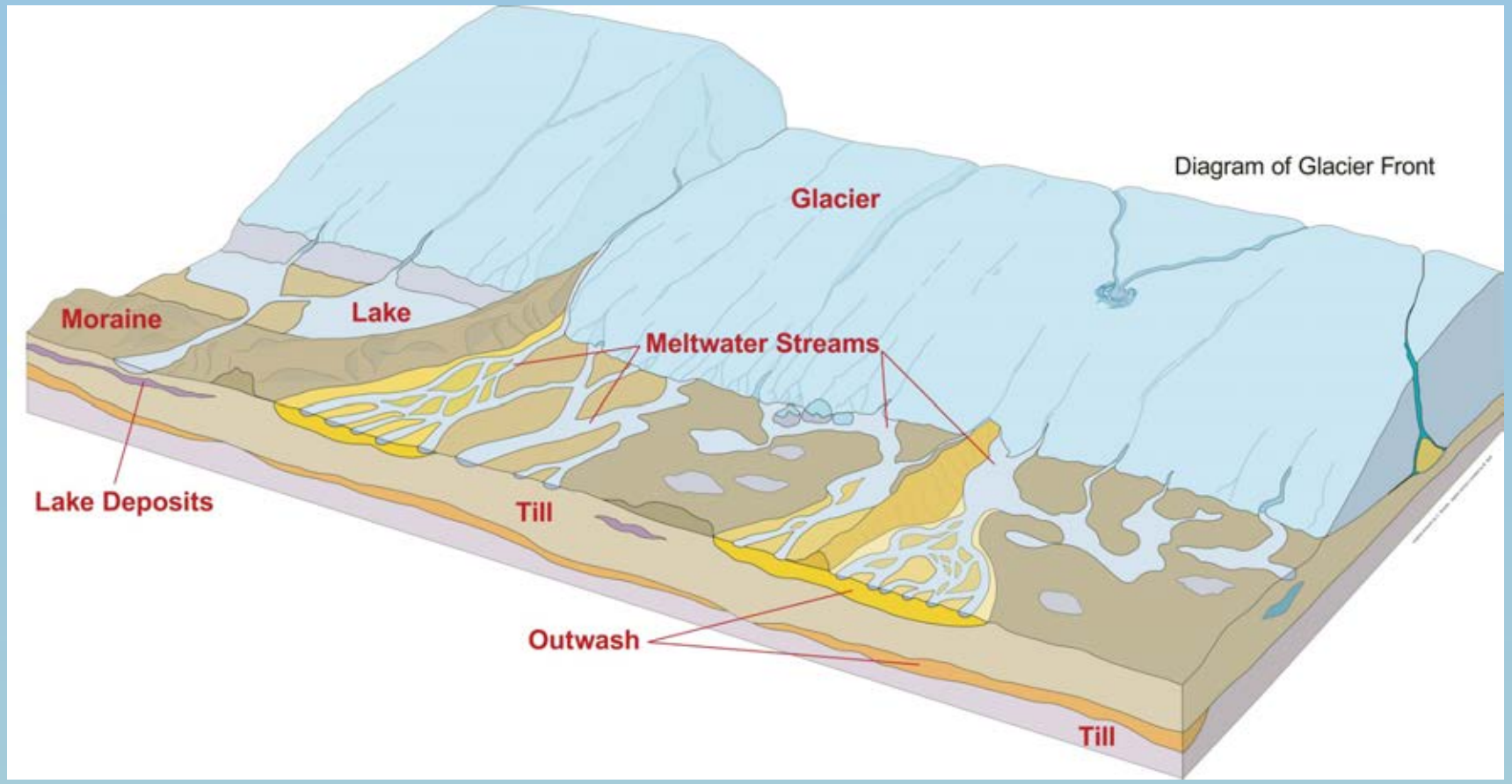
cross section

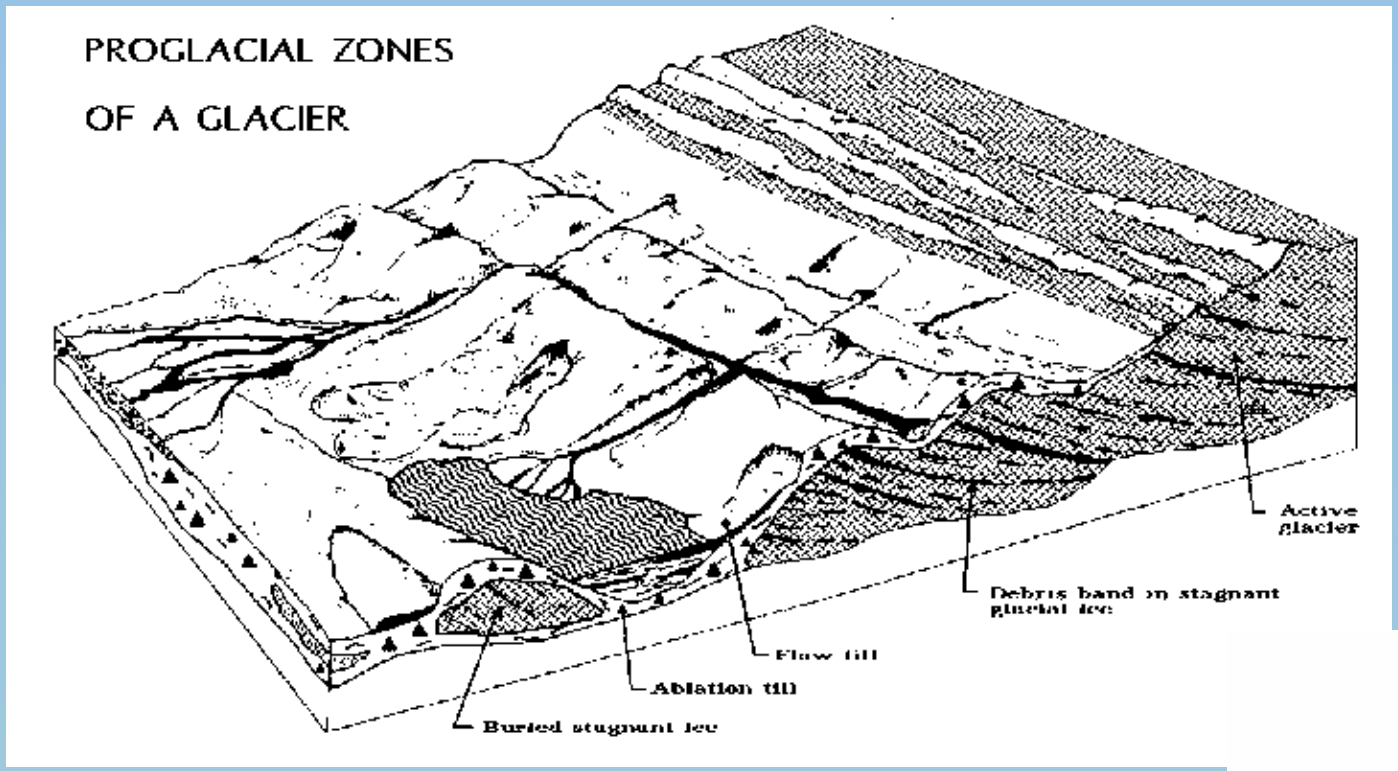
Glacial environments and deposits

- in front of the glacier (proglacial)
- beneath the glacier (subglacial)
- in contact with ice (ice-contact)



Environments of deposition within and proximal to glacial ice





Rock material ground up and mixed in and beneath the ice (active glacier in Iceland)

Glacier (and related) deposits

DEPOSIT	ORIGIN	MATERIAL
till (subglacial and supraglacial)	**glacier (direct)**	**unsorted mixture (gr., sand, silt, clay)**
ice-contact glacifluvial sediment	englacial water	sand and gravel
outwash	water (proglacial river)	sand and gravel
lacustrine	water	clay, silt, fine sand
loess	wind	silt
dune sand	wind	sand
alluvium	water (nonglacial)	silt, sand, clay
peat	depression	peat
Paleosols *(alteration of preexisting deposits)*	soil development	any of the above

(Glacial) Till ...(direct glacial env.)

- unsorted
- massive (not bedded)
- various clast sizes (clay, silt, sand, gravel)
- various rock and mineral tyes
- pebbles faceted or striated
- acts as aquitard in Midwest

Titusville till, Ohio)

Clinton County, IL

Keyesport S&G, IL
(Glasford till)

till deposition

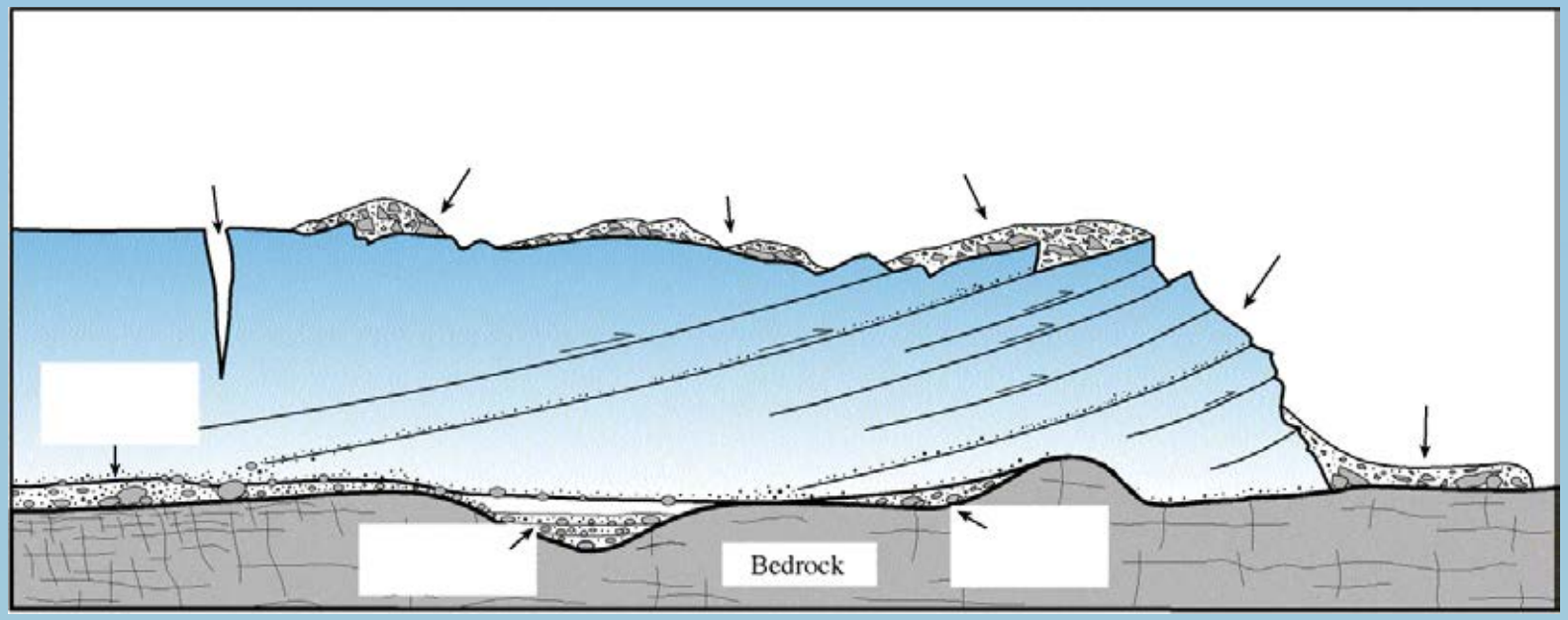
Taylor Glacier, Victoria Land, Antarctica, showing the formation of subglacial debris (basal till) that has melted out from the dark striped basal ice layer. Photo M. J. Hambrey, 1987.

2.5” diameter core of till --- AMS-2 (Ames, IL)

red till in Wisconsin (Kewaunee Fm. over Horicon Fm.)

till in Germany (wikimedia commons) pebbles embedded / supported by fine-grained matrix

various types of till (diamicton)



subglacial till / supraglacial till / flow till (or debris flow)

Ice-Contact Sediment

- highly variable in texture and origin
- sand, gravel, diamicton (unsorted), silt
- englacial channels are coarse-grained (sand and gravel)
- irregular bedding or structure (from let-down)

Lacustrine Sediment

Glacial Lake Pingree --- near Pingree Grove, Kane County, IL

- generally fine-grained
- clay, silt, fine sand
- stratified (laminated)
- rhythmic beds in ice-proximal areas
- may be fossiliferous

varved lake deposits

Peat

- glacial (interstadial) or postglacial
- wetland or depressional sediment
- preserves pollen and microfossils
- important for paleoclimatic records
- can be mined for low grade energy source (high C)
- source of drift-gas

Higginsville Section: buried peat layer

Outwash

Bylot Island, Canada

Thelan Pit: northeast Illinois (McHenry-Lake Counties)

- sand and gravel
- mined for aggregate
- aquifer material (holds groundwater)
- more rounded with longer transportation

Sand and gravel pit near Danville, IL

Loess (windblown silt)

- relatively fine-grained
- massive (generally not stratified)
- may contain paleosols within
- upper part contains modern soil (agricultural)
- may contain terrestrial fossils (snails, wood, mammals)

thick loess in southwestern Illinois (I-270 section); Collinsville, IL

Dune Sand

Green River Lowlands --- NW Illinois *(photo by Miao Xiaodong, ISGS)*

Alluvium (postglacial)

- deposited by stream or running water
- sorted or semi-sorted
- in stream bed, floodplain, delta, or fan

fine-grained alluvium in New Athens East Quadrangle (St. Clair Co.)

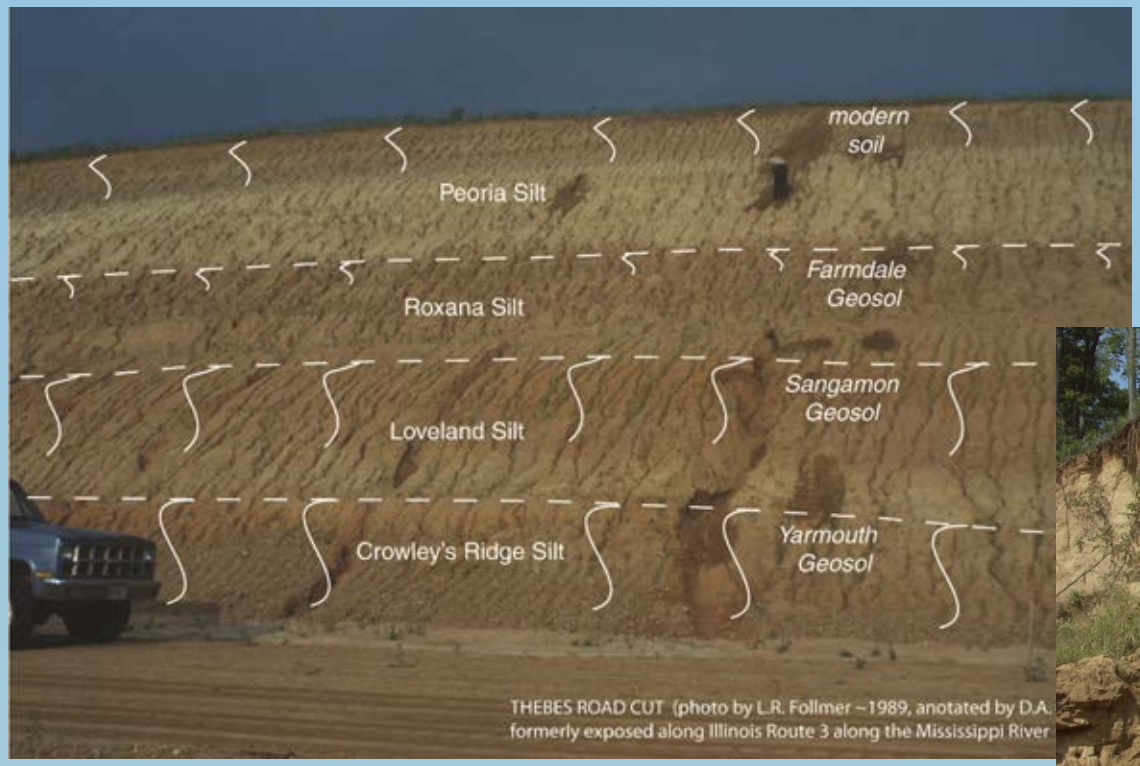
rocky alluvium in Valmeyer Quadrangle (Monroe Co.)

Historical Alluvium

Mascoutah Quadrangle,
St. Clair Co., IL

Coldwater Creek, Missouri

Paleosols (ancient or buried soils)



(interglacial)

(interstadial)

IN DEPTH: Discussion on Loess Deposits

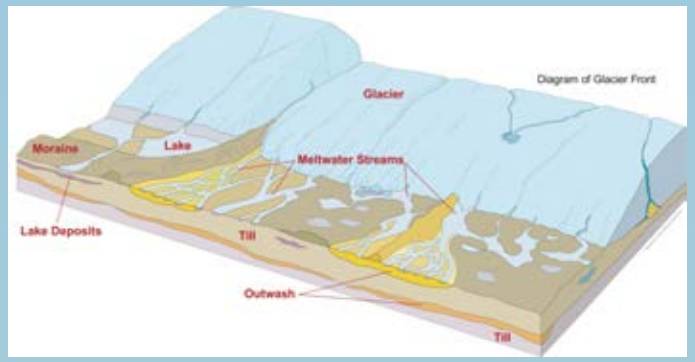
Dust storm in NW Kansas

Texas, 1935 (Dust bowl years)

repeated Dust Storms – process of loess deposition

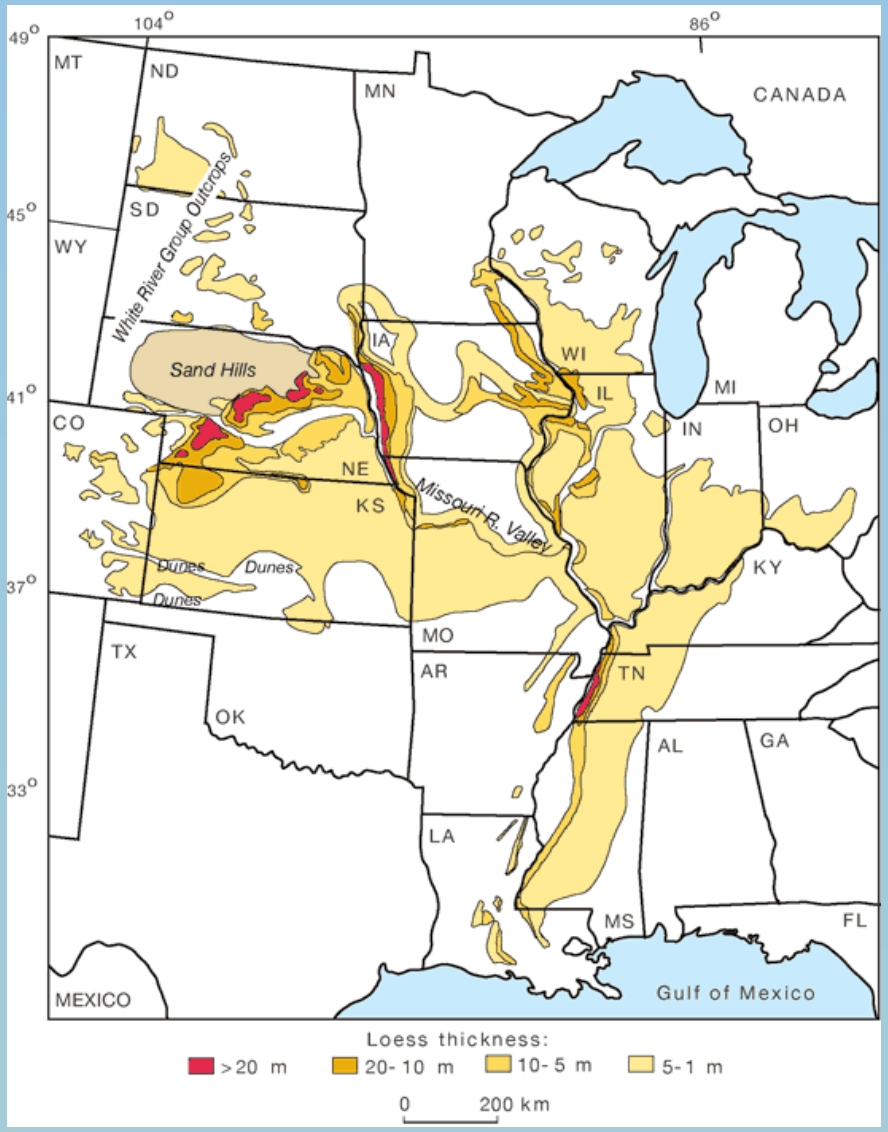
Origin of Loess in Illinois: dust deflation from outwash plains

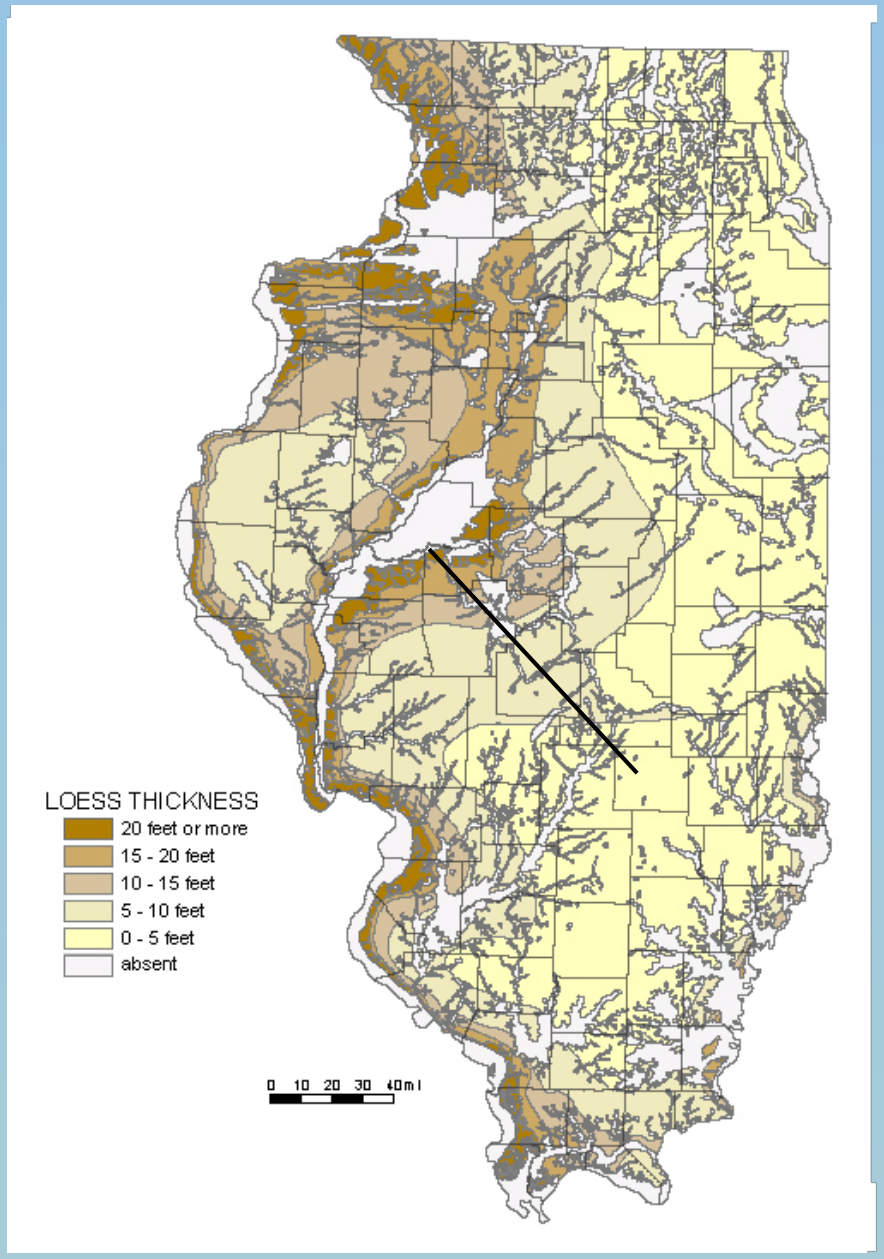
Iceland glacier and outwash



southeast Alaska ---- braided stream plain --- loess source (from very silty and sandy deposits)

LOESS THICKNESS MAPS





Loess thickness and grain size trends
(Guy Smith, 1942)

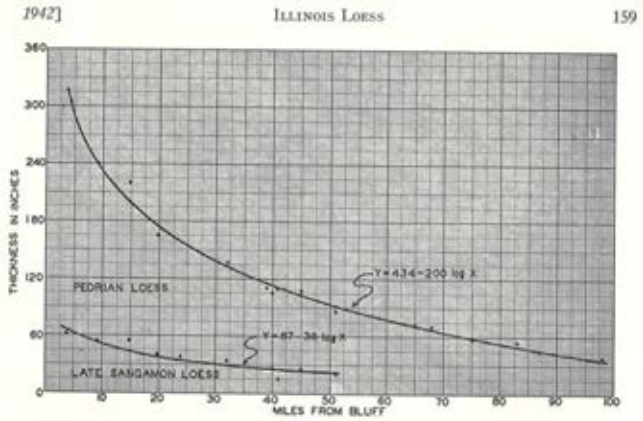


FIG. 6.—VARIATIONS IN THICKNESS OF PEORIAN AND LATE SANGAMON LOESS WITH DISTANCE FROM BLUFFS: TRAVERSE 1

Krumbein's graph[10*] of the loess depths along Mississippi river in Henderson county some 40 miles to the north of the point of origin of Traverse 1. All three graphs show an initial rapid but constant

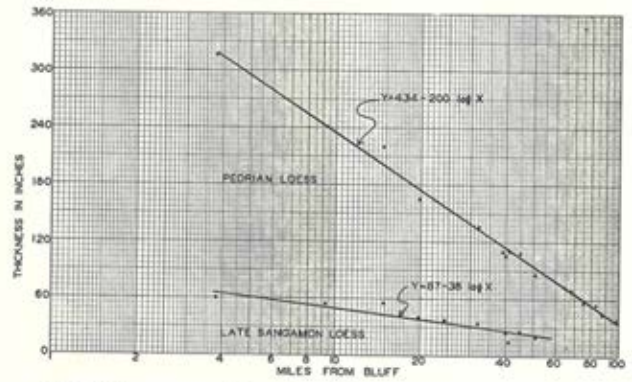


FIG. 7.—VARIATIONS IN THICKNESS OF PEORIAN AND LATE SANGAMON LOESS WITH LOGARITHM OF DISTANCE FROM BLUFFS: TRAVERSE 1

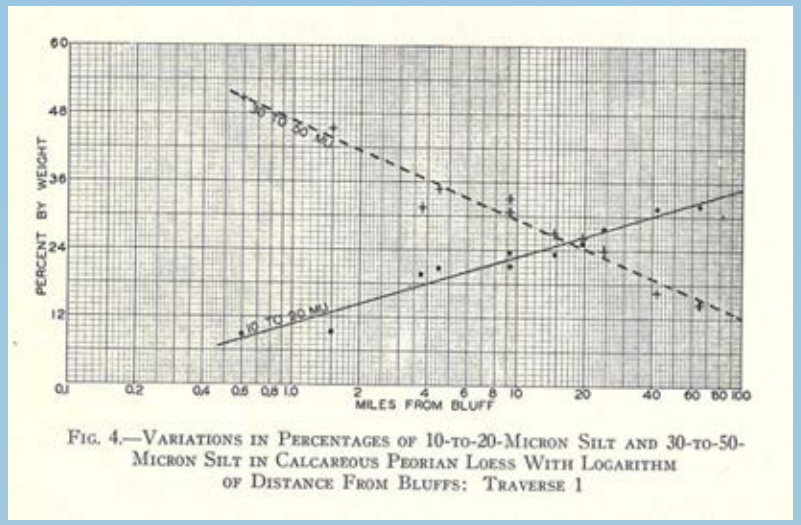


FIG. 4.—VARIATIONS IN PERCENTAGES OF 10-TO-20-MICRON SILT AND 30-TO-50-MICRON SILT IN CALCAREOUS PEORIAN LOESS WITH LOGARITHM OF DISTANCE FROM BLUFFS: TRAVERSE 1

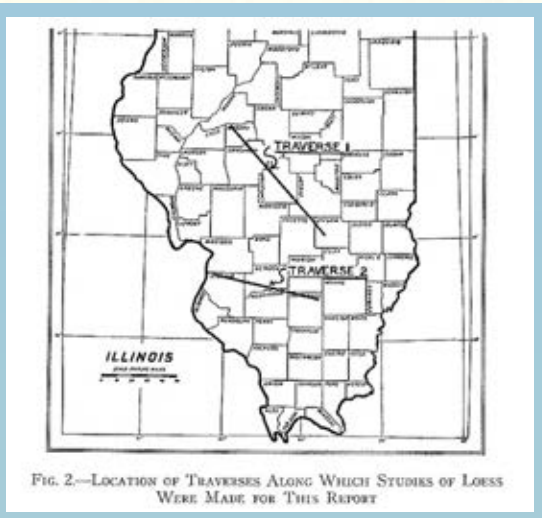
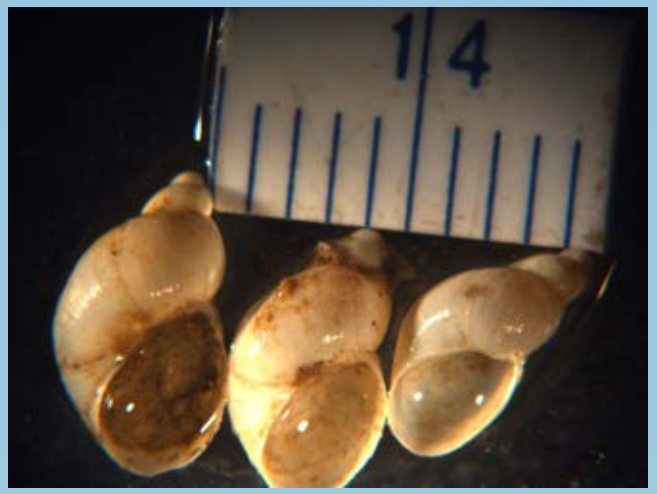


FIG. 2.—LOCATION OF TRAVERSES ALONG WHICH STUDIES OF LOESS WERE MADE FOR THIS REPORT

clay bed in loess

Loess draping hillside
(LaBrot Pit, Collinsville, IL)

Gastropods in Loess Deposits (Terrestrial)



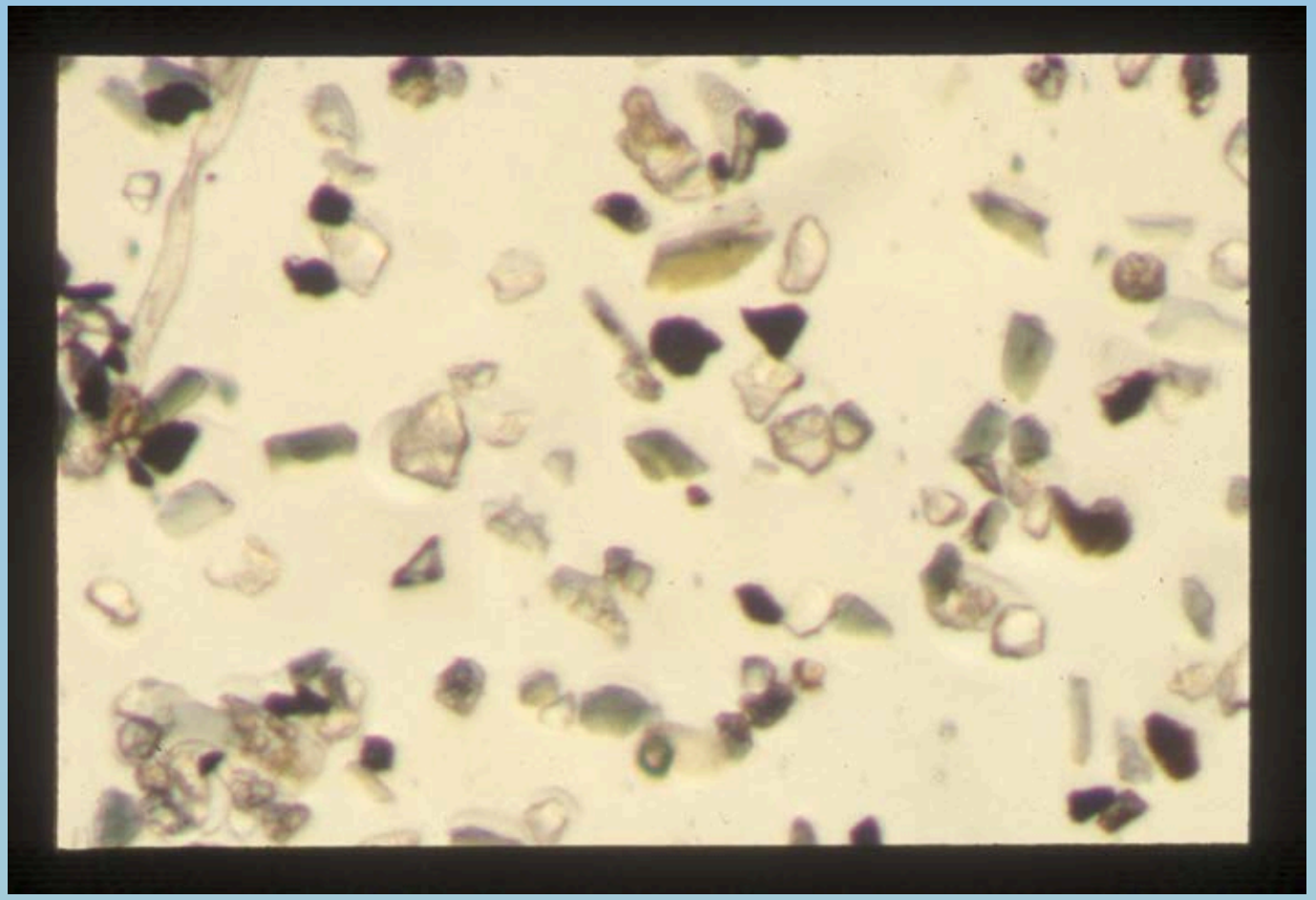
Fossil Mammoth in Loess

Elsah, Illinois

Loess-Paleosol Sequence (layers draping hillside)

Bon Harbor Hills, Kentucky

loess mineralogy



heavy mineral fraction; Green Bay Hollow Section, middle Peoria Silt, transmitted light

ROCKS LOESS SECTION

Western Kentucky

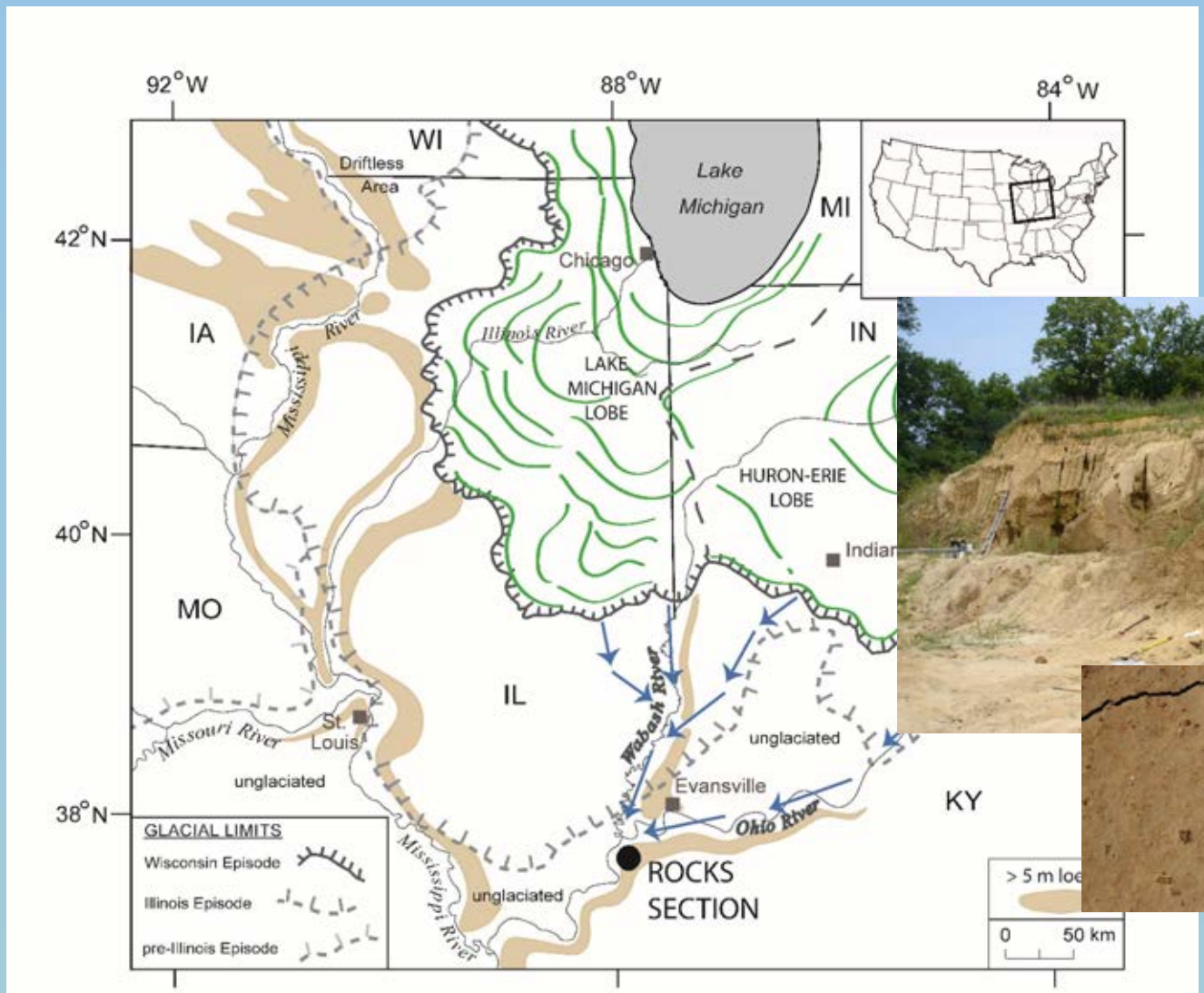


Figure 1. Location of Rocks Section in the central USA with respect to glacial limits. Significant last glacial moraines of the Lake Michigan and Huron-Erie lobes are indicated with curved green lines (in part from Loope et al., 2018). Dominant glacial meltwater pathways are shown with blue arrows. Area with loess thicker than 5 meters are shaded tan (modified from Fehrenbacher et al., 1986 and Bettis et al., 2003). Inset map shows location within the conterminous USA.

Loess-paleosol cyclicity

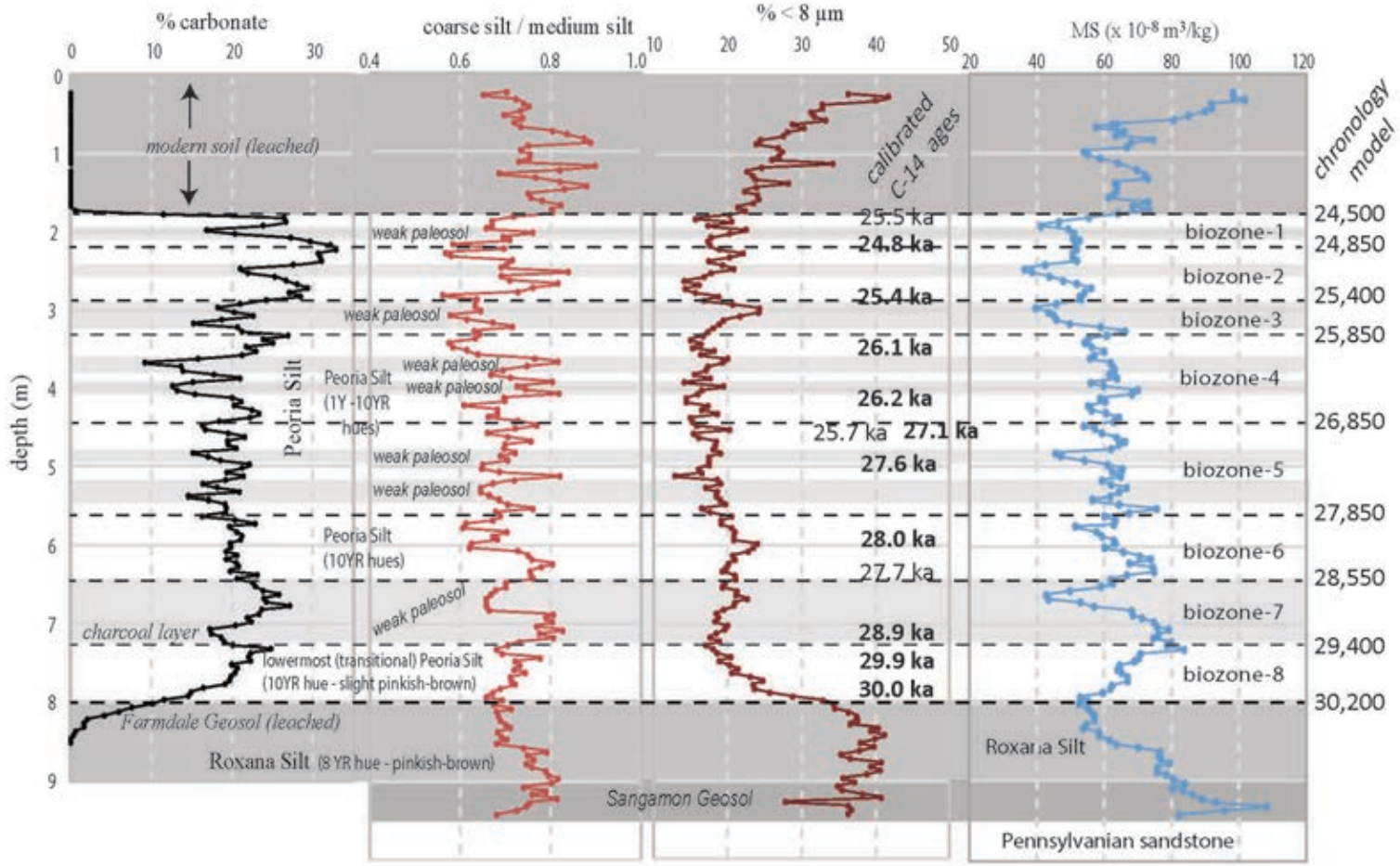


Figure 3. Carbonate content (< 74 µm fraction), coarse silt to medium silt ratio (31-63 µm /16-31 µm), percent < 8 µm fraction, and magnetic susceptibility (< 2 mm fraction) for the composite Rocks Section (Section A, Section B, and core). Calibrated radiocarbon ages on terrestrial shells and charcoal (at 710 cm) are indicated. Light gray shaded bands are zones with weak (or incipient) paleosols. Biostratigraphic zones are based on constrained hierarchical clustering.

ROCKS LOESS SECTION, Western Kentucky *(Grimley et al., 2020)*

LAND SNAIL SPECIES (25 in total): paleoclimate, paleoecology, chronology

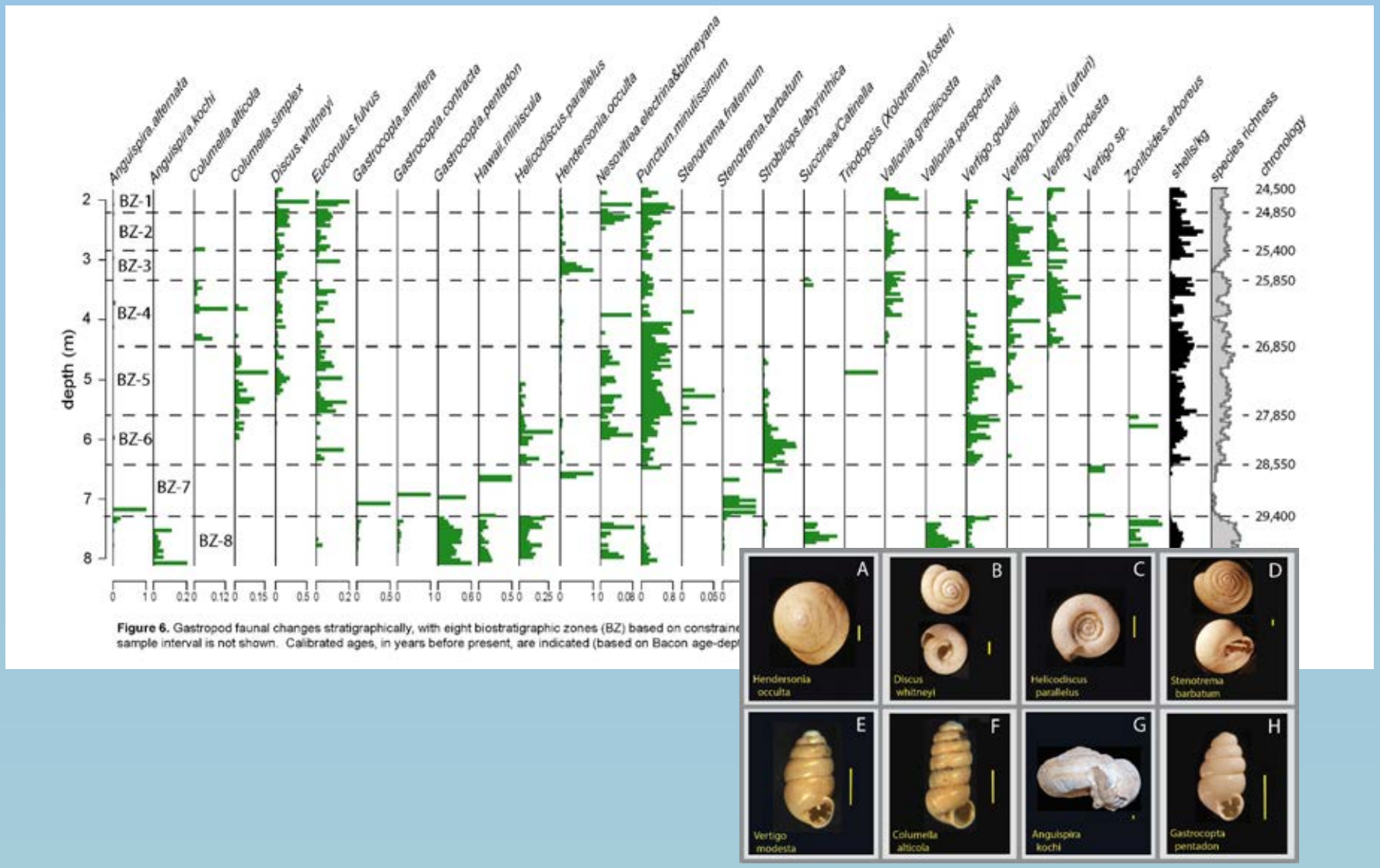


Figure 6. Gastropod faunal changes stratigraphically, with eight biostratigraphic zones (BZ) based on constraine
sample interval is not shown. Calibrated ages, in years before present, are indicated (based on Bacon age-dep

ROCKS LOESS SECTION, Western Kentucky *(Grimley et al., 2020)*

Multi-century scale climatic shifts

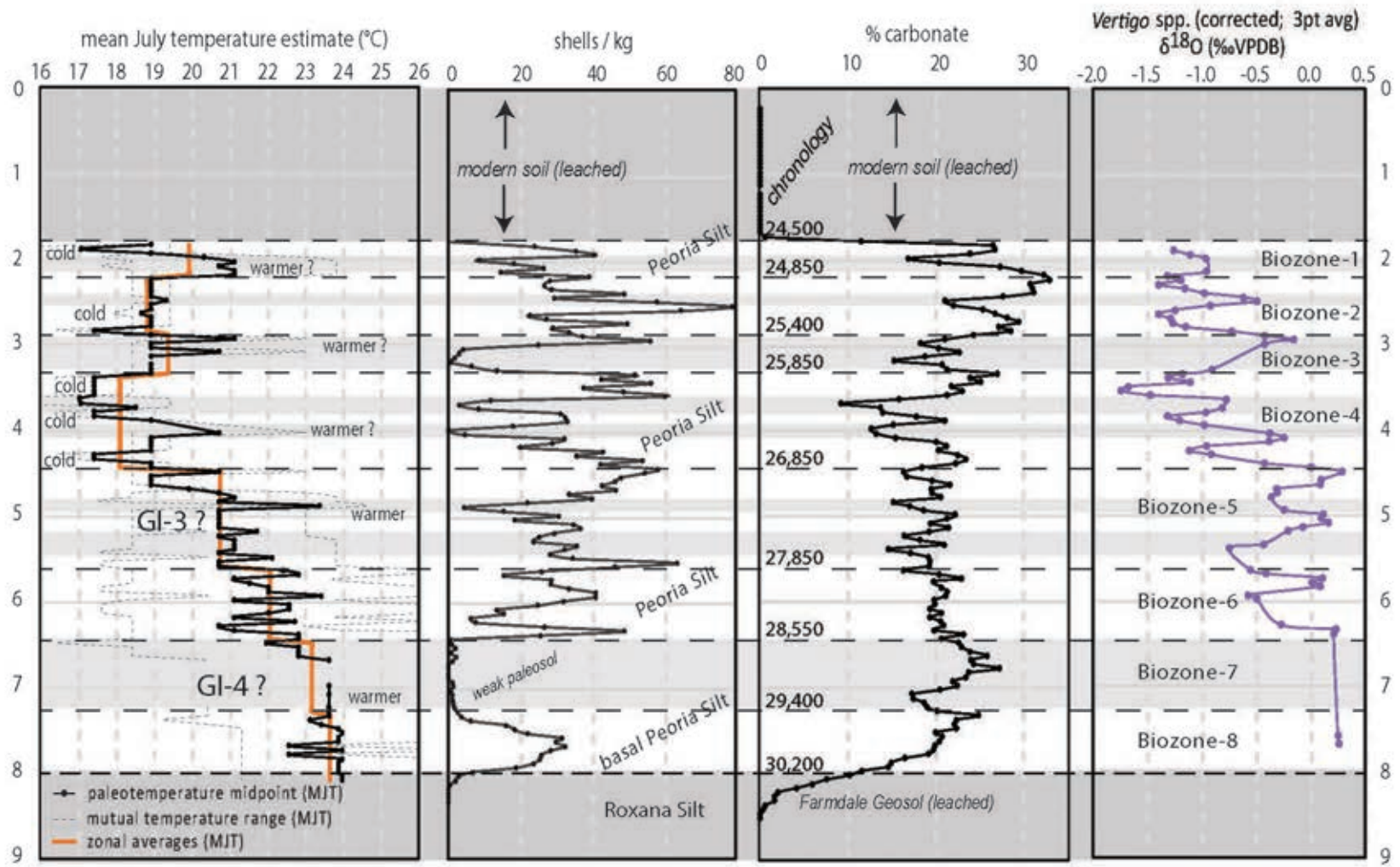


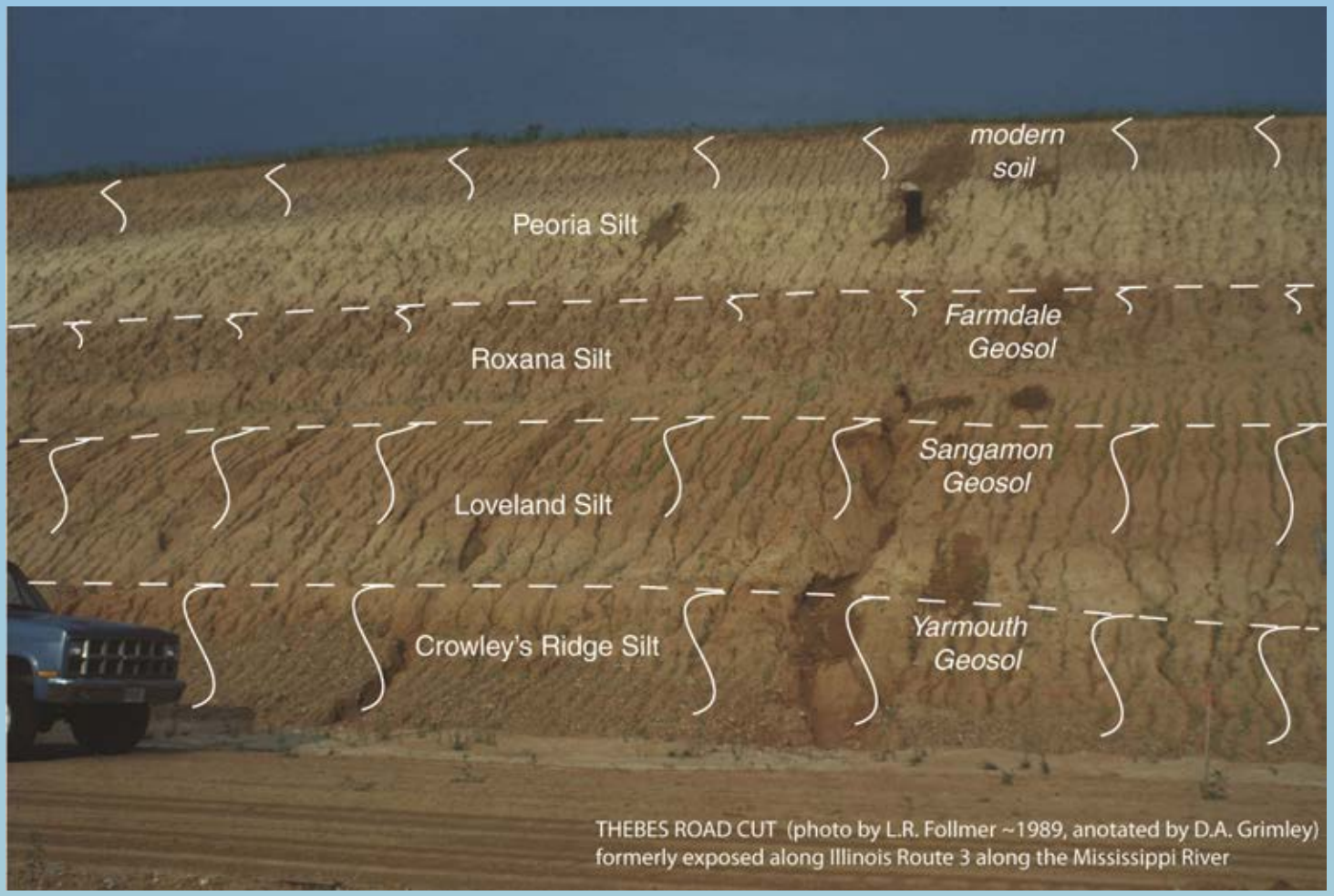
Figure. 8. Comparisons with depth among mean July temperature (based on mutual climatic range method from gastropod assemblages), shell concentration (per kg), carbonate content (< 74 µm), and a 3-pt moving average of corrected Vertigo delta O-18 from the Rocks Section. Calibrated radiocarbon ages from terrestrial shells and charcoal are indicated. Mutual temperature range warm and cold limits are represented by fine dashed lines. The midpoint MJT is indicated by a solid black line and the zonal MJT averages by an orange line. Chronological correlations of paleosols and warmer MJT estimates within Biozones 5 and 7 to Greenland Interstadials (GI) 3 and 4 at ~ 27.7 ka and ~28.8 ka are speculative.

Wisconsinan Loess over Sangamon paleosol (last interglacial)

Taylorville, Illinois

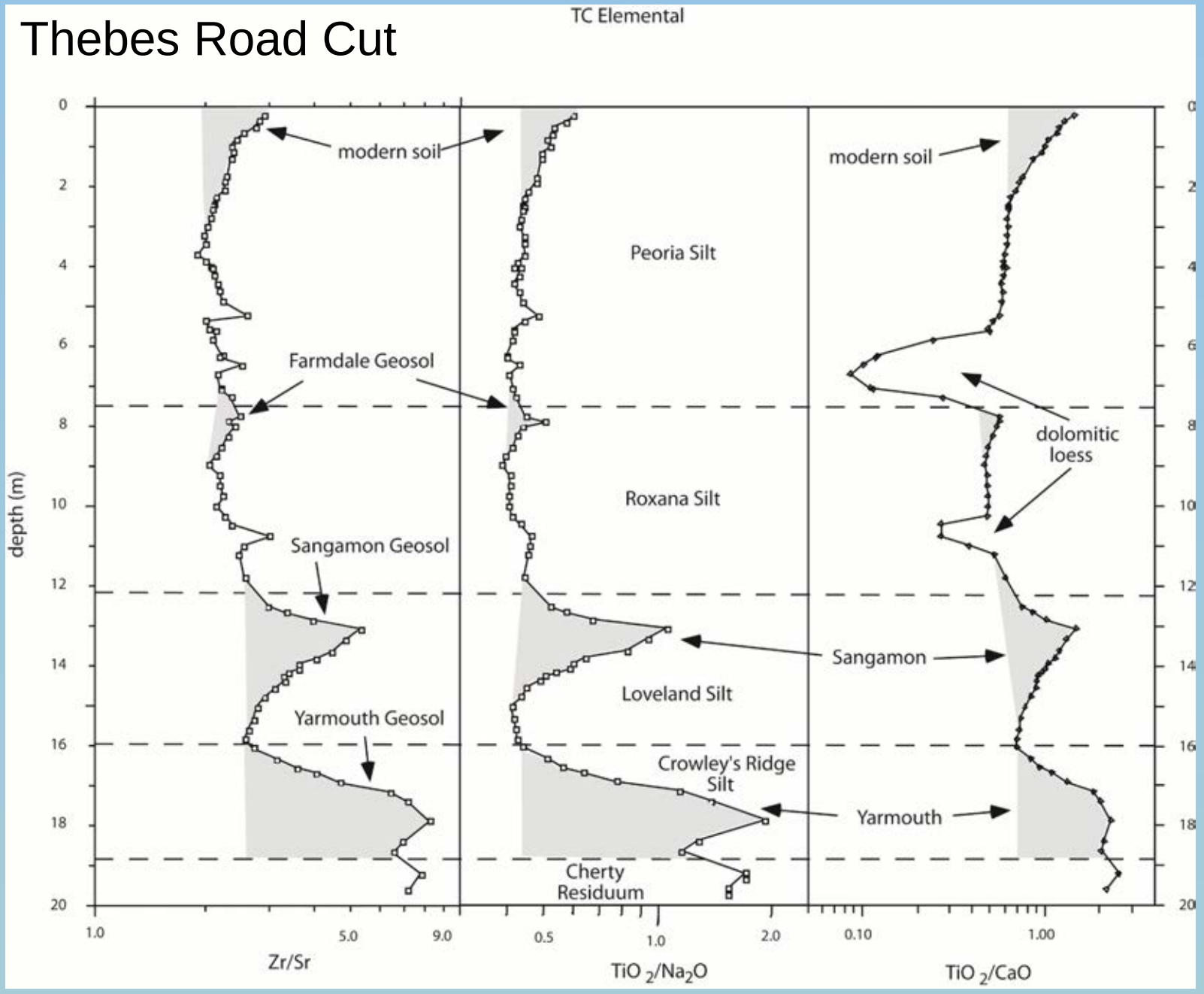
Ogles Creek Section

Loess-Paleosol Sequences



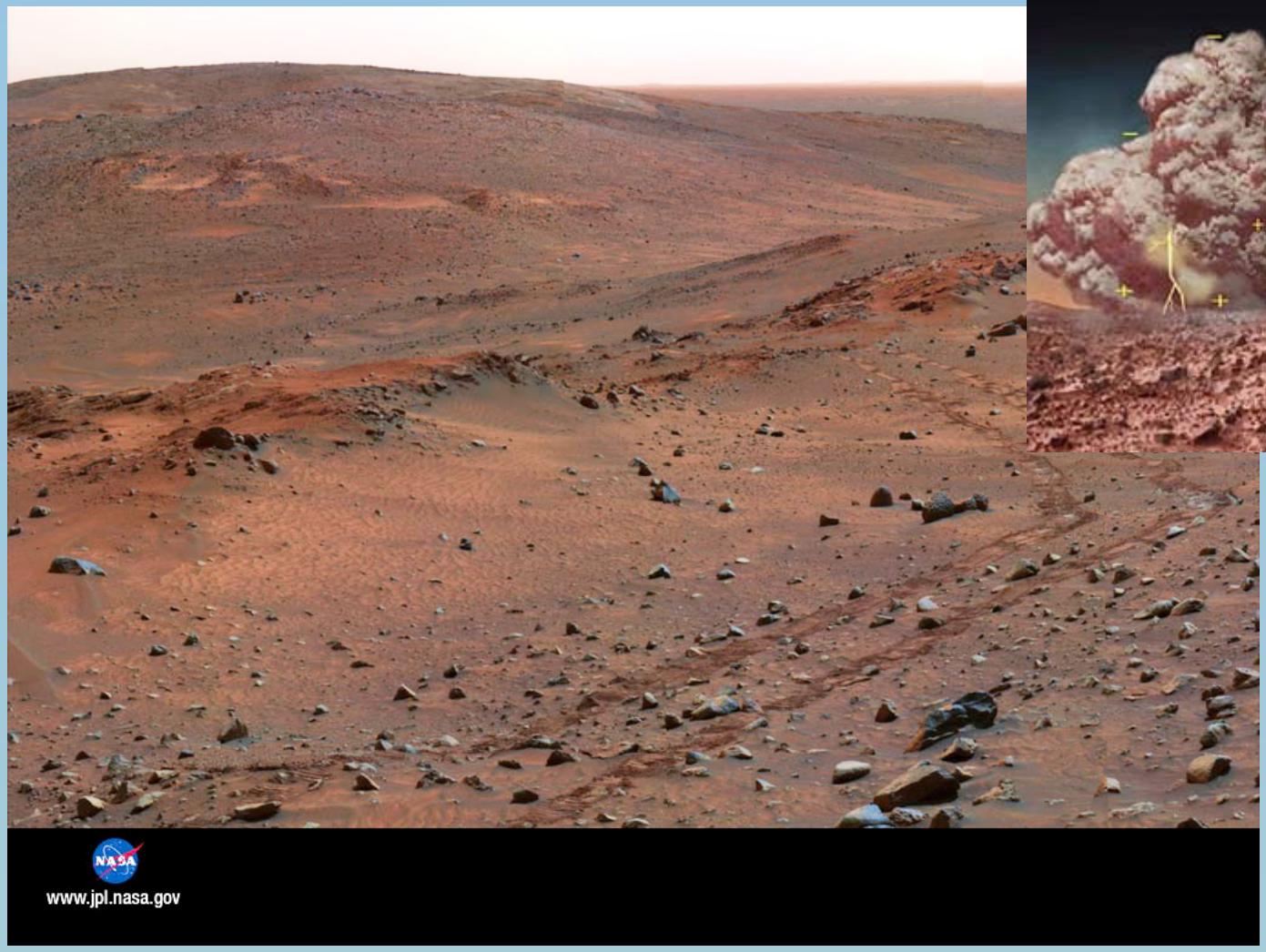
Thebes Road Cut; *southernmost Illinois (Alexander County)*

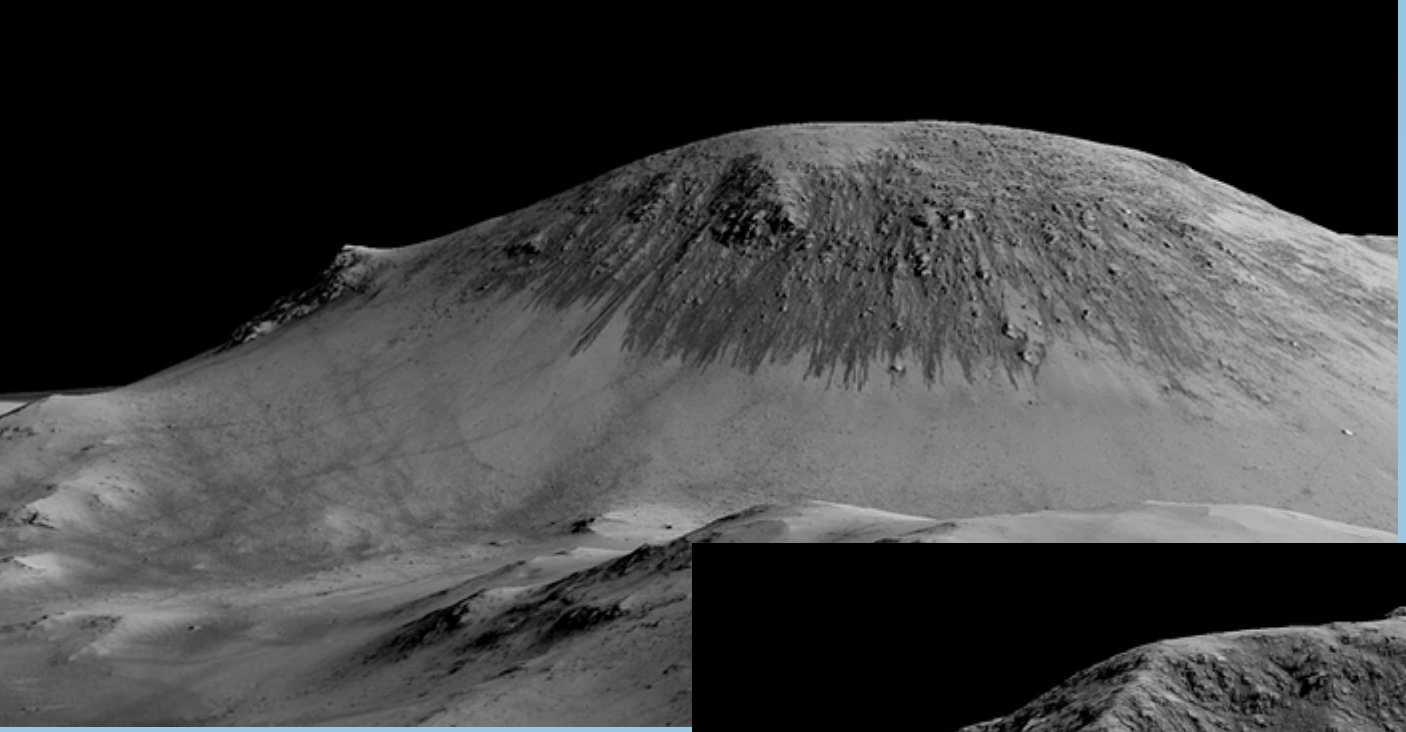
Thebes Road Cut

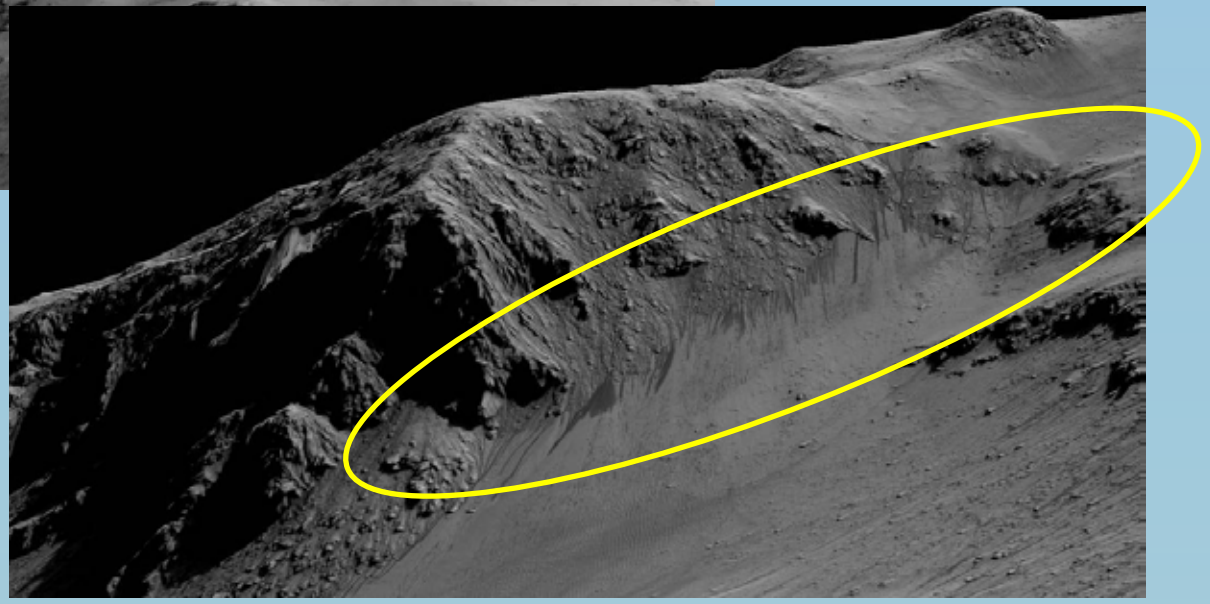


modern soils in loess

dust (loess) on Mars







Views of 100 m-long dark narrow streaks where scientists detected hydrated salts at Horowitz crater, corroborating a hypothesis that the streaks are formed by briny liquid water.

Photographs: Mars Reconnaissance orbiter/University of Arizona/JPL/NASA

https://www.nasa.gov/image-feature/jpl/pia19918/recurring-lineae-on-slopes-at-horowitz-crater

local Wisconsin Episode deposits

First St. and Springfield Ave., Champaign, IL; 2009

loess w/modern soil over stratified sands over clayey till

loess/till; 5th and Univ. Ave. 1999

1st and Spring.; loess/outwash 1999

- sand pit west of IL-47 near Mahomet, IL (~2016);
- last glacial outwash, deposited about 22,000 to 23,000 years ago

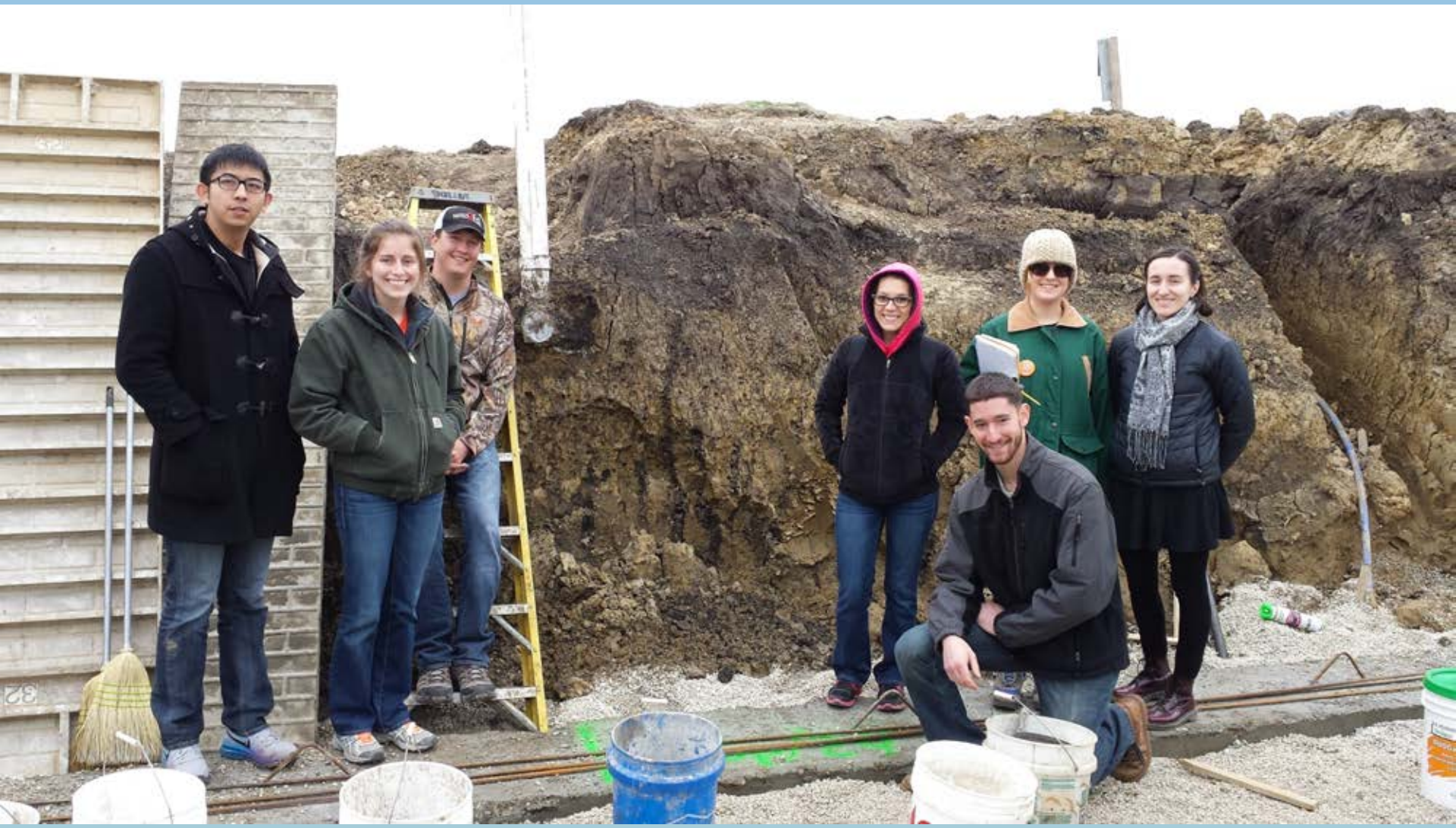
River Bend Forest Preserve
(Mahomet, IL); 30-foot core

last interglacial soil

Postglacial alluvium
(including historical deposits)

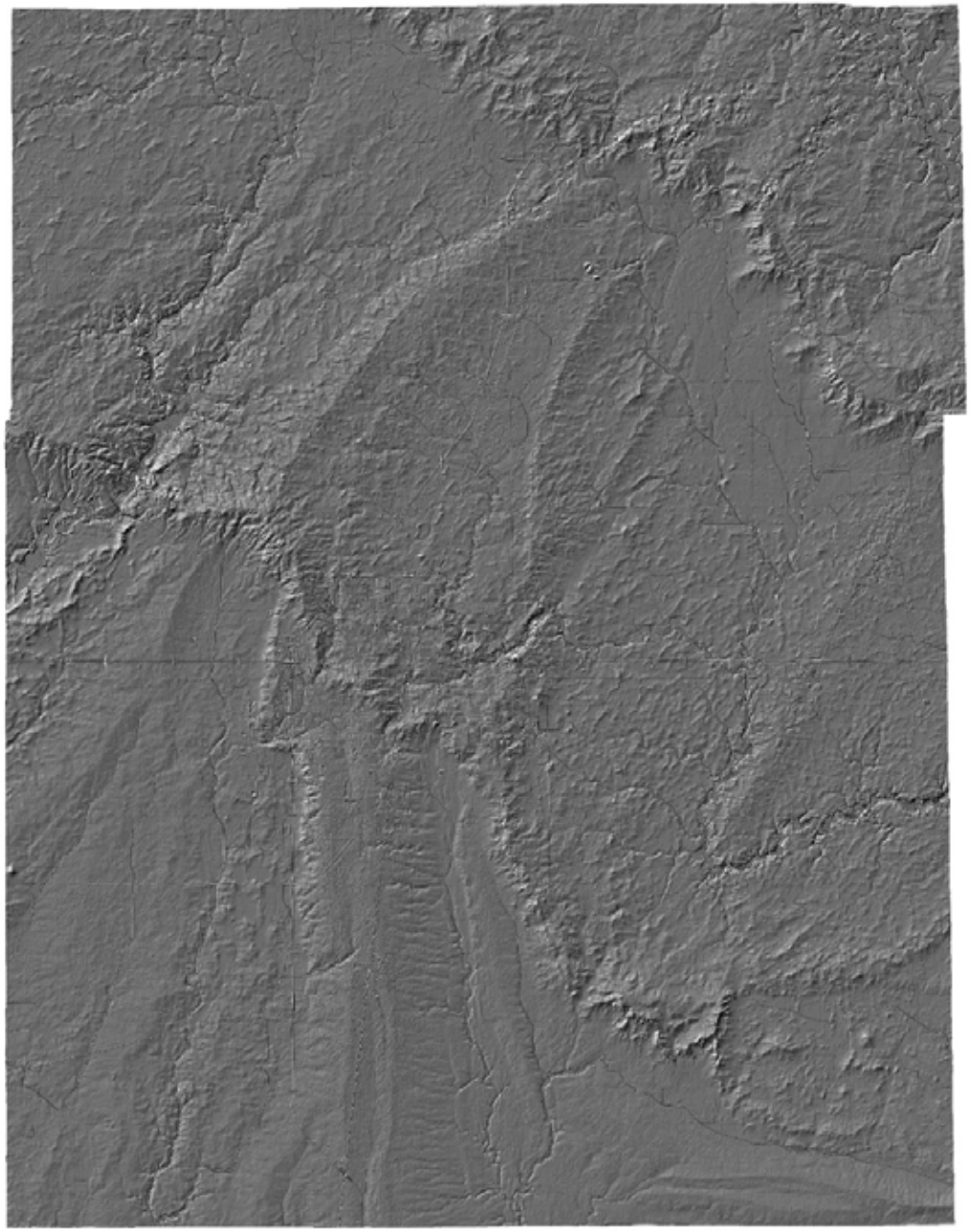
Phillippe Creek,
Champaign County, IL

Crayfish borrows (krotovina) in loess over till exposure

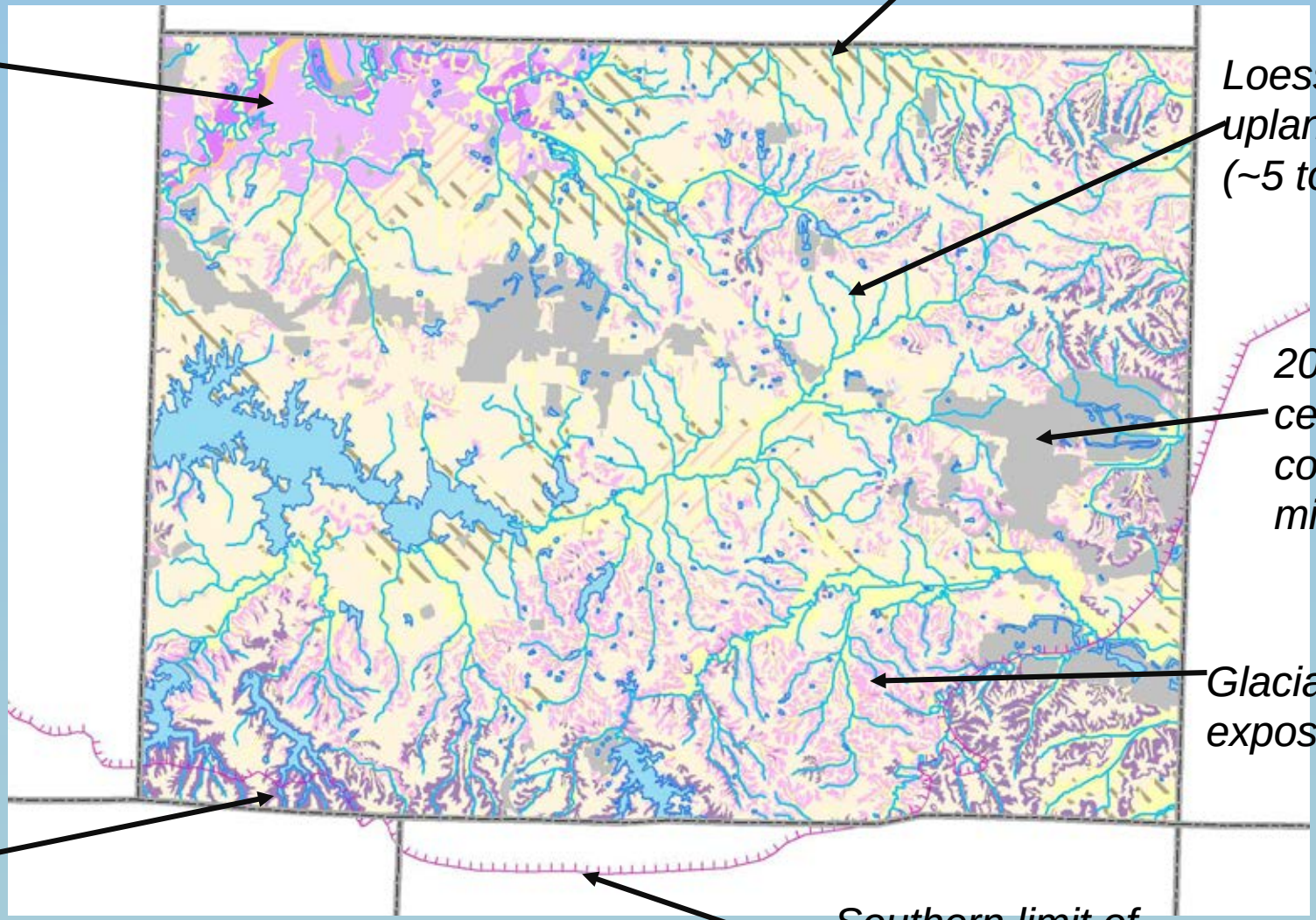


Home construction near Savoy, IL (~ 2015)

LiDAR image, Champaign County



Williamson County Surficial Geology Mapping (2020)



River valley (alluvium and terraces

Backwater Lake (Glacial Lake Muddy)

Loess on uplands (~5 to10 ft)

20th century coal mines

Glacial till exposures

bedrock exposures (unglaciated)

DRAFT MAP – D Grimley, 9/2020

Southern limit of Continental Glaciers in North America

Mapping highlights: **Williamson County SG compilation**

*Borrow pit in **loess** (Wisconsin Episode) and **till** (Illinois Episode); w. of Marion, IL*

*Laminated **lake sediment** (Illinois Episode); south of Marion, IL*

*Fossil conifer wood in Illinois Episode **till***

Mapping highlights: **Williamson County compilation**

*Post-European settlement **alluvium** (with coal mine effects) over pre-settlement Holocene alluvium (Cahokia Formation)*

*Exposure along Big Muddy River with Equality Formation (last glacial slackwater **lake sediment**)*

Fossil amphibious gastropod (Pomatiopsis lapidaria)

Pomatiopsis lapidaria ---- an amphibious gastropod common to slackwater lake sediments

Pomatiopsis lapidaria -- amphibious

Coldwater Creek Section

Wisconsin Episode deposits: indirectly related to glaciation

massive **loess deposits**: Collinsville, IL

(up to 90 feet thick)

stratified **lake sediments**:

exposed along Kaskaskia River

loess and lacustrine sediment

Fulton Section (along Mississippi River, western TN)

Sangamon Geosol (fossil soil) development

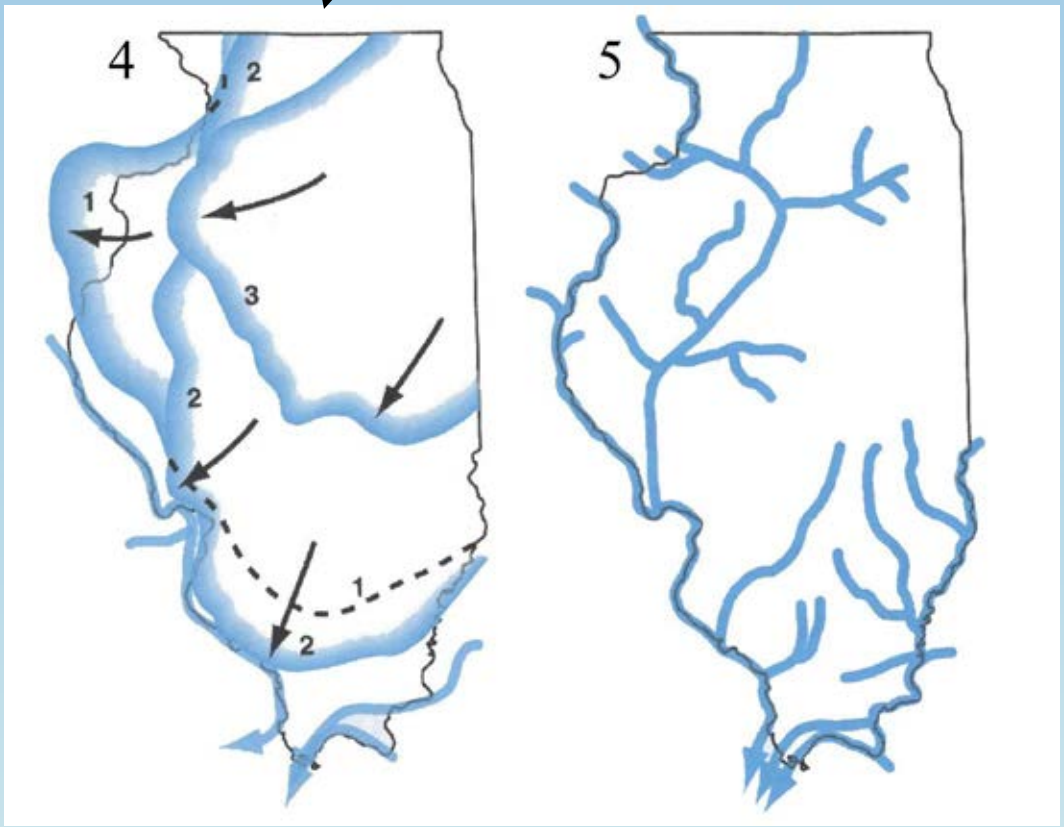
- Sangamon Geosol in sand and gravel

- *Highland, Madison County, IL*

- Sangamon Geosol developed in glacial till

- *Ogles Creek Section, St. Clair County, IL*

Illinois Episode



~ 200,000 to 130,000 years ago

Illinois Episode deposits and features

fractured **glacial till** (oxidized along fractures); unsorted, massive deposit with erratic pebbles

striations

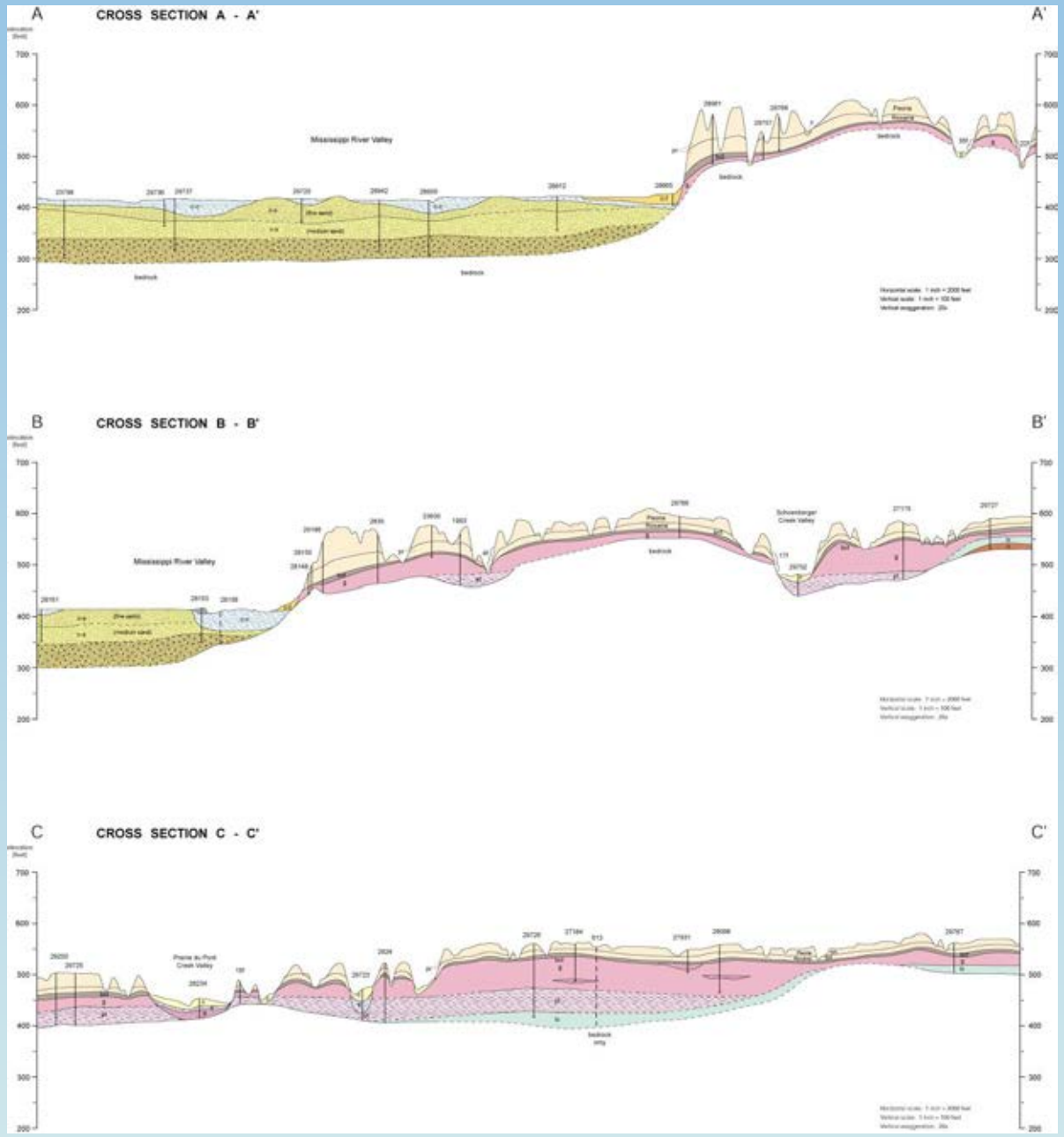
hairpin erosion mark (Alton, IL)

Ogles Creek Section (paleosol, till, lake sediment): St. Clair County, IL

Glacial ridges in south-central Illinois

Neudecker's Mountain, Madison County

Keyesport sand and gravel pit, Bond County



Cross-Sections of Quaternary Deposits

Principal Surficial Mapping Units: St. Louis Metro East Area

Unit	Material	Color / Sed.	Paleon-tology	Comp./ Mineralogy	Eng. Props.	Distri-bution	Origin	Age
Cahokia Fm.	Clay, silt, sand (mapped separately)	**Fines upward**	Deciduous wood	Leached of carbonates	Soft (low Qu); high w%	Meand. stream patters	Alluvium	Post-glacial
Equality Fm.	Silty clay, silt, fine sand	Crudely strat;grey -tan-pink	Spruce wood ; ostracodes	High expandables	**Low Qu (< 1.5); w 20-30 %**	Large trib. valleys and terraces	Lake sediment	Wisconsin Episode
Henry Fm.	**Sand and gravel**	Stratified	Spruce wood	Calcareous		Mississippi Valley; braided	Outwash	Wisconsin Episode
Peoria Silt	Silt	Massive Tan	Terrestrial gastropods; Mammoth	Dolomitic, high expandables	Low Qu and blow count	Uplands	Loess	Wisconsin Episode
Roxana Silt	Silt	Massive **Pinkish**	Terrestrial gastropods **(*Allogona*)**	Rel. high expandables and kaolinite	Low Qu and blow count	Uplands	Loess	Wisconsin Episode
Glasford Fm.	**Loamy diamicton** (some sand)	Tan to grey	Incorporated fossils	High dolomite, 40-60 % illite	**Qu > 1.5** **w 15-22 %**	Uplands and trib. valleys	Till and ice marginal	Illinois Episode
Peters-burg Silt	Silt to silty clay loam	Crudely strat. Tan to grey	Spruce wood; aquatic and terrestrial gastropods **(*Pomatiopsis*)**	Generally similar to Glasford	Moderate Qu and w	Buried valleys	Lake sediment and loess	Illinois Episode
Banner Fm.	**Silty clay loam diamicton** (some sand)	Orange – brown to grey	Incorporated fossils	High calcite and expandables	**Qu > 1.5** **w 20-26 %**	Buried valleys	Till and ice marginal	pre-Illinois Episode

Sangamon Geosol

Yarmouth Geosol