On the Origin of Macomb County Soils

The science behind the soil in our backyard

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- Gardener

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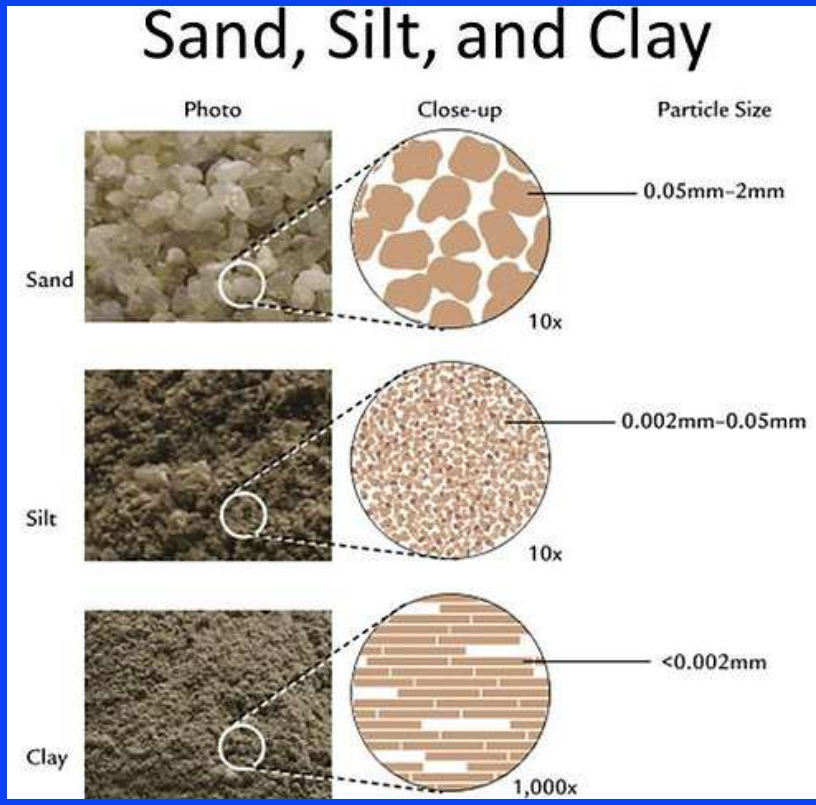
Outline

- Particle Size and Texture
- How soils form and their importance
- Glacial history of Michigan and Macomb County
- Soil Data on the Web
- How do we fix our soil?
- Bonus story of the Petoskey Stone

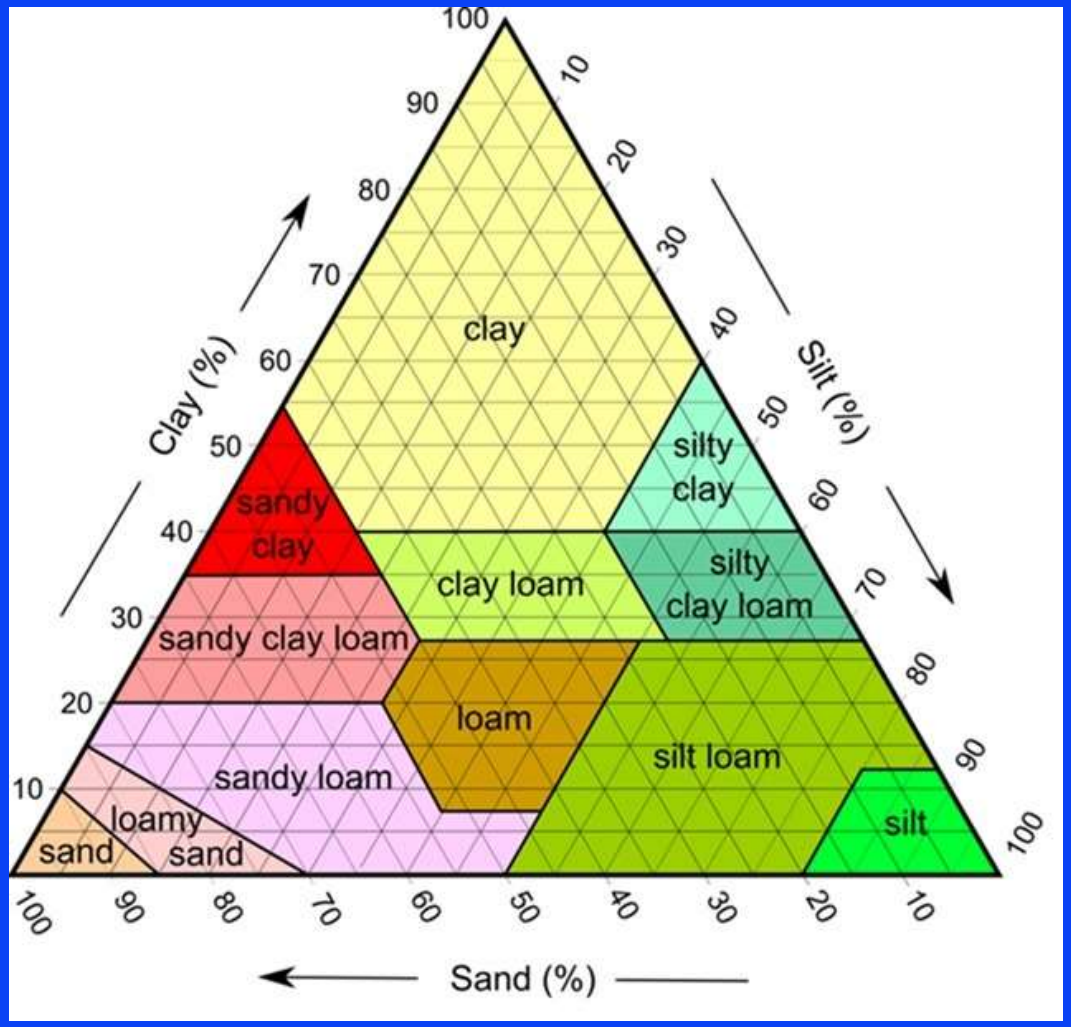
Particle Size vs. Texture

Particle Sizes

- Sand is relatively large and difficult to entrain. Sand also promotes infiltration (0.063 mm – 2 mm)
- Silt is most easily eroded component. Loess sediments are particularly susceptible. (0.002 mm - 0.063 mm)
- Clays are cohesive and tend to remain bound to the soil structure; however, once detached they remain in in suspension (<0.002 mm)



Soil Texture



Definition of a Soil

It Depends:

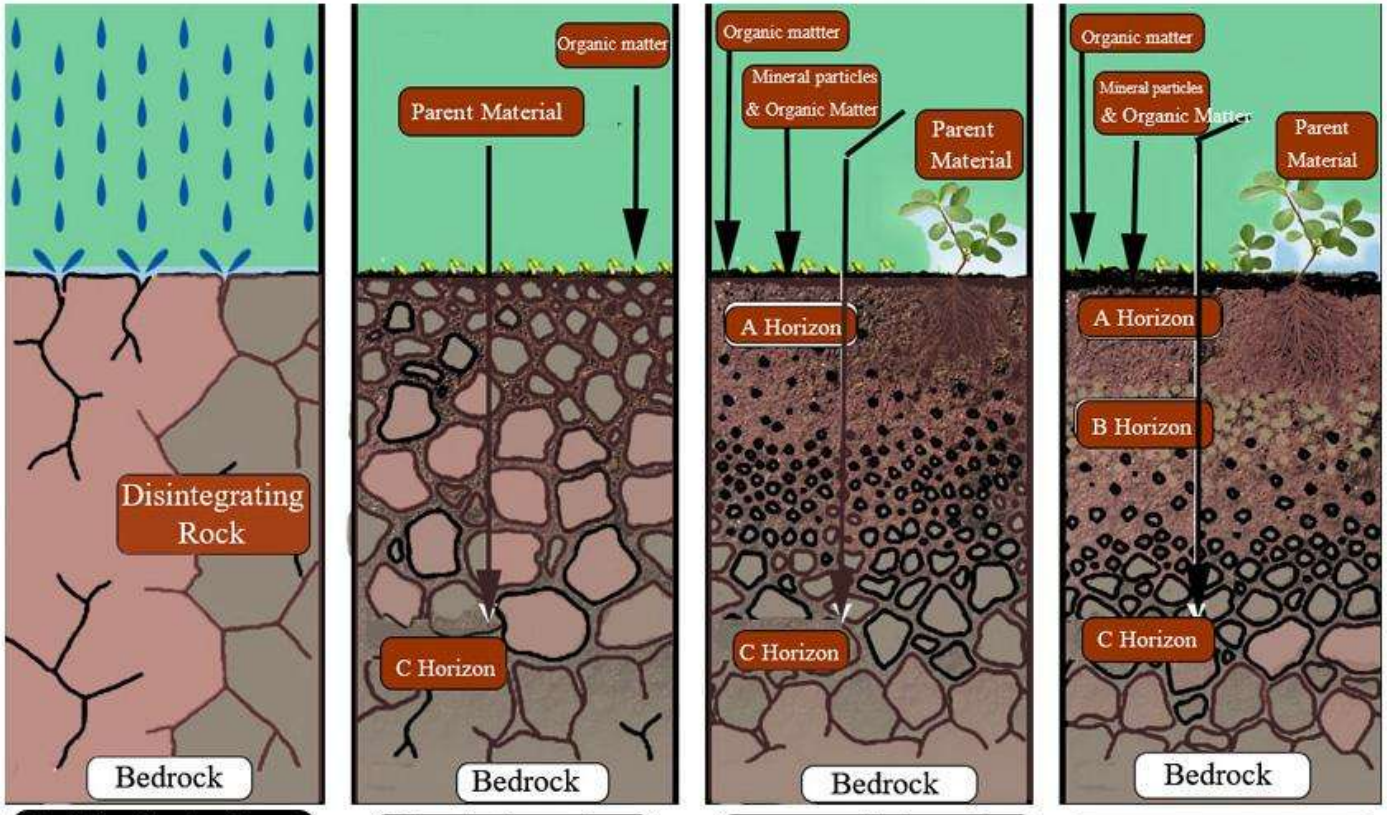
USDA - Soil is a naturally occurring mixture of mineral and organic ingredients with a definite form, structure, and composition. The exact composition of soil changes from one location to another.

Gardeners – Material which nourishes and supports growing plants. A living media.

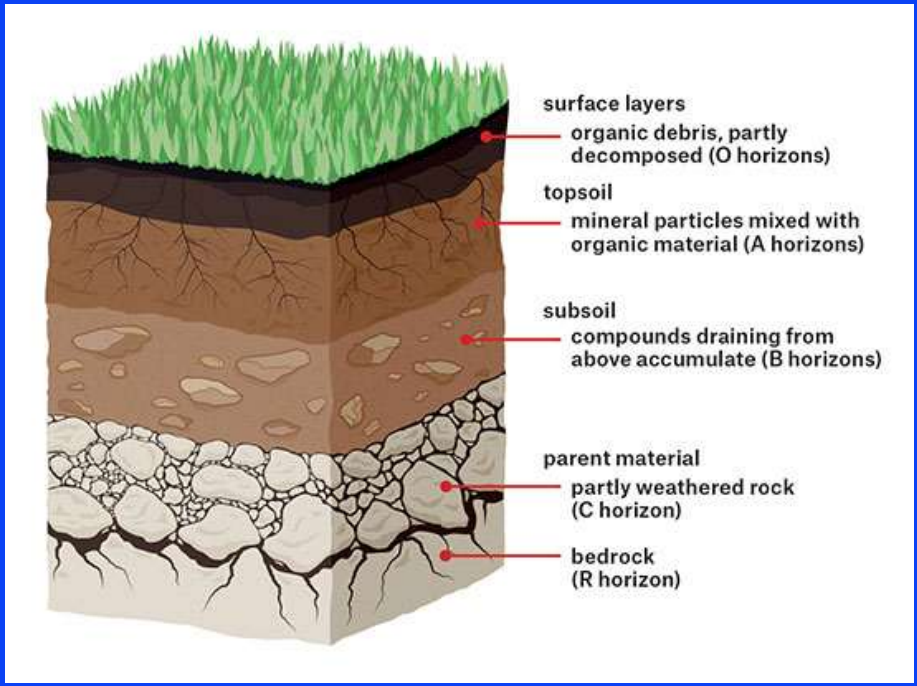
Geologists – Loose surface of the Earth that has undergone the pedogenic process.

Engineers – Any unconsolidated sediment.

Formation of Soil



Soil Formation (continued)



Soil Building process is slow (hundreds of years)

Source: Wordpress.com

Michigan State Soil

A Horizon
This horizon is the surface horizon. It is darker than other horizons as it contains the most organic matter. Organic matter coats and stains the soil particles. The organic matter comes from annual accumulation of plant material that decomposes in the soil each year.

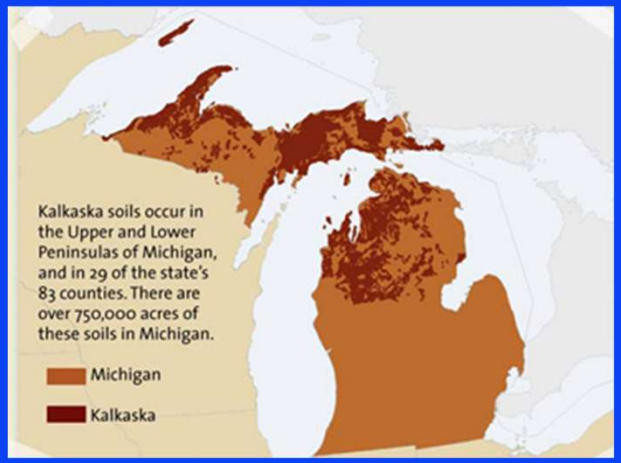
E Horizon
This horizon is grayer than the others because organic matter, iron and aluminum have been moved downward by water.

Bhs Horizon
This horizon has an accumulation of organic matter, iron and aluminum oxides that have been leached downward from the overlying horizons. Leached organic matter is the dominant component of this horizon.

Bs Horizon
This horizon has an accumulation of organic matter, iron and aluminum oxides that have been leached downward from the overlying horizons. Leached iron and aluminum oxides are the dominant component of this horizon.

BC Horizon
This is a transitional horizon that has some features of the overlying and underlying horizons.

C Horizon
This is the unaltered parent material (the material from which the soil was formed) that was produced by the sandy deposits left by the glaciers that covered Michigan. The C horizon has little or no soil development and looks much like it did when it was first deposited.



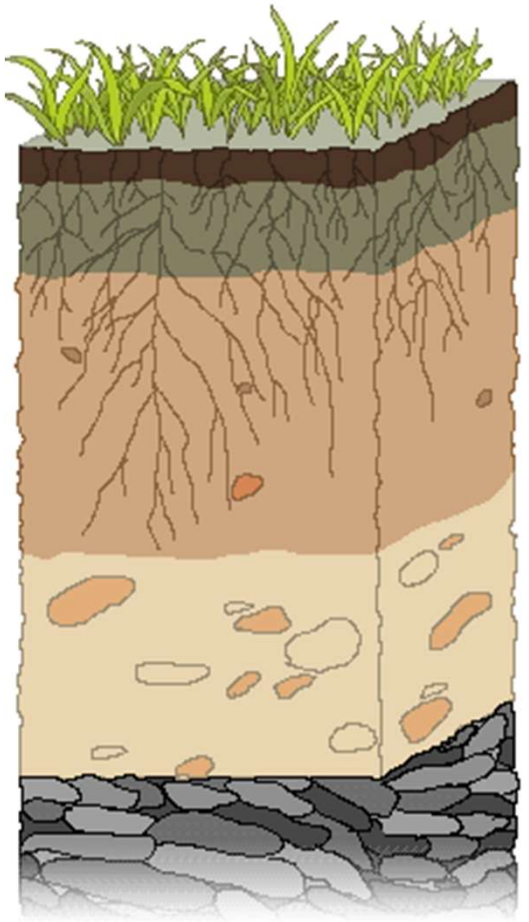
Why is Soil Important?

- Nutrients
  - Feed the soil, not the plant
  - Plants lack a mouth

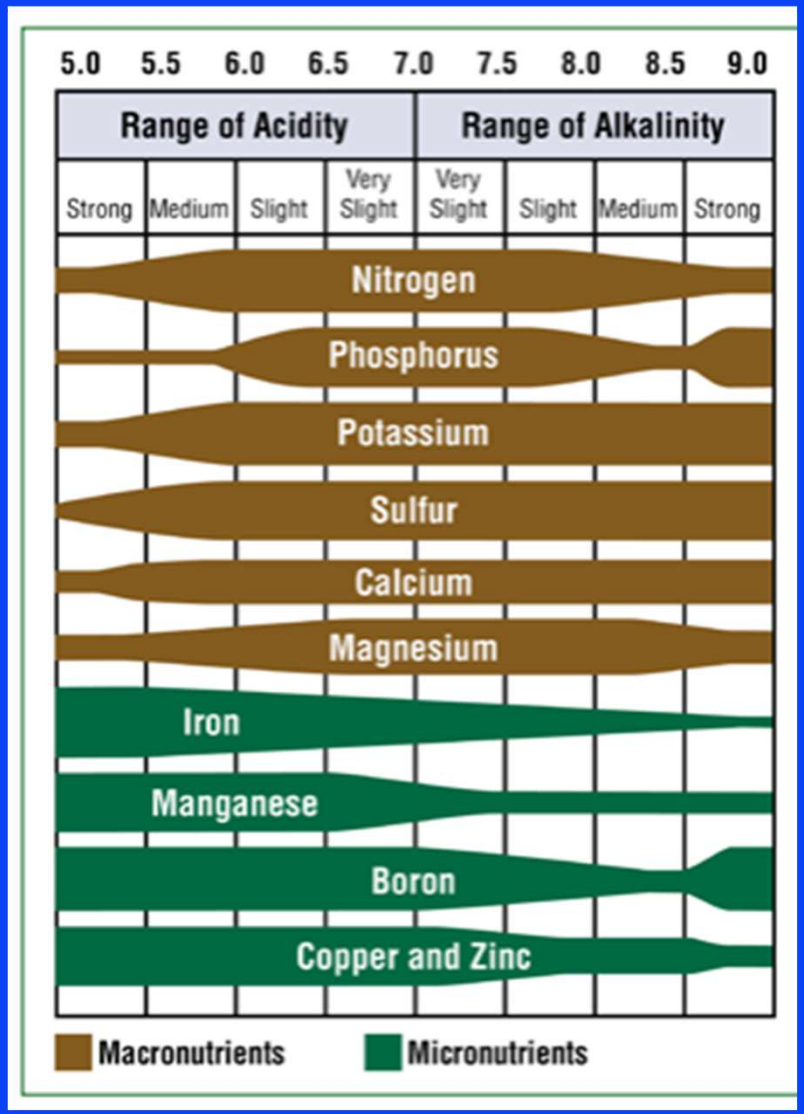
- Drainage and Aeration

Why is Soil Important?

- Nutrients
- Drainage and Aeration



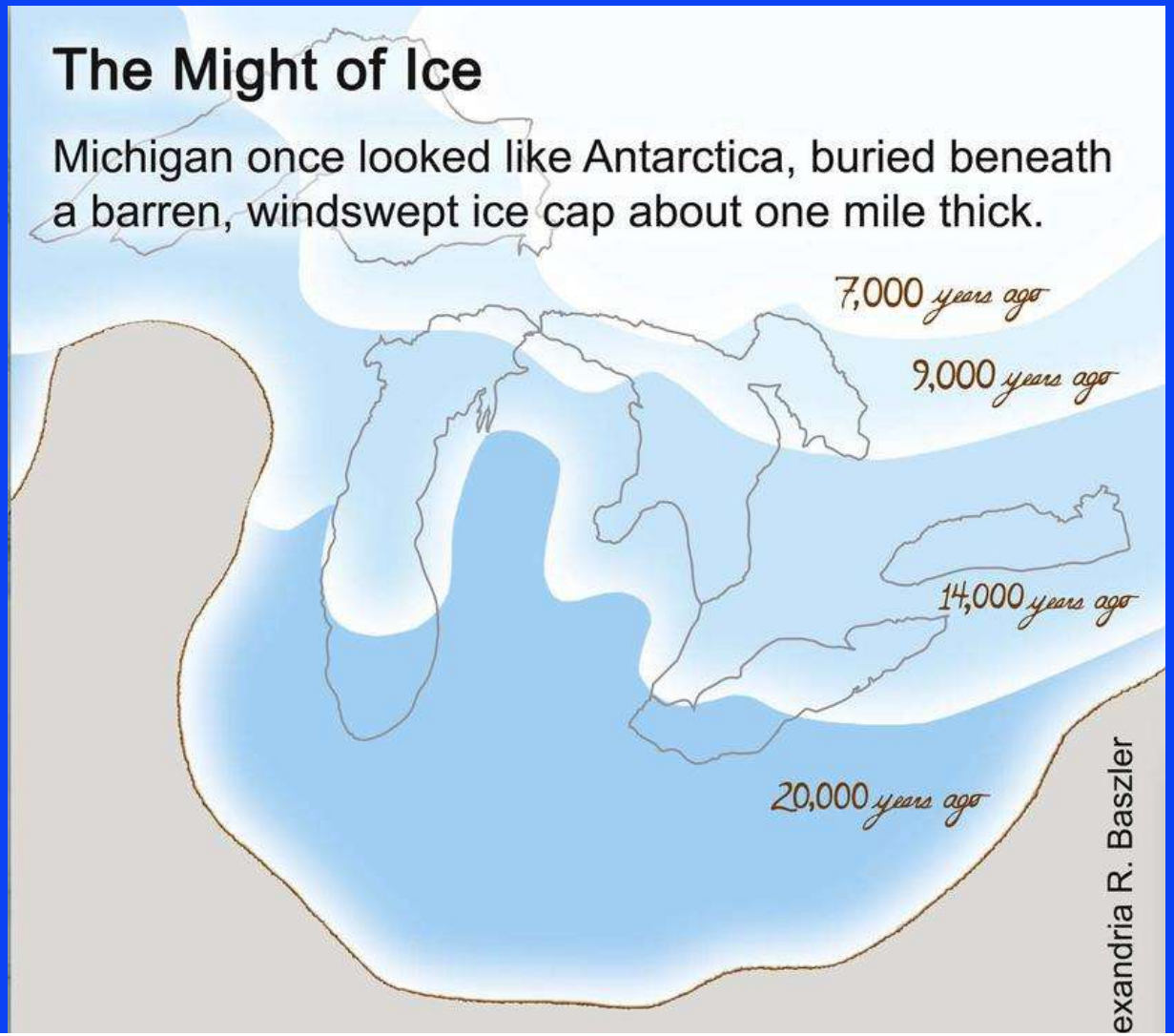
pH and Nutrient Availability



Nutrient	Macro/micro
Carbon	Macro
Hydrogen	Macro
Oxygen	Macro
Nitrogen	Macro
Phosphorus	Macro
Potassium	Macro
Calcium	Macro
Magnesium	Macro
Sulfur	Macro
Boron	Micro
Copper	Micro
Iron	Micro
Manganese	Micro
Zinc	Micro
Molybdenum	Micro
Chlorine	Micro
Cobalt	Micro
Nickel	Micro

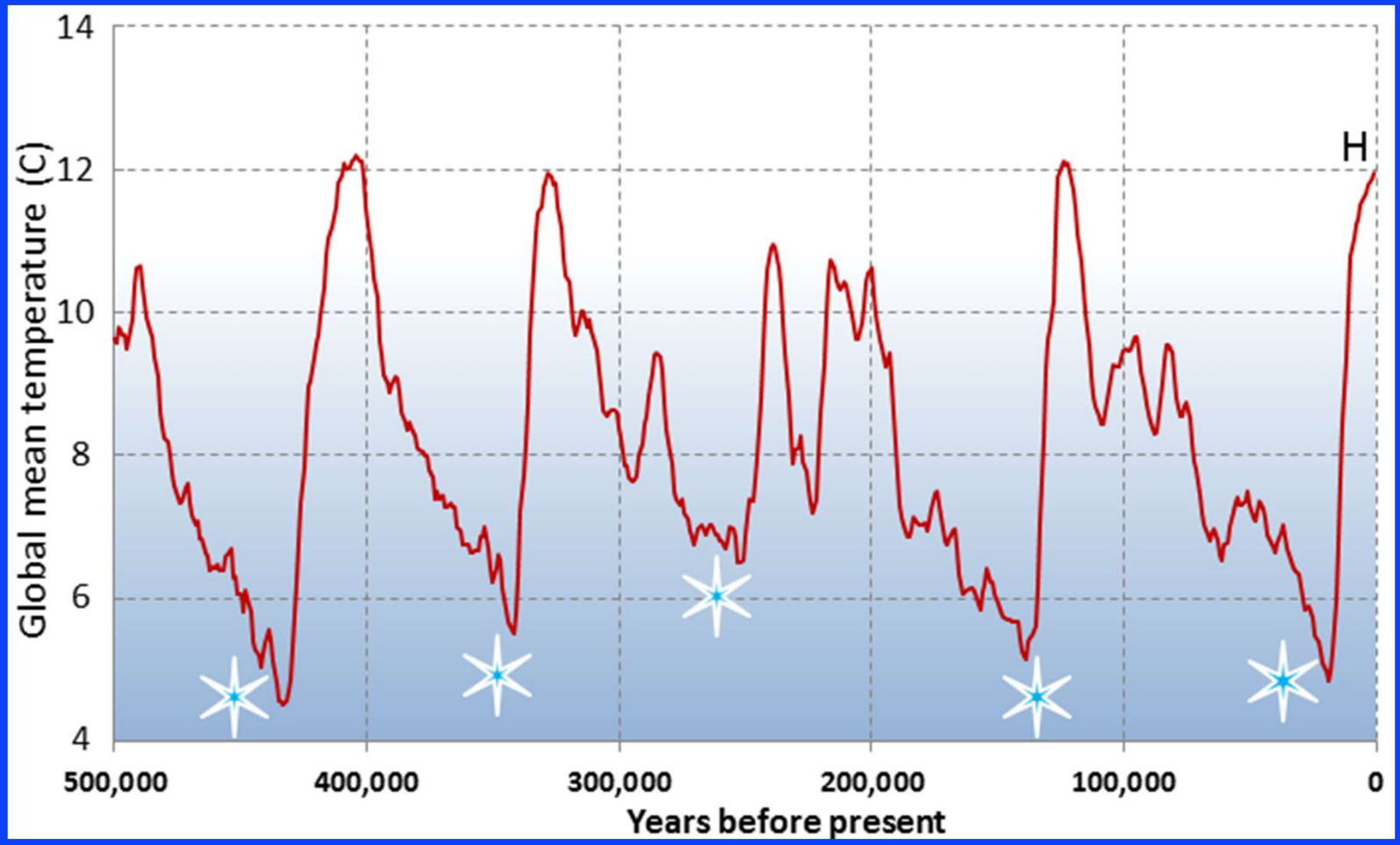
Figure 1. *This graph shows how nutrient availability changes with the pH of mineral soils. Nutrients are most available when the band is wide. When the band is narrow, the nutrients are less available. Graphic adapted from the* Corn & Soybean Field Guide *(Purdue Extension publication ID-179). Source: Brady and Weil, 2007.*

Our Glacial History



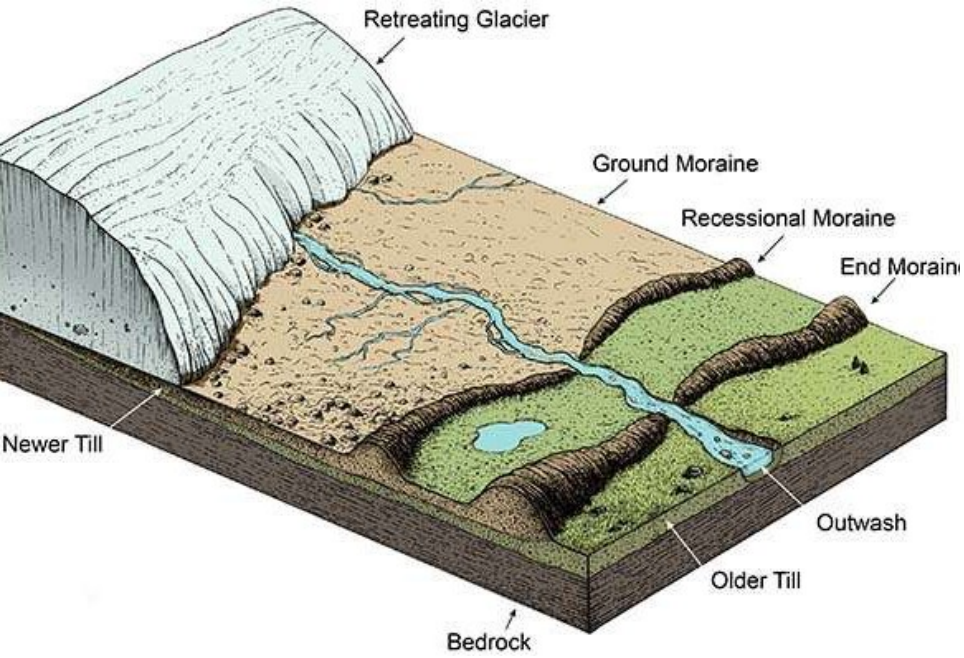
- Past landscapes erased
- Causes of Glaciation
- Very Heavy
- Store Large Quantities of Water

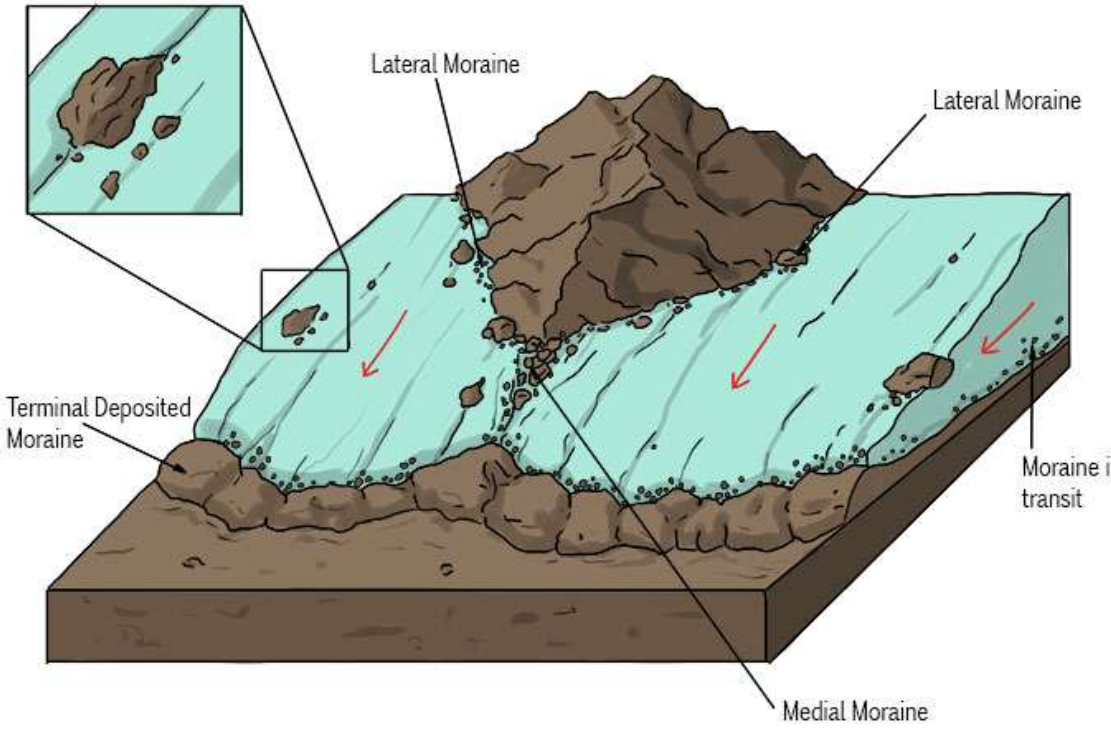
Glacial Advances and Retreats Over 500,000 years



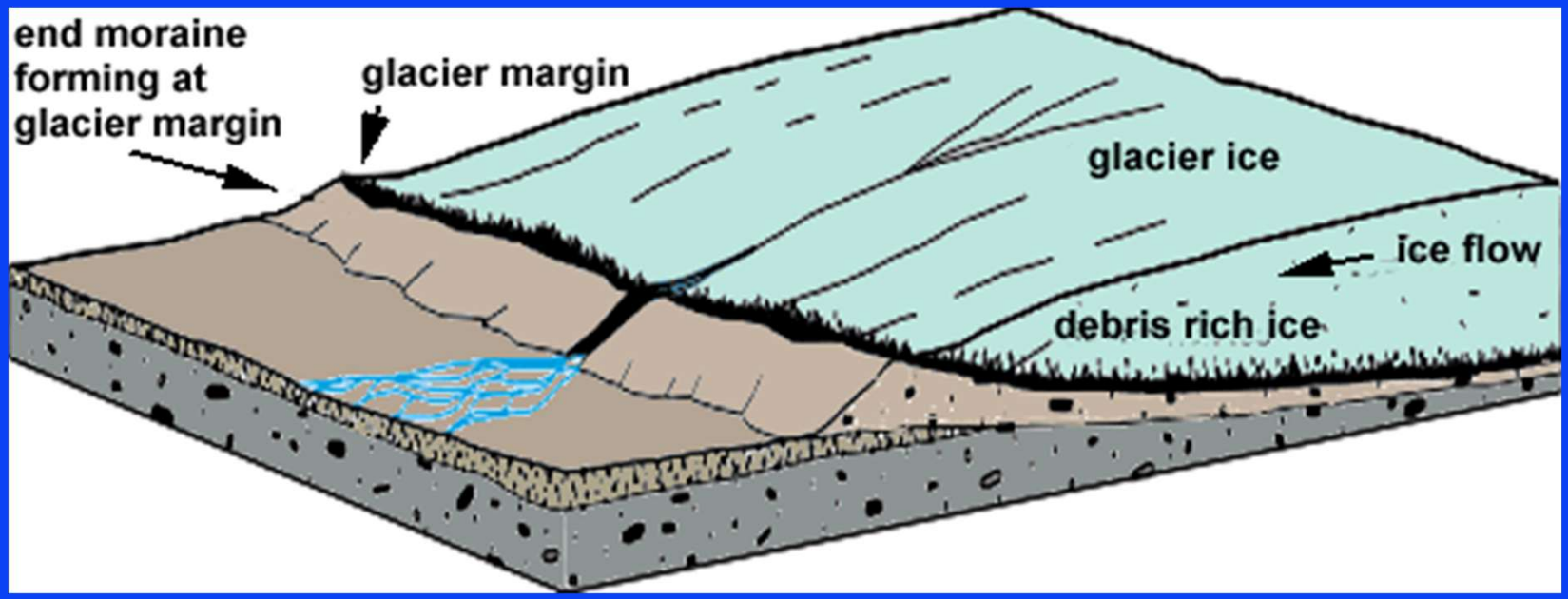
Source: BC Open Textbook

Moraines – Recessional, End and Ground





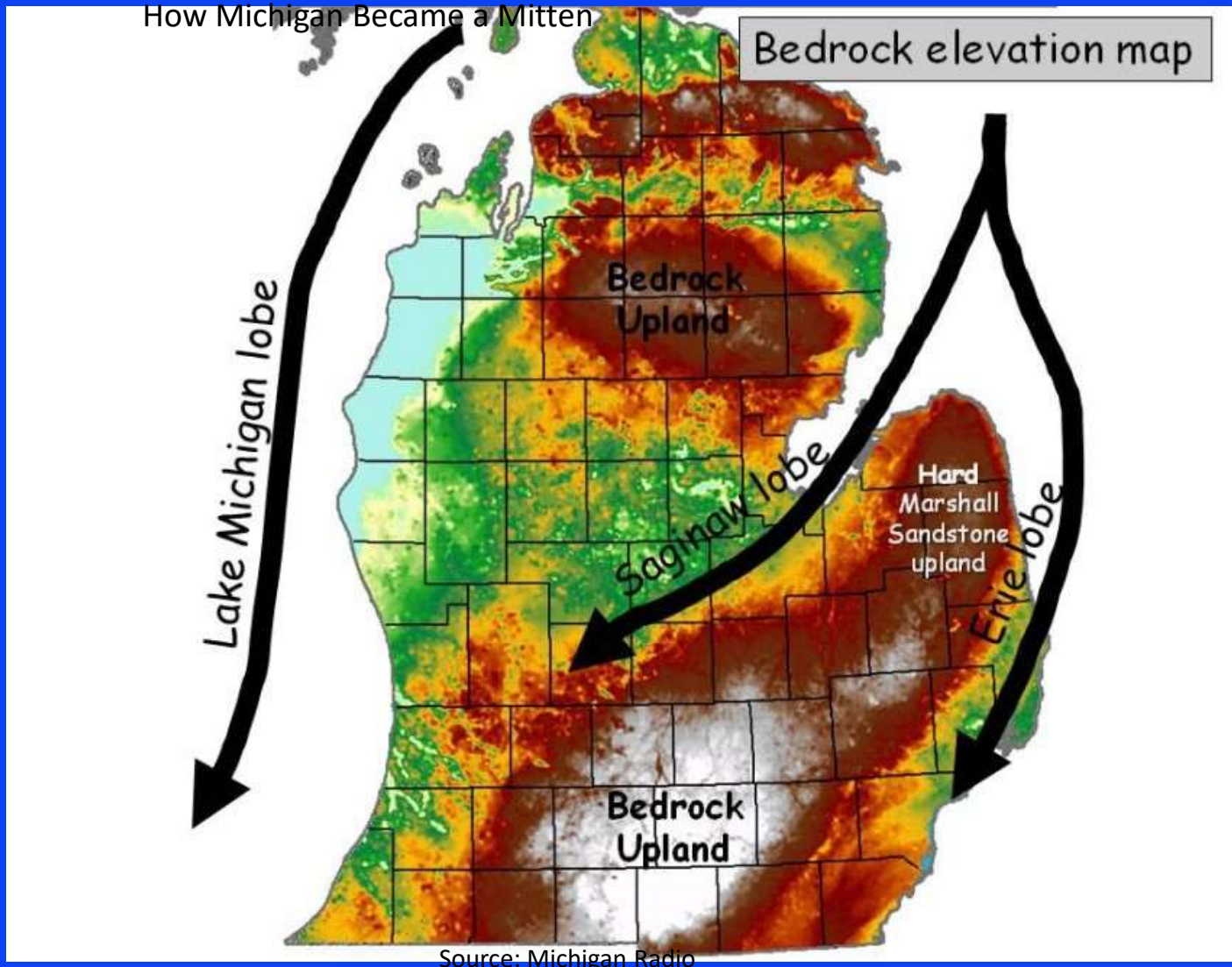
Moraines – Recessional, End and Ground



Lobes and Pro-Glacial Lakes

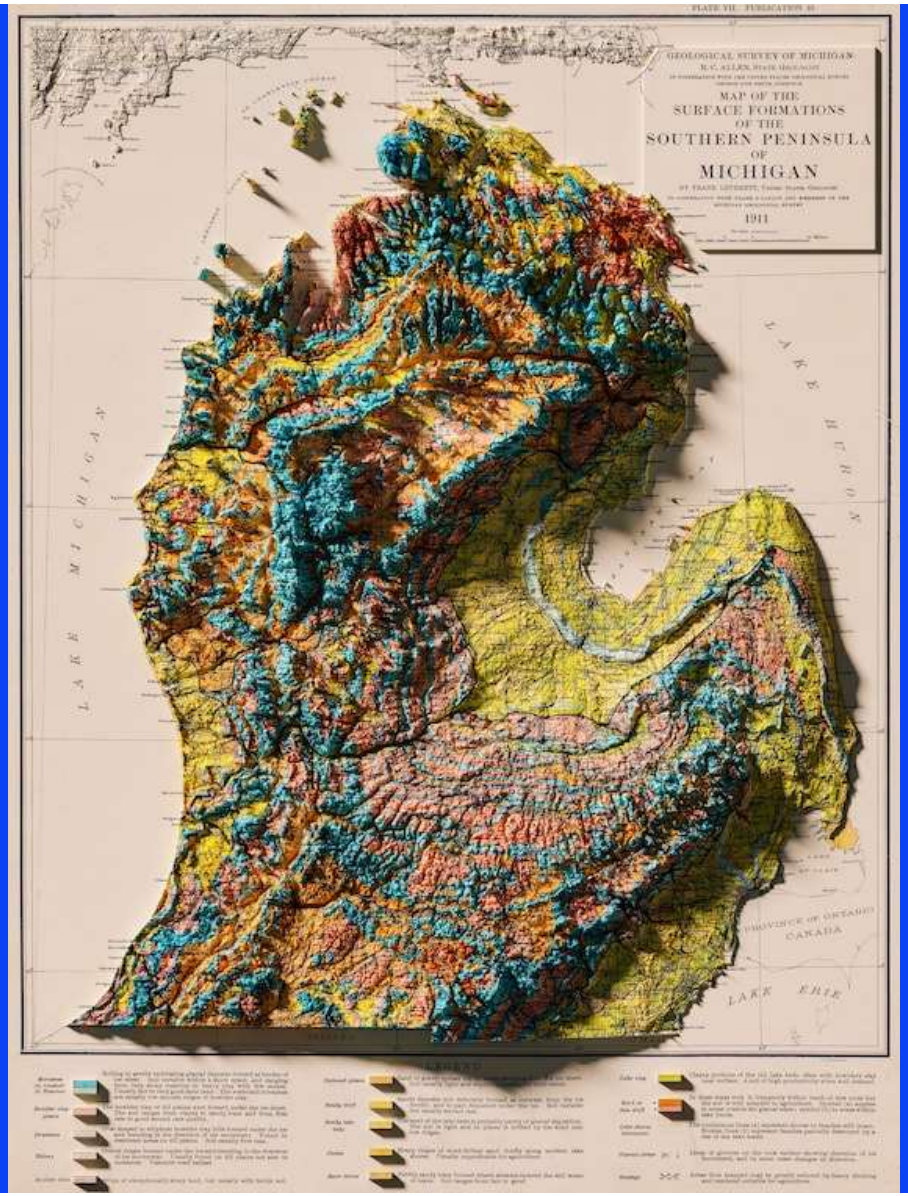
Source: Kincare et al.

How Michigan Became a Mitten

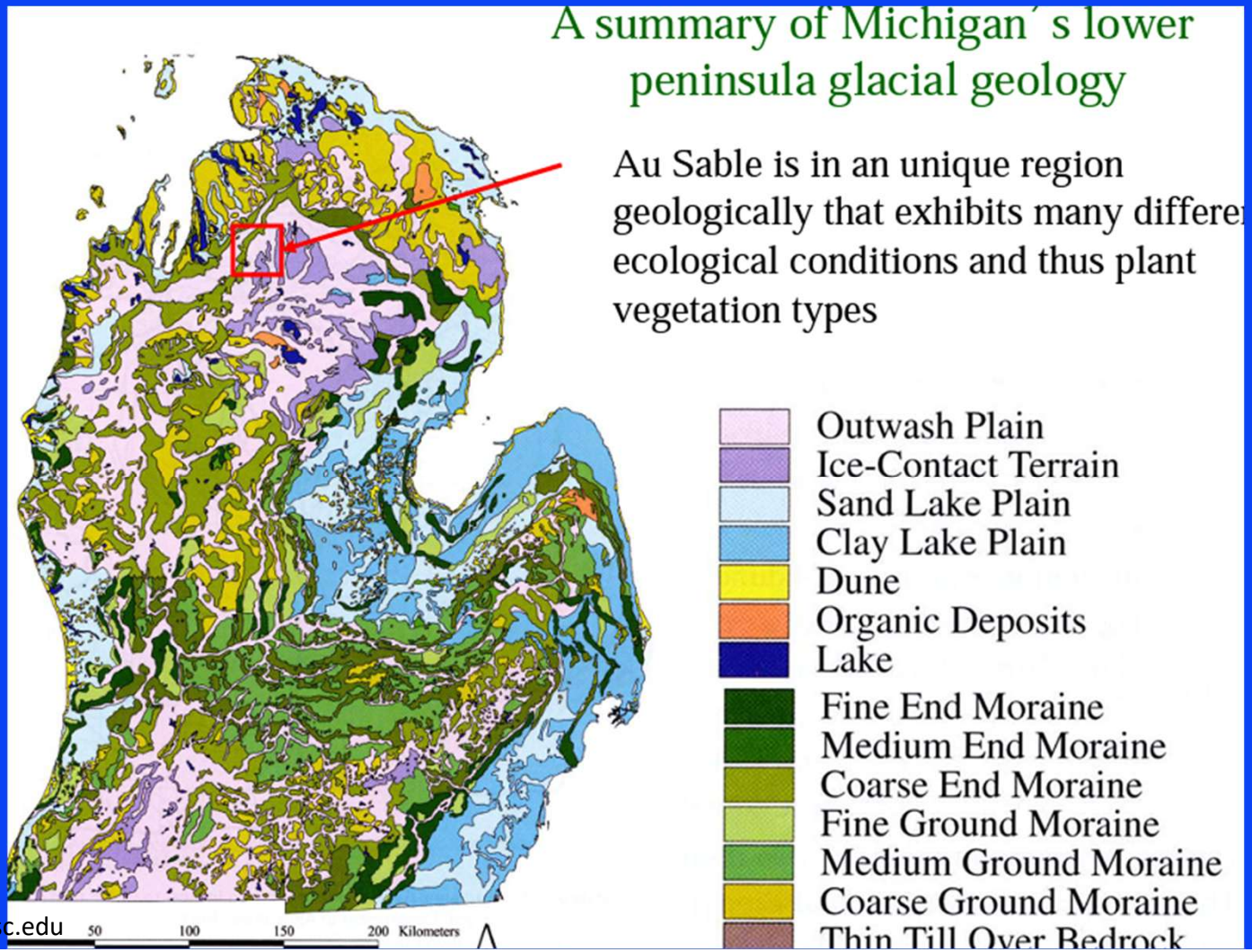


Source: Michigan Radio

Resulting Topography

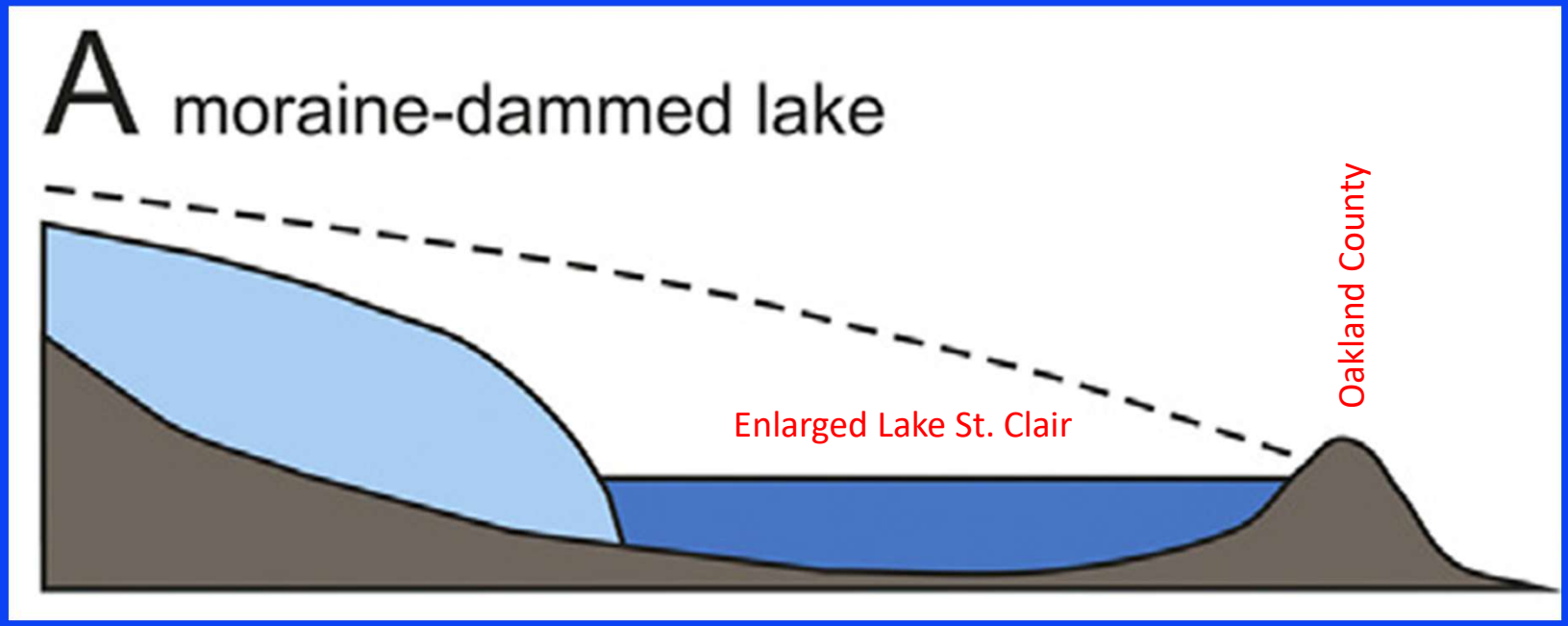


Surficial Sediment

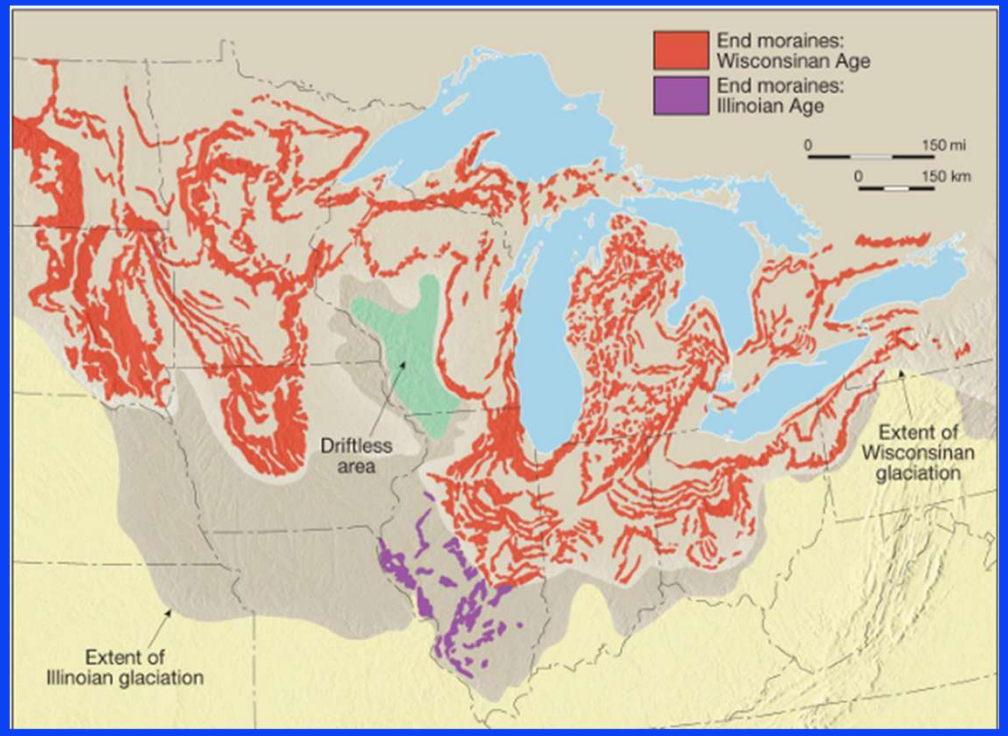


Source: Sytsma.botany.wisc.edu

Moraines and Pro-Glacial Lakes



Topography Left Behind



Glacial Outwash – Sand and Gravel

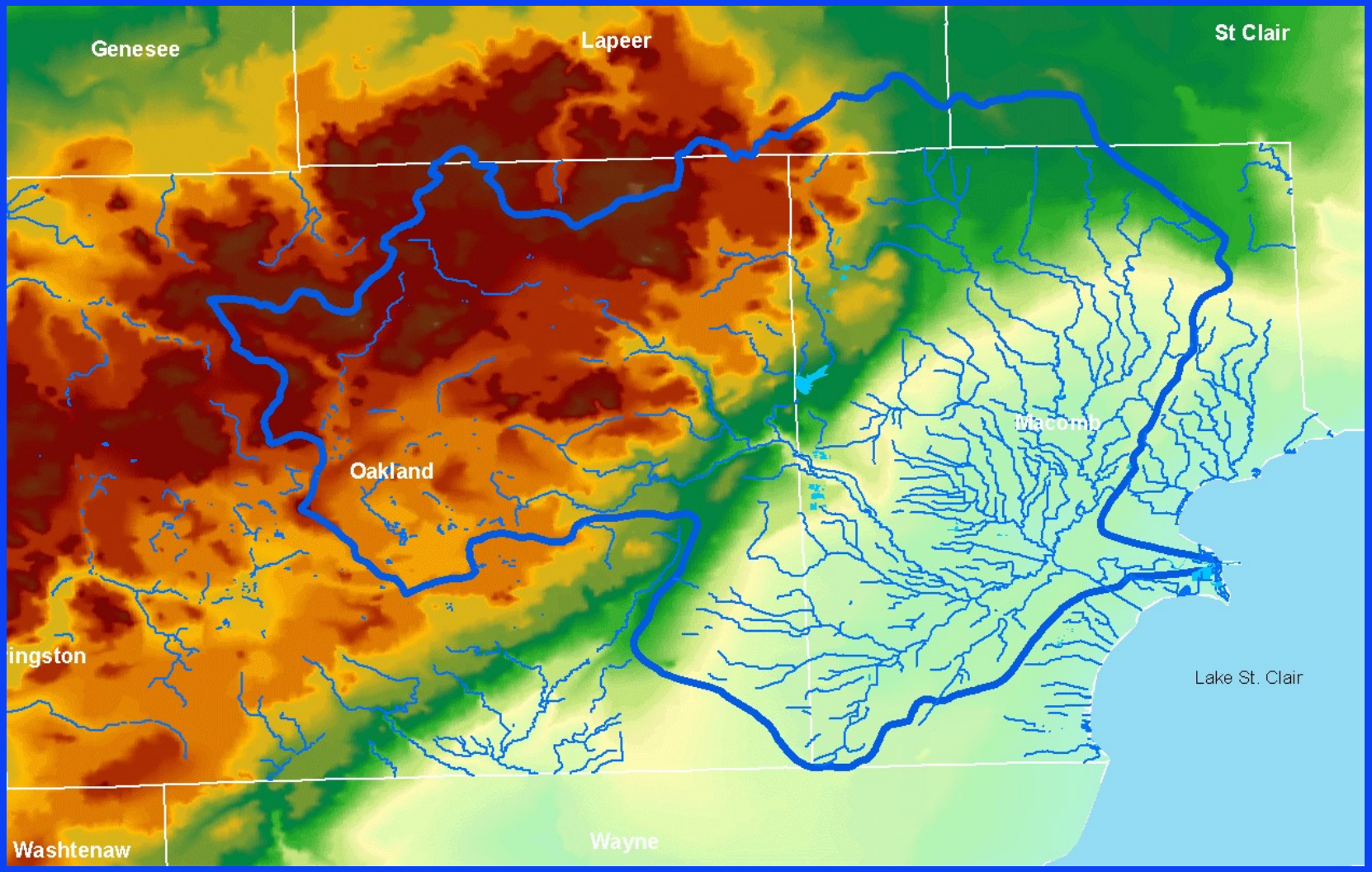
Glaciers are Dirty

Source: Staffordshire U Blogs

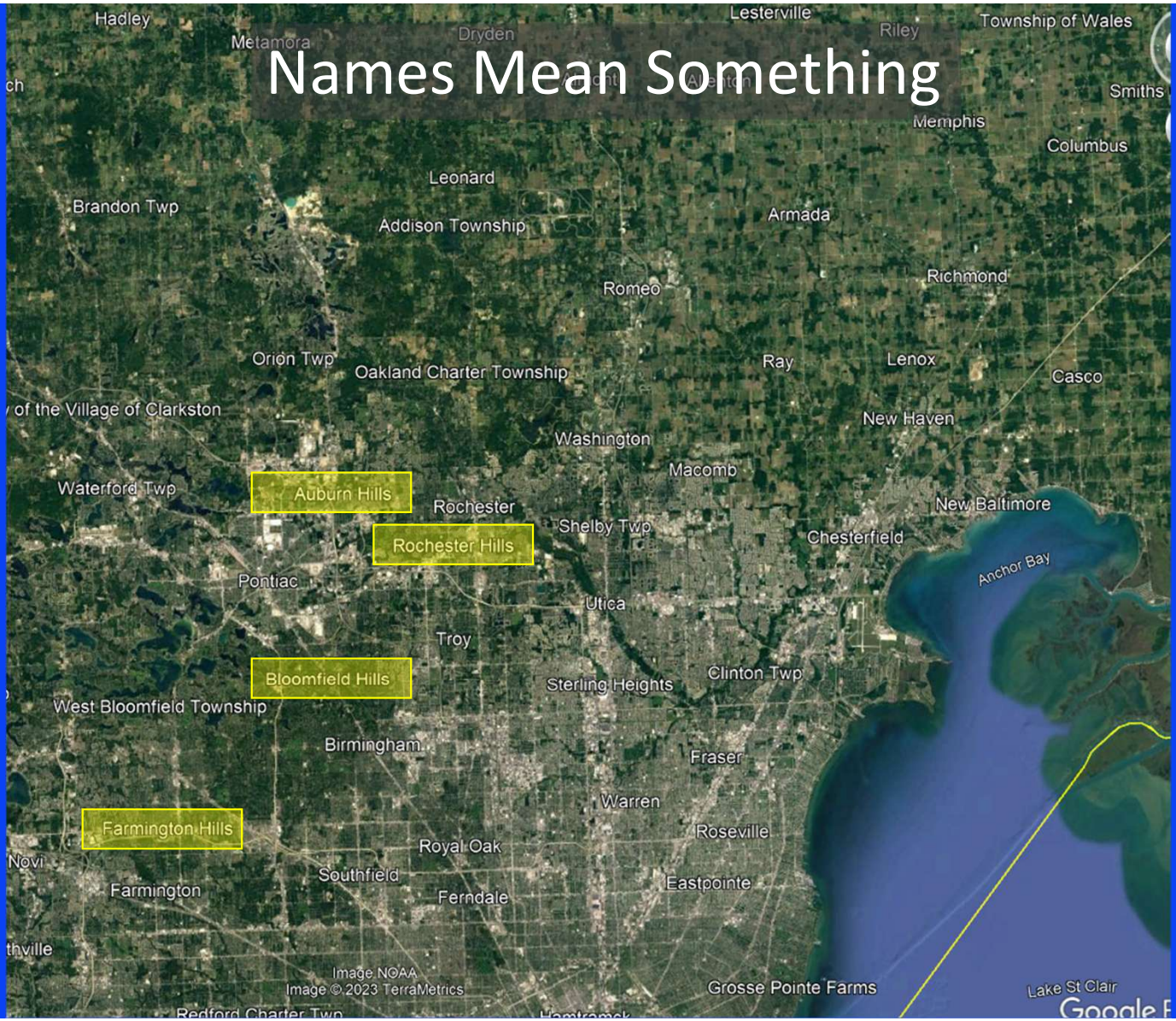
Source: Science

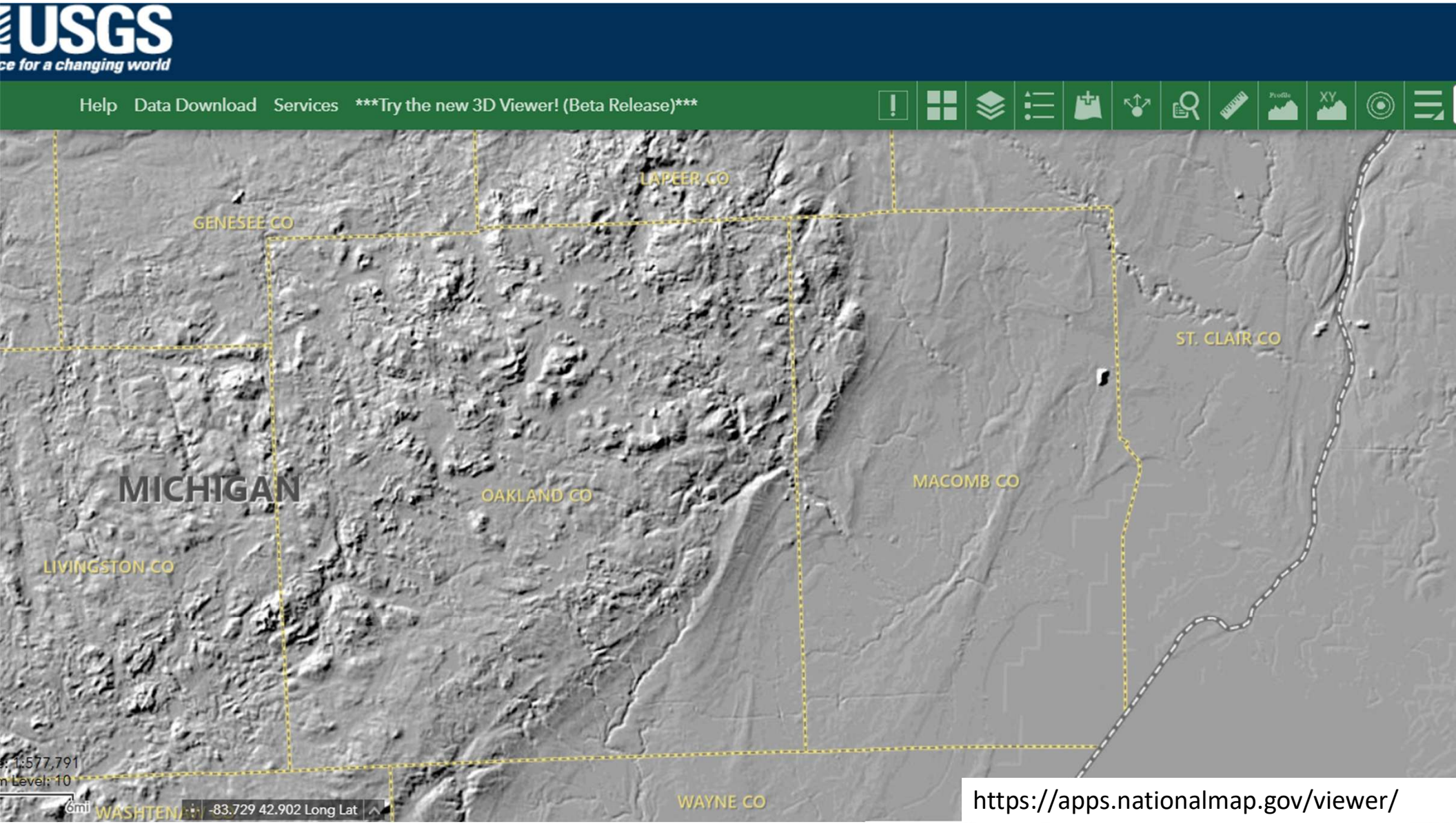
Glaciers are Dirty

Macomb County Topography



Names Mean Something

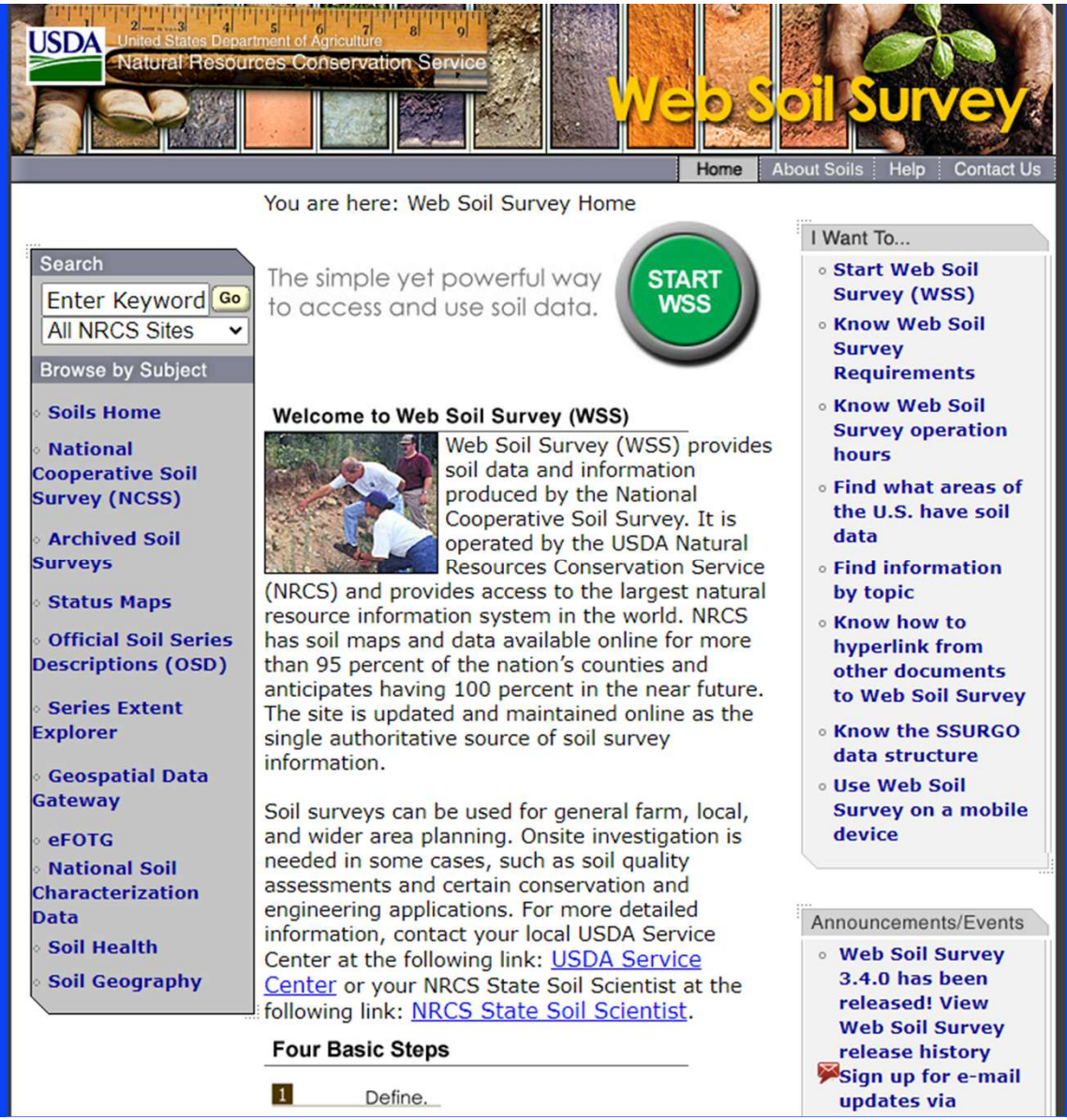




https://apps.nationalmap.gov/viewer/

Sources of Additional Soil Information

Google:
Web Soil Survey



Soil Details

Macomb County, Michigan

SdA—Selfridge loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2whvw
Elevation: 540 to 830 feet
Mean annual precipitation: 28 to 38 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Selfridge and similar soils: 90 percent
Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of th mapunit.

Description of Selfridge

Setting

Landform: Deltas, glacial drainage channels, water-lain moraines, nearshore zones (relict), wave-worked till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Sandy and loamy glaciolacustrine deposits over loamy till

Typical profile

Ap - 0 to 9 inches: loamy sand
E - 9 to 17 inches: sand
Bw - 17 to 27 inches: sand
Bt1 - 27 to 30 inches: sandy loam
2Bt2 - 30 to 35 inches: clay loam
2Cg - 35 to 79 inches: clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.01 to 1.42 in/hr)
Depth to water table: About 6 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0

Macomb County, Michigan

Lg—Lenawee silty clay loam, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2wcf7
Elevation: 560 to 980 feet
Mean annual precipitation: 28 to 38 inches
Mean annual air temperature: 45 to 52 degrees F
Frost-free period: 135 to 230 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Lenawee and similar soils: 93 percent
Minor components: 7 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lenawee

Setting

Landform: Lakebeds (relict)
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey glaciolacustrine deposits

Typical profile

Ap - 0 to 9 inches: silty clay loam
Bg - 9 to 39 inches: silty clay loam
Cg - 39 to 80 inches: silty clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to low (0.00 to 0.01 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 21 percent
Maximum salinity: Nonsaline (0.0 to 0.6 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.0 inches)

Interpretive groups

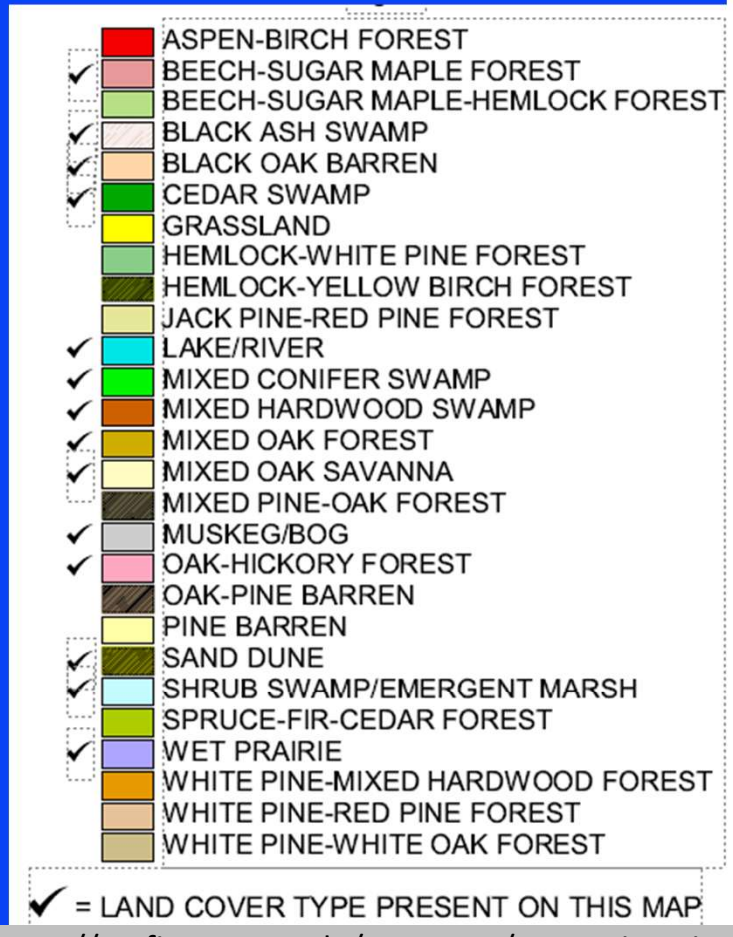
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: D
Ecological site: F099XY013MI - Wet Lake Plain Flats

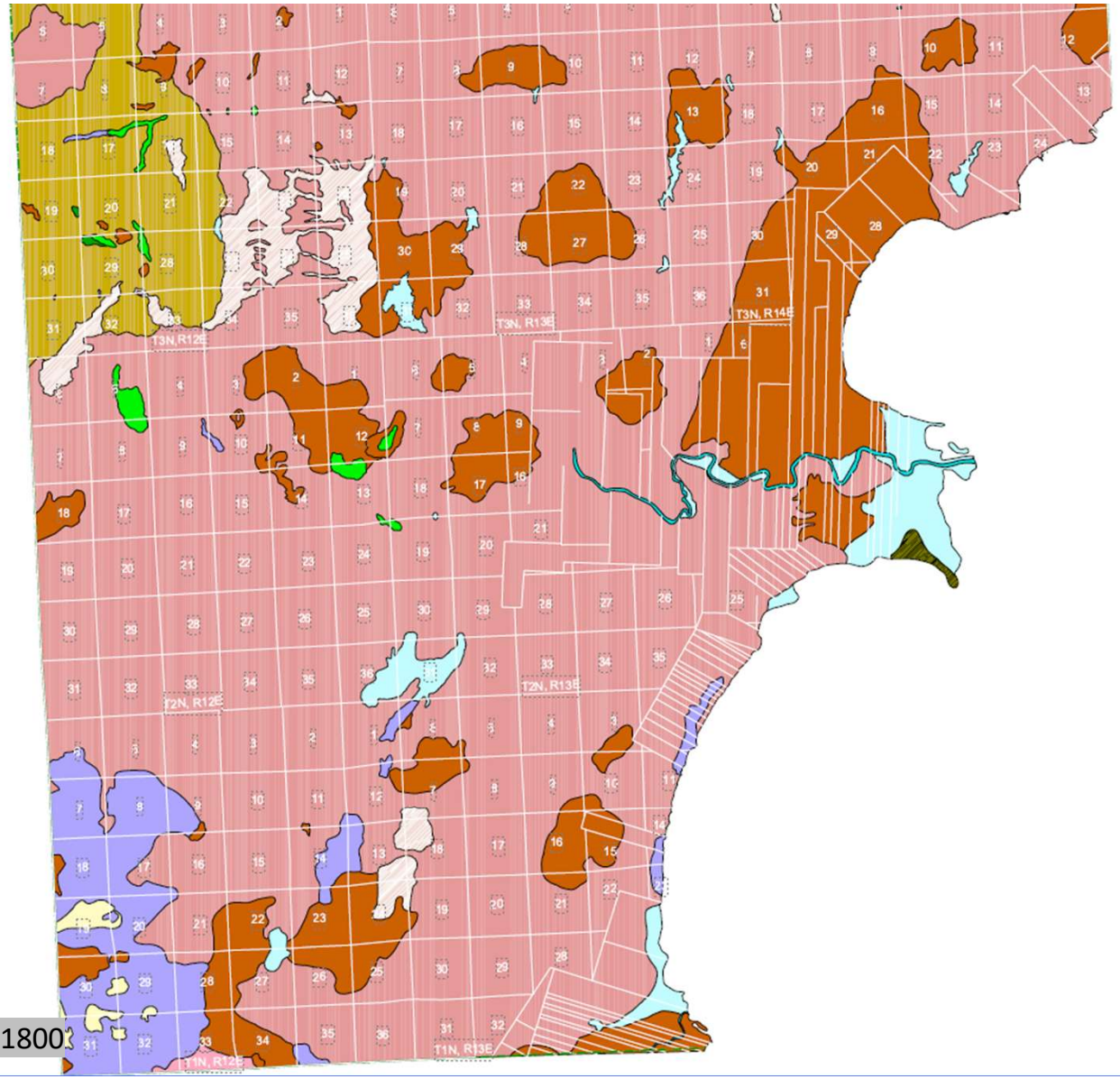
Additional Soil Information

Macomb County, Michigan

Map symbol and soil name	Depth	Sand	Silt	Clay	Moist bulk density	Saturated hydraulic conductivity	Available water capacity	Linear extensibility	Organic matter	Erosion factors			Wind erodibility group	Wind erodibility index
										Kw	Kf	T		
	In	*Pct*	*Pct*	*Pct*	*g/cc*	*micro m/sec*	*In/In*	*Pct*	*Pct*					
SdA—Selfridge loamy sand, 0 to 3 percent slopes														
Selfridge	0-9	78-84- 88	5-10- 19	2- 6- 7	1.45-1.55-1.60	10.00-55.00-100.00	0.06-0.11-0.35	0.0- 0.5- 1.1	1.4- 2.6-4.7	.05	.05	5	2	134
	9-17	78-92- 99	0- 6- 15	0- 2- 7	1.55-1.65-1.70	10.00-55.00-100.00	0.04-0.05-0.11	0.0- 0.0- 0.4	0.0- 0.5-1.5	.02	.02			
	17-27	76-92- 99	0- 5- 20	0- 3- 9	1.55-1.65-1.70	10.00-55.00-100.00	0.02-0.06-0.15	0.0- 0.1- 1.0	0.0- 0.4-1.1	.05	.05			
	27-30	53-72- 82	4-15- 31	6-13- 17	1.55-1.60-1.70	1.00-10.00-100.00	0.01-0.13-0.32	0.3- 1.0- 1.5	0.0- 0.3-1.0	.24	.24			
	30-35	21-32- 50	20-36- 49	16-32- 37	1.50-1.65-1.75	0.10-0.55-10.00	0.03-0.09-0.31	0.9- 3.2- 4.9	0.3- 0.6-1.0	.32	.32			
	35-79	10-24- 50	30-43- 64	15-33- 39	1.50-1.70-1.95	0.10-0.55-10.00	0.09-0.10-0.29	0.3- 2.3- 4.3	0.1- 0.4-0.8	.37	.37			

Michigan Natural Features Inventory





https://mnfi.anr.msu.edu/resources/vegetation-circa-1800

How do we “Fix” any of these soils?

- Add organic matter
- Add organic matter
- Add organic matter

Questions

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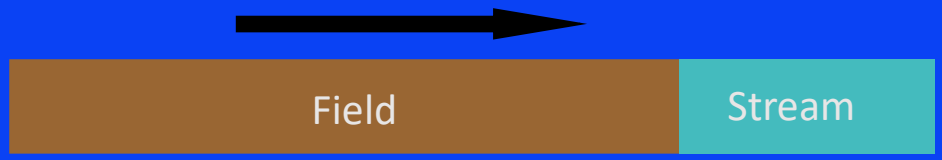
Sediment Delivery

Flat Field



Little or no potential to move sediment from field to stream

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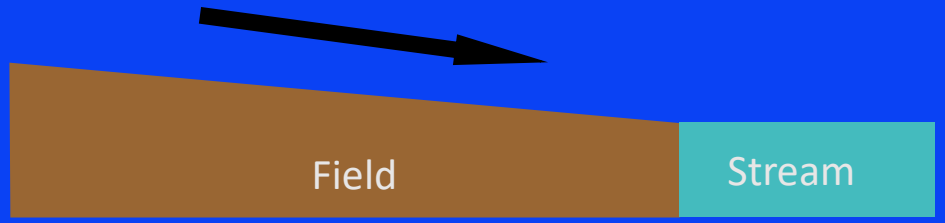
Sediment Delivery

Mild Sloped Field



Sediment begins moving off field into stream

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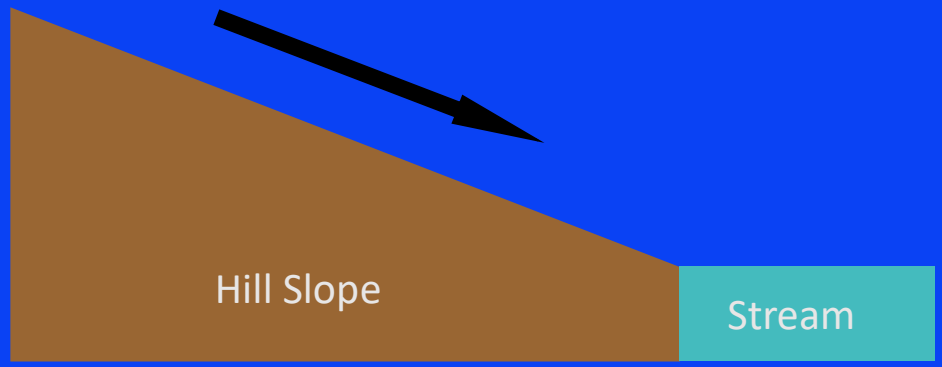
Sediment Delivery

Steep Hill Slopes



Sediment rapidly moves off field into stream

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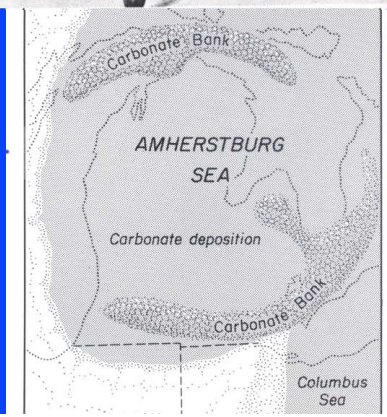
Appalachian Orogeny and the Death of *Hexagonoria*

Source: Dorr and Eschman, 1970



Devonian Great Lakes (~350 Mybp)

Hexagonoria percarinata

Source: Dorr and Eschman, 1970

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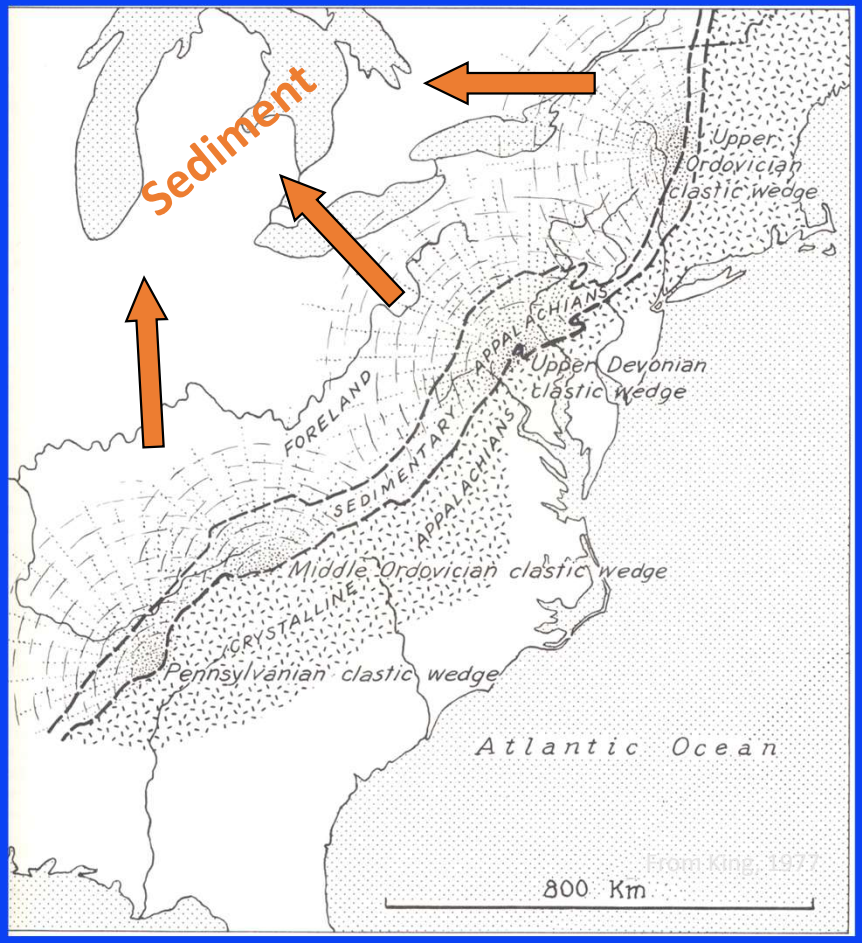
Appalachian Orogeny and the Death of *Hexagonoria*



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All sedimentary rock in the Great Lakes originated from eroded material

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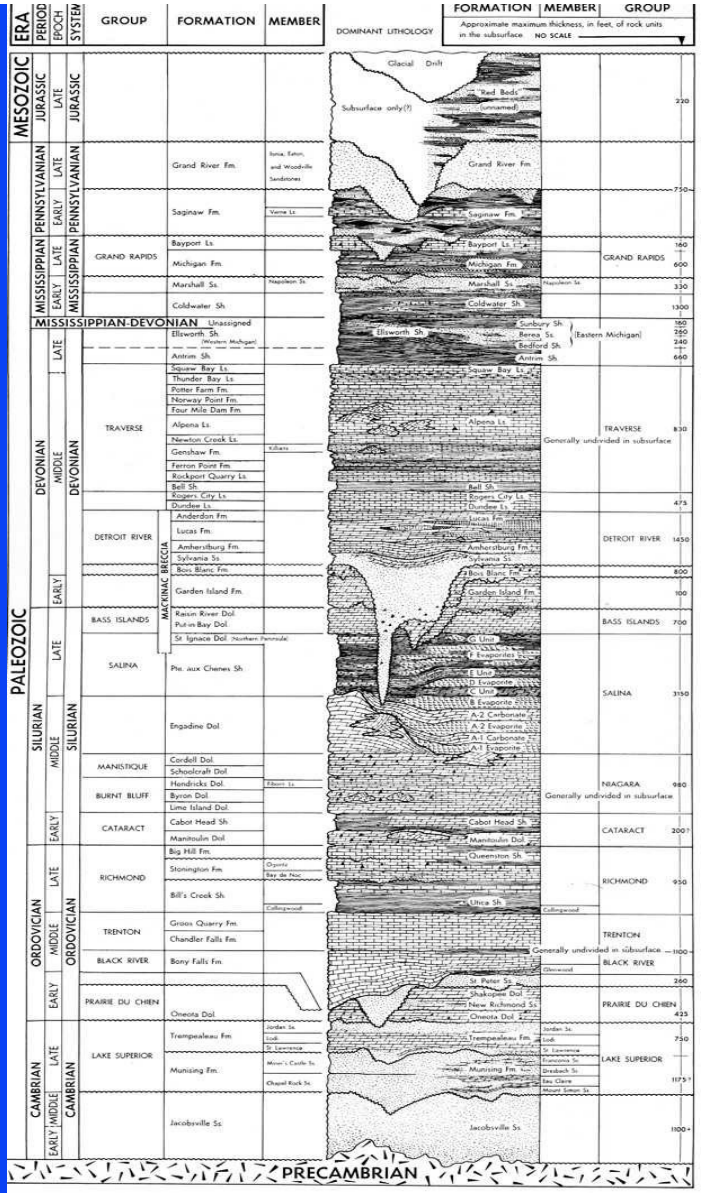
Much Sedimentary Rock



Questions

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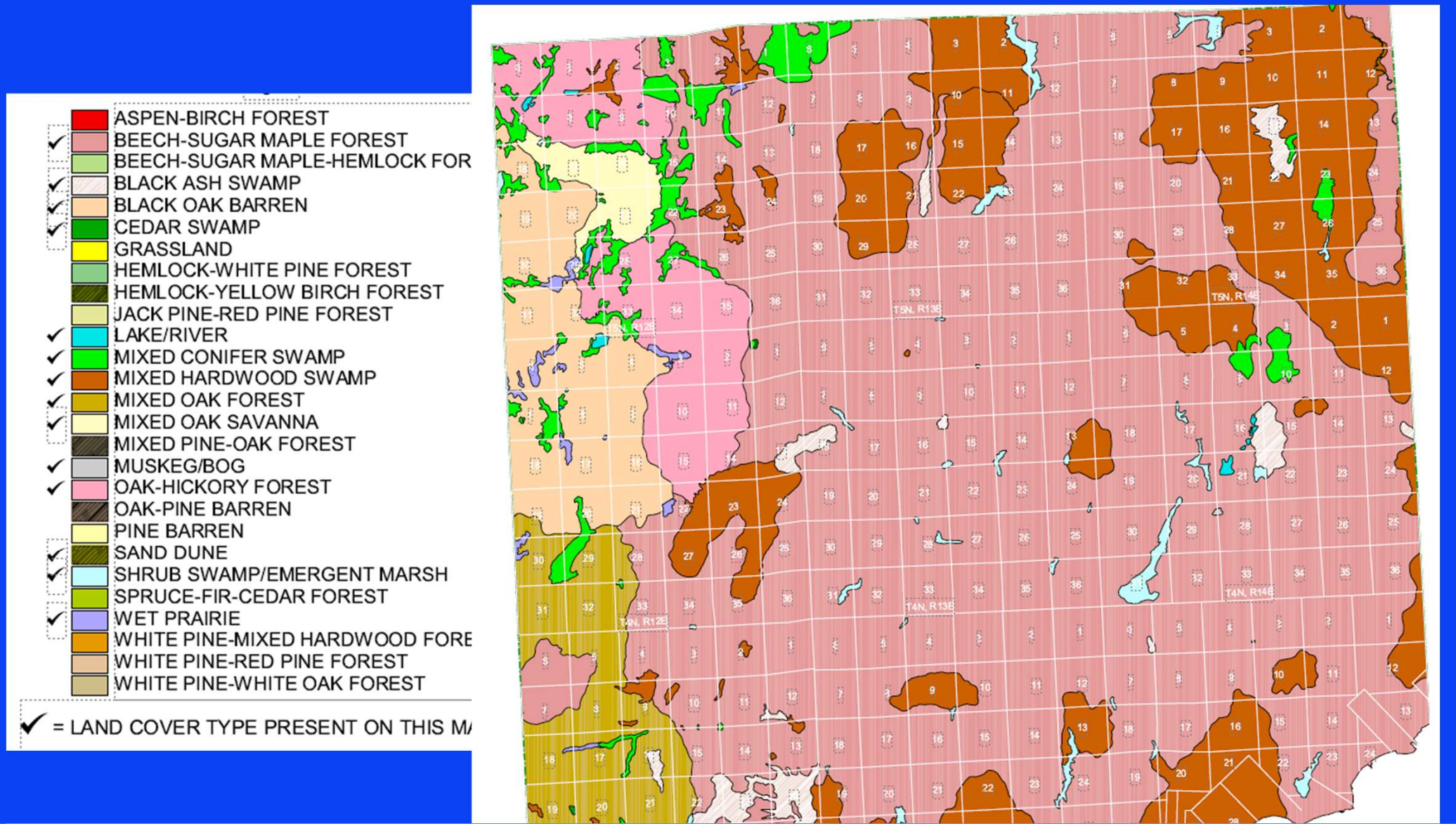
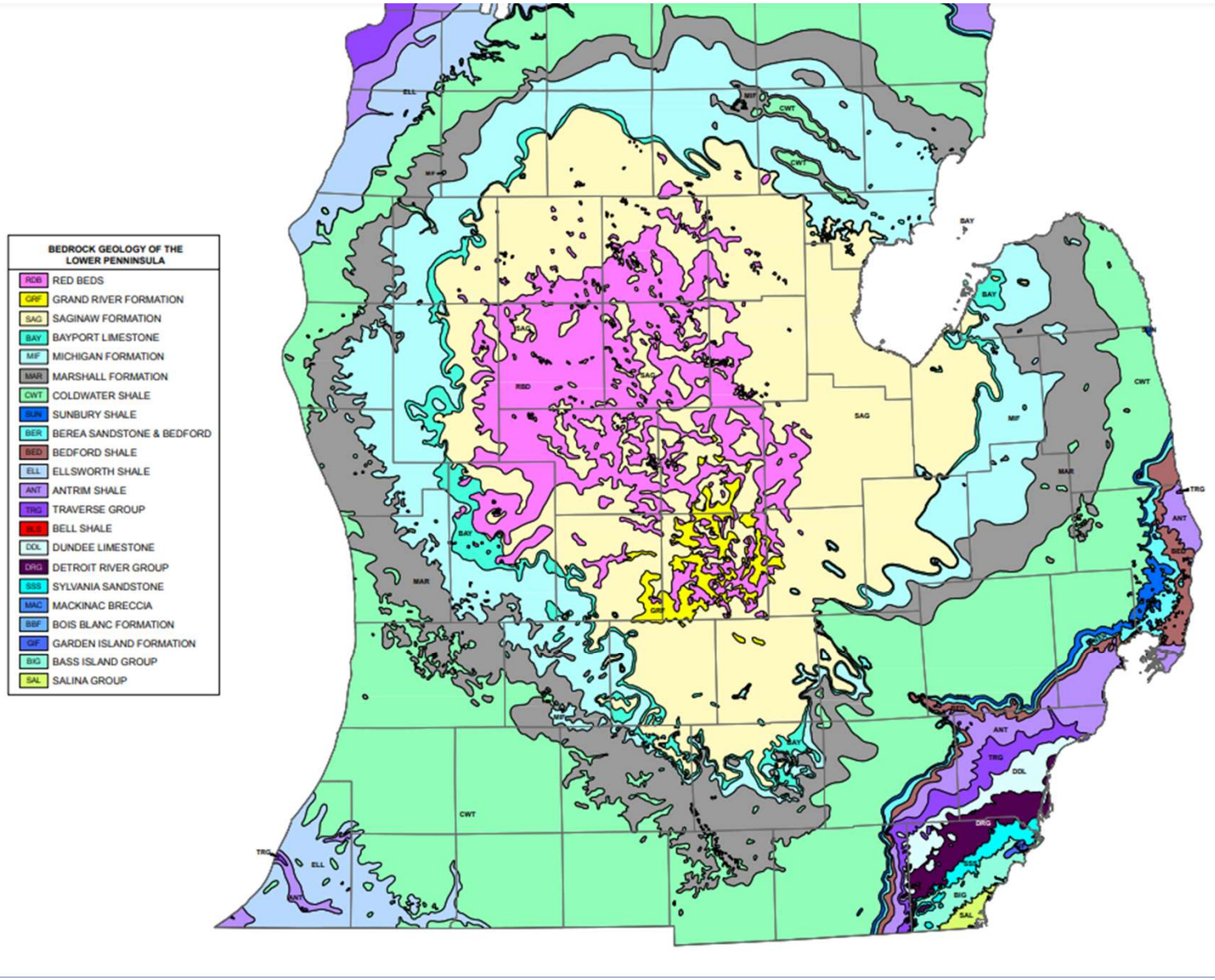

ASPEN-BIRCH FOREST
BEECH-SUGAR MAPLE FOREST
BEECH-SUGAR MAPLE-HEMLOCK FOR
BLACK ASH SWAMP
BLACK OAK BARREN
CEDAR SWAMP
GRASSLAND
HEMLOCK-WHITE PINE FOREST
HEMLOCK-YELLOW BIRCH FOREST
JACK PINE-RED PINE FOREST
LAKE/RIVER
MIXED CONIFER SWAMP
MIXED HARDWOOD SWAMP
MIXED OAK FOREST
MIXED OAK SAVANNA
MIXED PINE-OAK FOREST
MUSKEG/BOG
OAK-HICKORY FOREST
OAK-PINE BARREN
PINE BARREN
SAND DUNE
SHRUB SWAMP/EMERGENT MARSH
SPRUCE-FIR-CEDAR FOREST
WET PRAIRIE
WHITE PINE-MIXED HARDWOOD FORE
WHITE PINE-RED PINE FOREST
WHITE PINE-WHITE OAK FOREST
= LAND COVER TYPE PRESENT ON THIS MA
T5N, R13E
T5N, R14E
T4N, R13E
T4N, R14E


BEDROCK GEOLOGY OF THE LOWER PENNINSULA
RDB RED BEDS
GRF GRAND RIVER FORMATION
SAG SAGINAW FORMATION
BAY BAYPORT LIMESTONE
MIF MICHIGAN FORMATION
MAR MARSHALL FORMATION
CWT COLDWATER SHALE
SUN SUNBURY SHALE
BER BEREA SANDSTONE & BEDFORD
BED BEDFORD SHALE
ELL ELLSWORTH SHALE
ANT ANTRIM SHALE
TRG TRAVERSE GROUP
BLS BELL SHALE
DDL DUNDEE LIMESTONE
DRG DETROIT RIVER GROUP
SSS SYLVANIA SANDSTONE
MAC MACKINAC BRECCIA
BBF BOIS BLANC FORMATION
GIF GARDEN ISLAND FORMATION
BIG BASS ISLAND GROUP
SAL SALINA GROUP

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Sediment Delivery

Slope Matters

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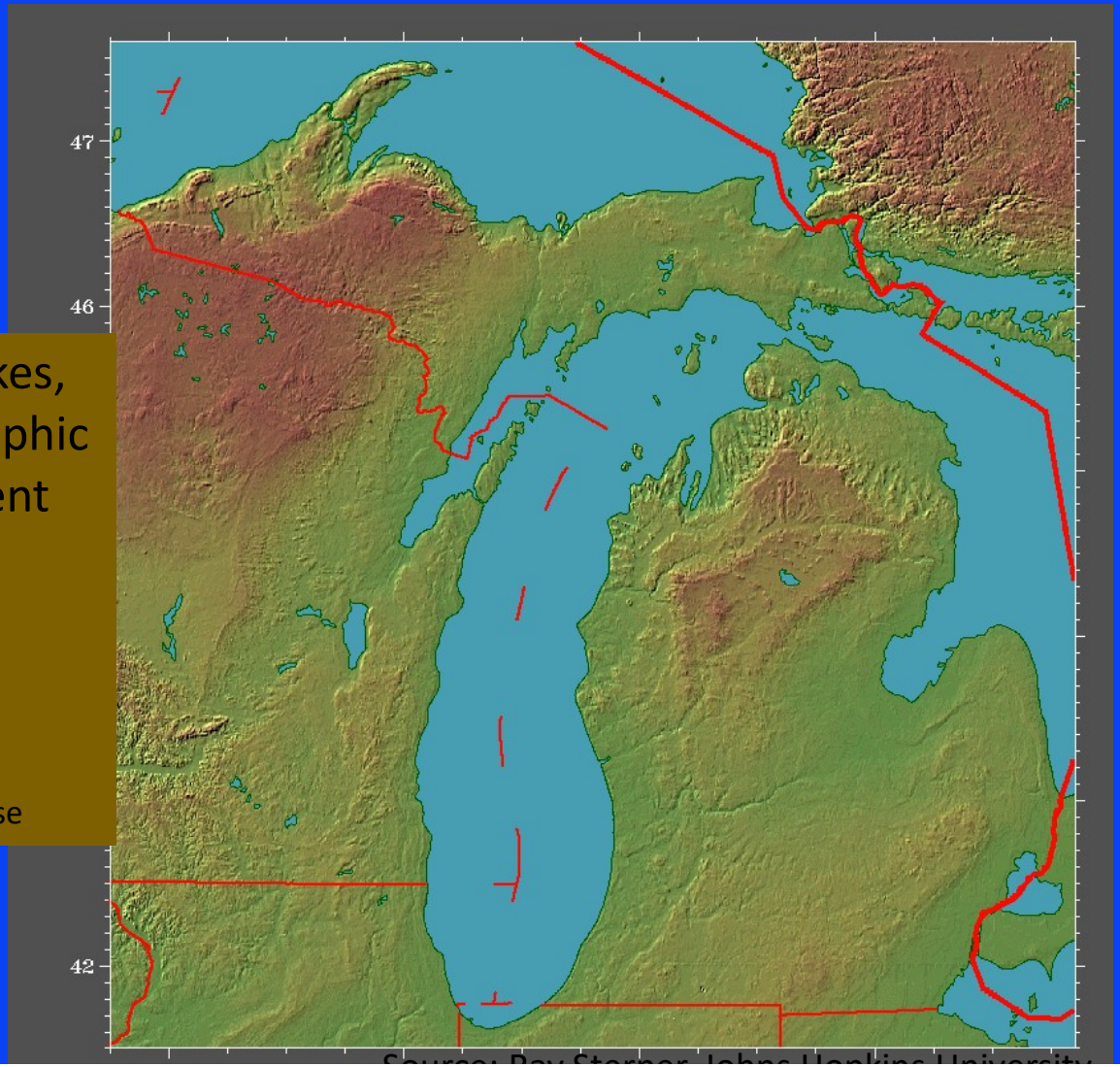
Great Lakes Relief



Around the Great Lakes, there is little topographic relief to drive sediment delivery

…but that wasn't always the case

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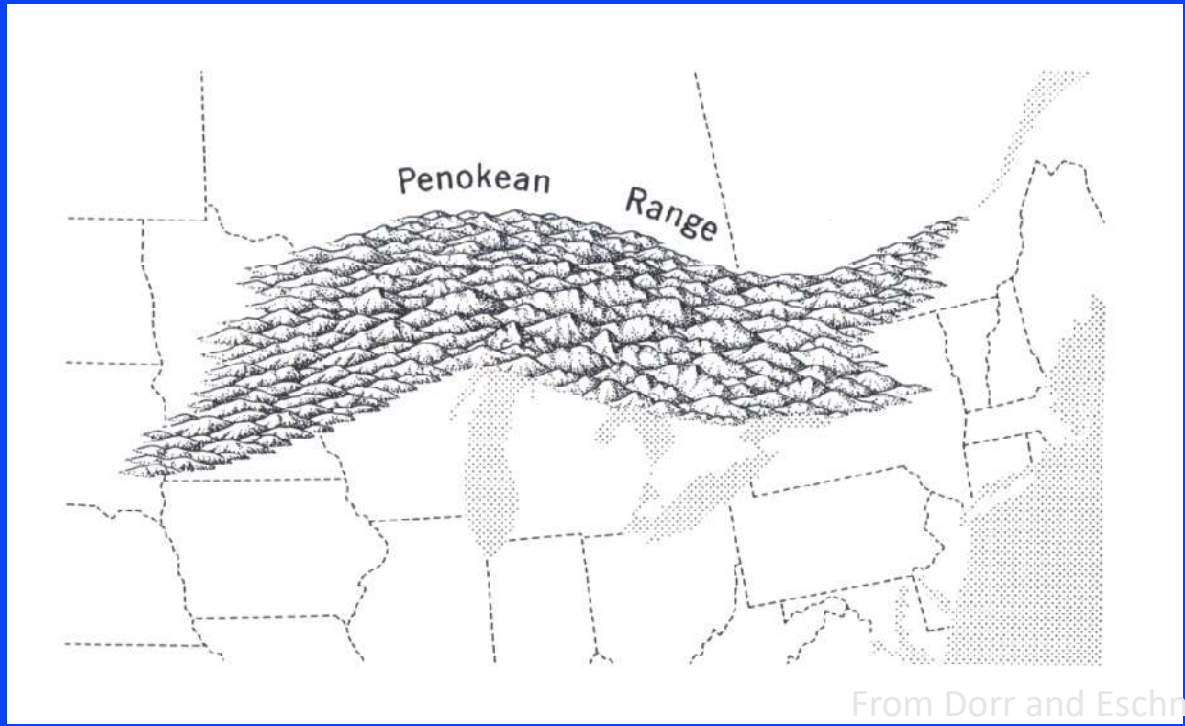
Historic Relief in Michigan



From Dorr and Eschman, 1970

Penokean orogeny build this range during Middle Precambrian (1640 million years ago). This range has long since eroded away.

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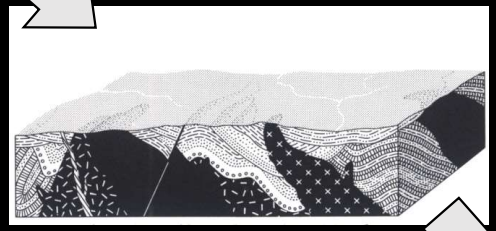
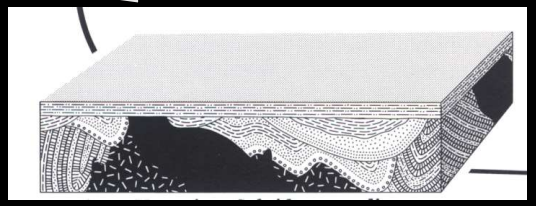
Erosion Cycle

Mountain Building – high sediment yield



Mountains Eroding – moderate sediment yield



Mountains gone – Low relief, low sediment yield

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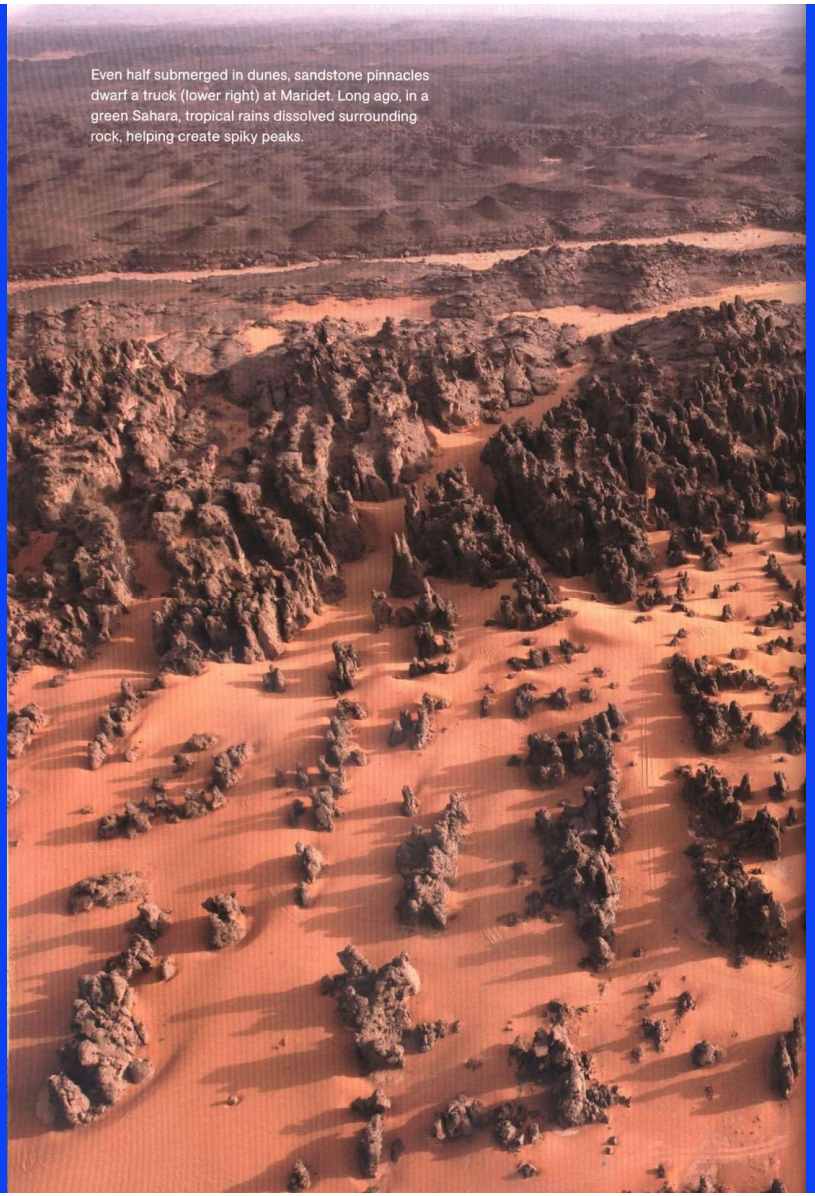

Even half submerged in dunes, sandstone pinnacles dwarf a truck (lower right) at Maridet. Long ago, in a green Sahara, tropical rains dissolved surrounding rock, helping create spiky peaks.

Source: National Geographic