



UNIVERSITY OF MINNESOTA EXTENSION

MAKING A DIFFERENCE IN MINNESOTA: ENVIRONMENT + FOOD & AGRICULTURE + COMMUNITIES + FAMILIES + YOUTH

Big Woods, Big Rivers

MINNESOTA MASTER NATURALIST PROGRAM

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LESSON ONE: GEOLOGY

Rocks, Ice, and Rain



By SehLax (CC BY-SA)

OBJECTIVE: *Understand that the landscape of the Big Woods, Big Rivers region is the result of both climatic and geologic forces.*




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Geology + Glaciers + Climate

MN Landscape & Biomes




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ROCK TYPES




Sedimentary

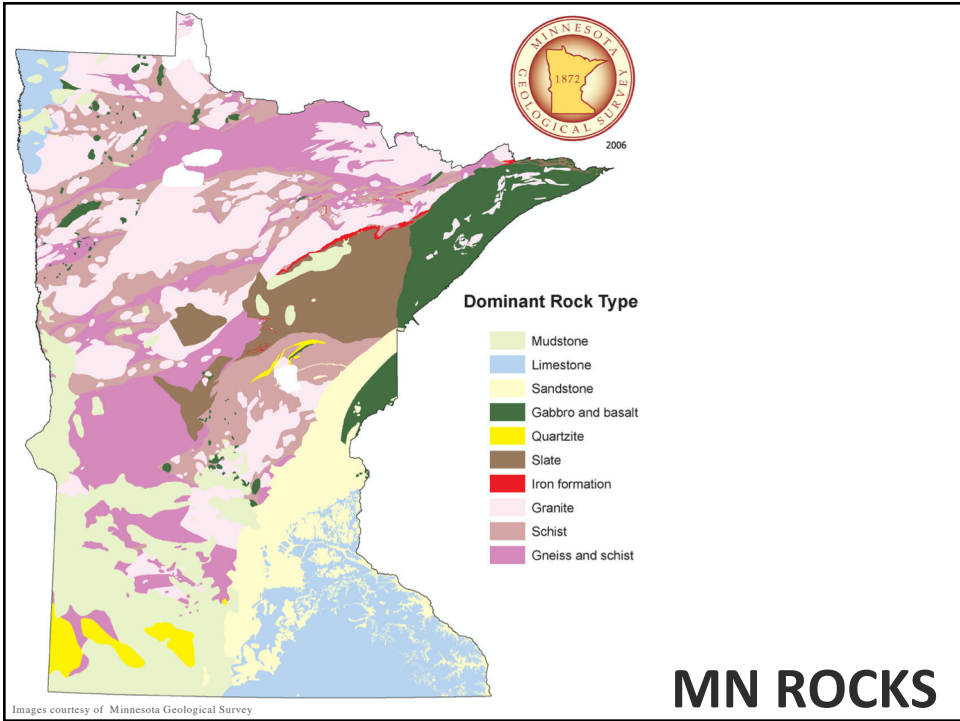
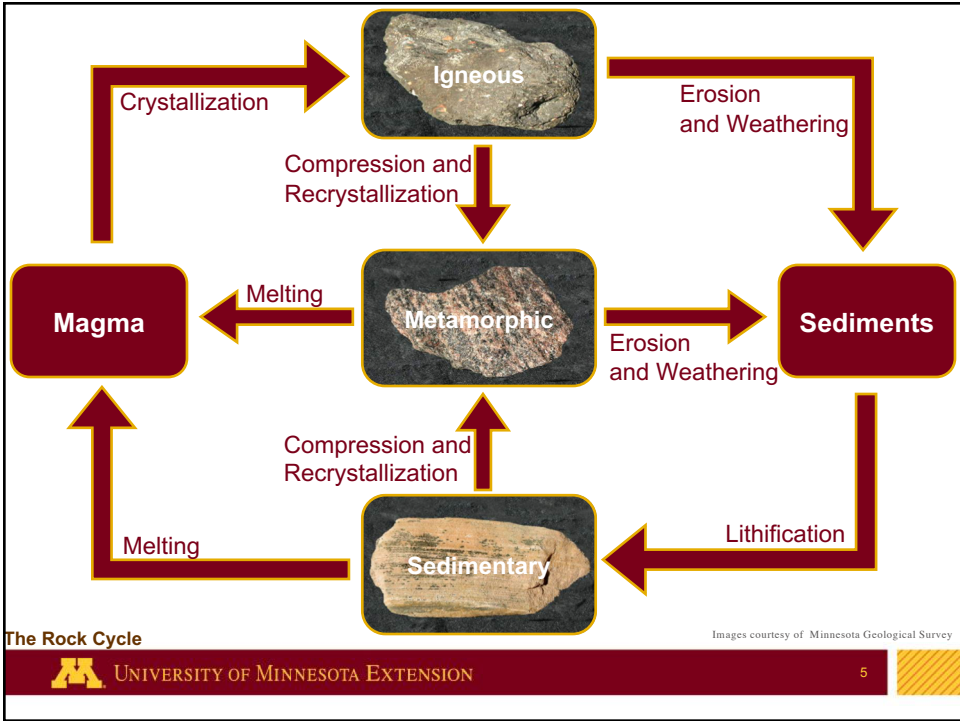
Igneous

Metamorphic


Images courtesy of Minnesota Geological Survey

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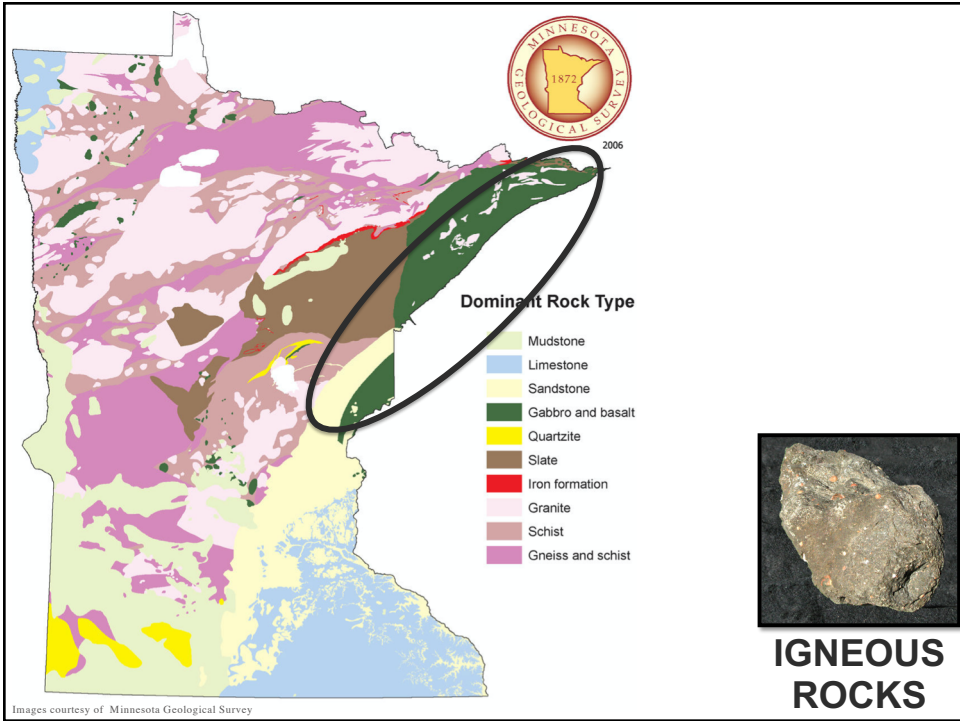


Q: Where? What? How?
 Igneous Rocks (Basalt) from the North Shore:
 Gooseberry Falls State Park
 Lava cooling/crystalizing at the surface of an ancient
 divergent plate boundary called the Midcontinent rift.




By Danielle J. Onist / CC BY SA

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Dominant Rock Type

- Mudstone
- Limestone
- Sandstone
- Gabbro and basalt
- Quartzite
- Slate
- Iron formation
- Granite
- Schist
- Gneiss and schist



IGNEOUS ROCKS


Images courtesy of Minnesota Geological Survey




Q: Where? What? How?

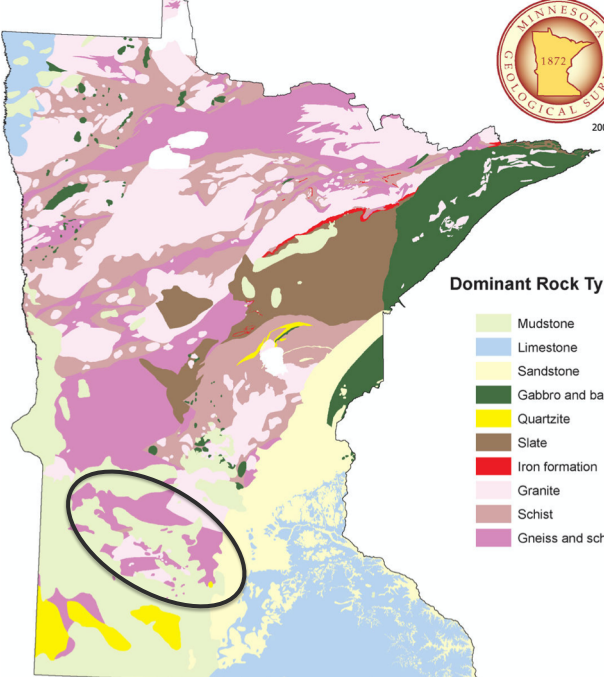
Metamorphic Rocks (Morton Gneiss) in Morton, Minnesota:
Junction of Highways 19 & 71

Igneous (granitic) rocks were compressed.



By Brian Kennedy (CC BY-SA)



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2006

Dominant Rock Type

- Mudstone
- Limestone
- Sandstone
- Gabbro and basalt
- Quartzite
- Slate
- Iron formation
- Granite
- Schist
- Gneiss and schist



**METAMORPHIC
ROCKS**

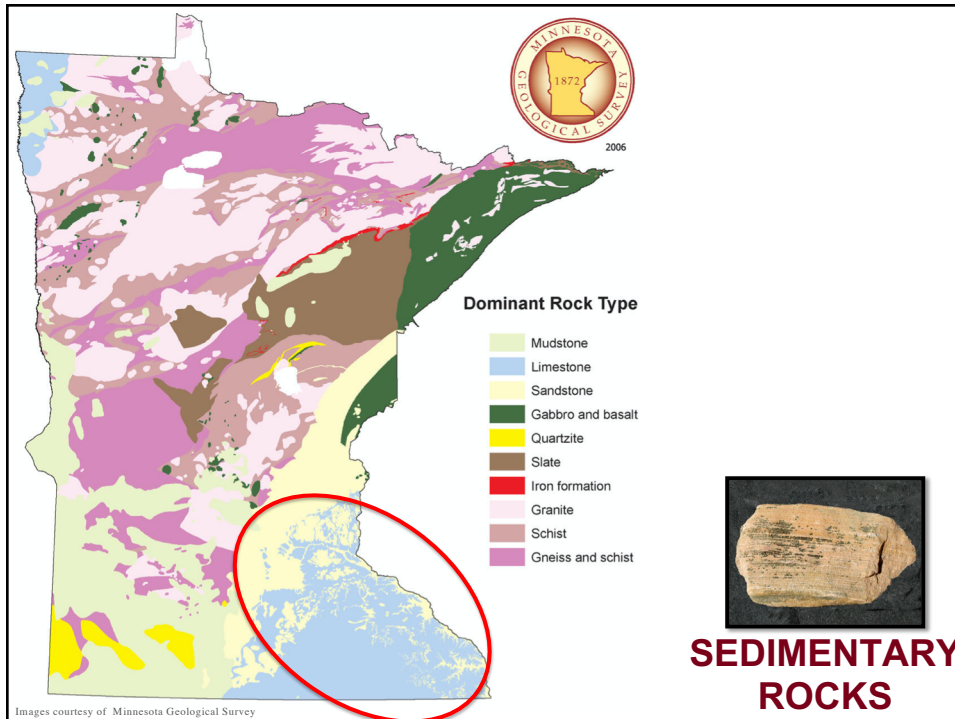
Images courtesy of Minnesota Geological Survey

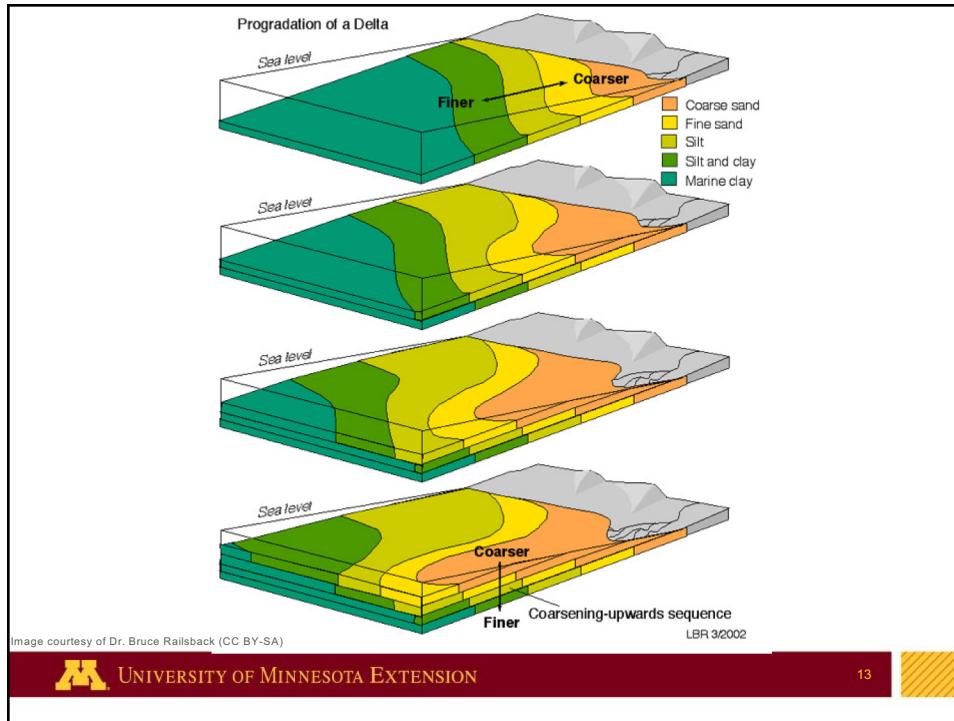
**Q: Where?
What? How?**

Sedimentary Rocks Along
River Georges and
Outcrops

Minnehaha Falls Regional
Park

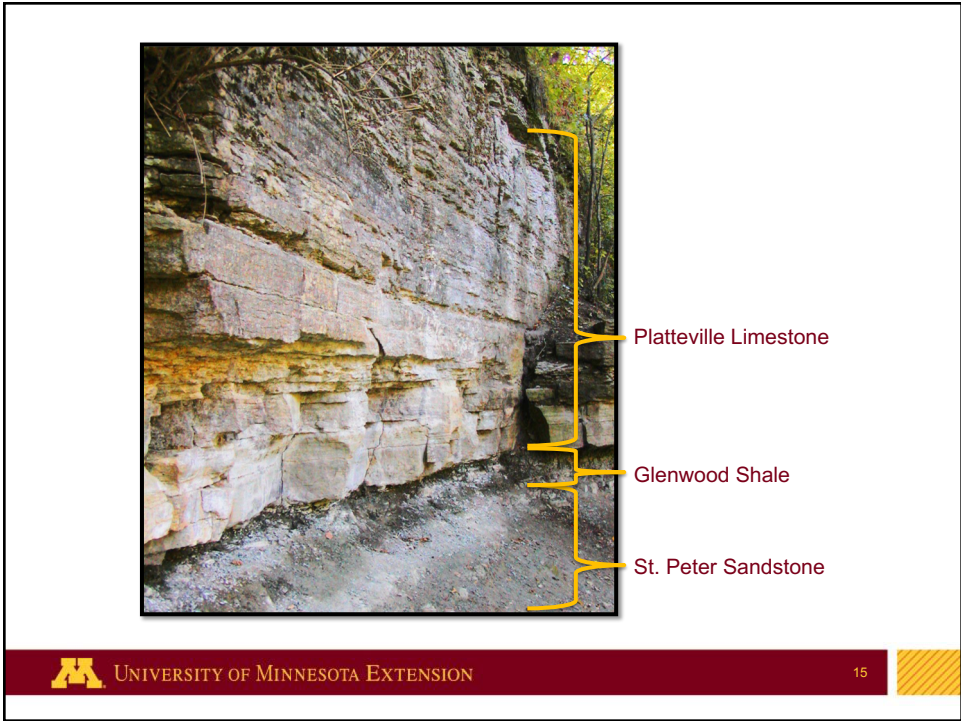
Created by ancient shallow
seas that covered MN
when it was located near
the equator.





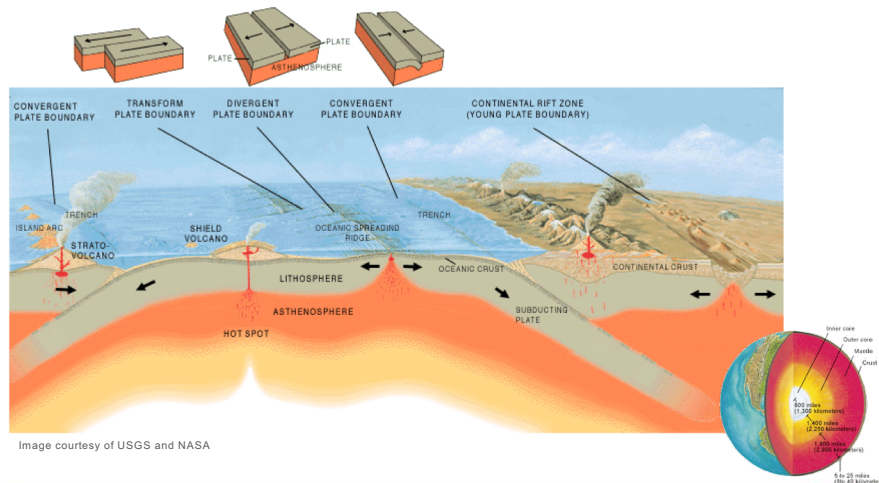
Sediments and Corresponding Sedimentary Rocks		
<i>Sediment</i>	<i>Sedimentary Rock</i>	<i>Where the sediment accumulates</i>
Gravel	Conglomerate	Alluvial fans, river channels, wave-swept coastlines
Sand	Sandstone	Desert dunes, river channels, shorelines, deltas, shallow seas
Mud	Shale	Lakes, river floodplains, tidal flats, distal deltas, deep sea
Shells and Lime mud	Limestone	Warm shallow seas
CaCO ₃ produced by marine plankton	Chalk	Deep sea
SiO ₂ produced by marine plankton	Chert	Deep sea
Woody plant matter Peat	Coal	Swamps
Salt	Rock salt	Lagoons or Marginal seas in horse latitudes

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THEORY OF PLATE TECTONICS

Earth's solid outer crust, the lithosphere, is separated into plates that move over the asthenosphere, the molten upper portion of the mantle.



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OPTIONAL VIDEOS

- National Geographic Video on Plate Tectonics (6 mins)
<https://www.nationalgeographic.org/media/plate-tectonics/>
- Clip from BBC documentary film "Earth The Power Of The Planet" (1 min)
<https://www.youtube.com/watch?v=ryrXAGY1dmE>

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CURRENT LOCATION OF EARTH'S PLATES

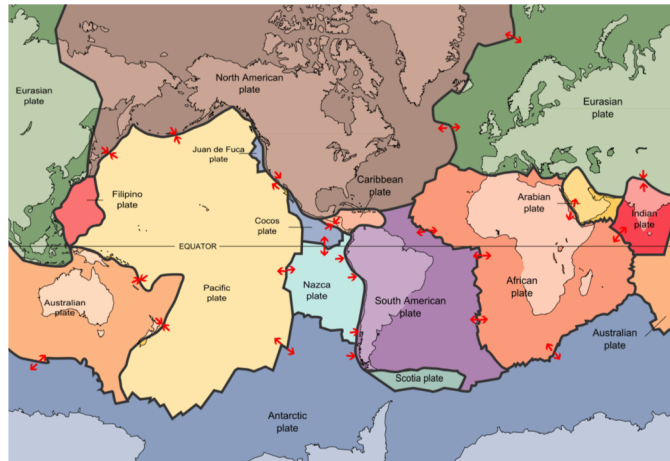
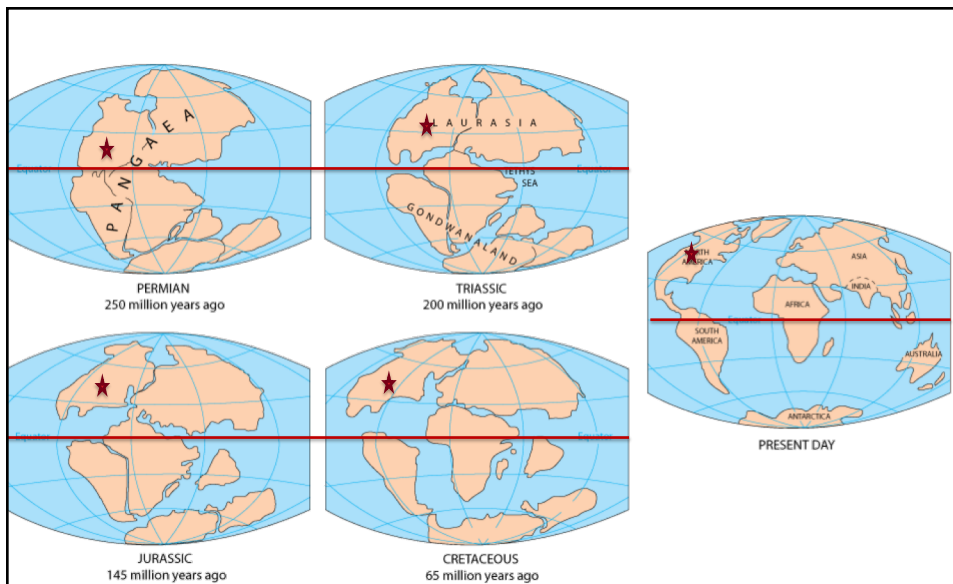


Image courtesy of USGS



Images courtesy of USGS

OPTIONAL VIDEOS

- Animation on Global Plate Reconstruction
(30 secs, requires Adobe Flash)
<http://www.regents-earthscience.com/geologic-history.html>
- BBC Video on Pangaea (1.5 mins)
<https://www.bbc.co.uk/programmes/p00fztwb>



PRESENT DAY EARTH



Image: By US Government, public domain with no restrictions



HOW WAS THE CURRENT LANDSCAPE OF MINNESOTA FORMED?



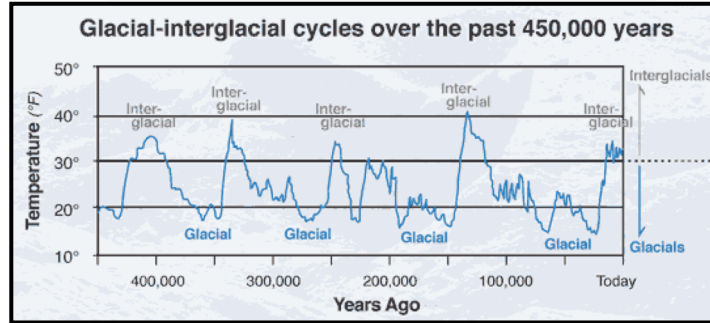
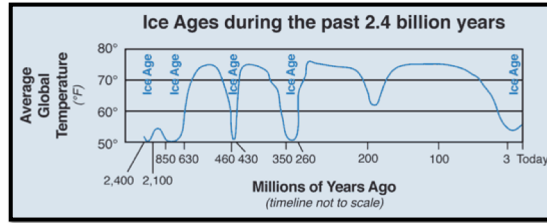
Mouth of the glacier Schlatenkees, Austria By SehLax (CC BY-SA)

Geology + Glaciers Climate --- MN Landscape & Biomes

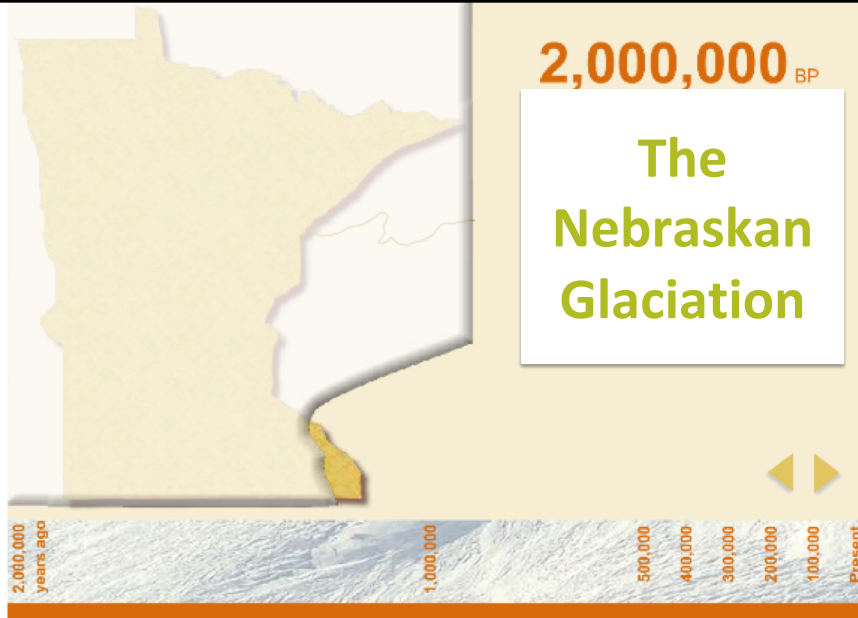


By SehLax (CC BY-SA)

GLACIAL AND INTERGLACIAL CYCLES



Images courtesy of Utah Geological Society



Images courtesy of the Water Resources Center & Minnesota River Basin Data Center - Minnesota State University, Mankato

400,000^{BP}

The Kansan Glaciation

2,000,000 years ago 1,000,000 500,000 400,000 300,000 200,000 100,000 Present

Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

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150,000^{BP}

The Illinoian Glaciation

2,000,000 years ago 1,000,000 500,000 400,000 300,000 200,000 100,000 Present

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100,000_{BP}

The Wisconsin Glaciation

2,000,000 years ago 1,000,000 500,000 400,000 300,000 200,000 100,000 Present

Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

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35,000_{BP}

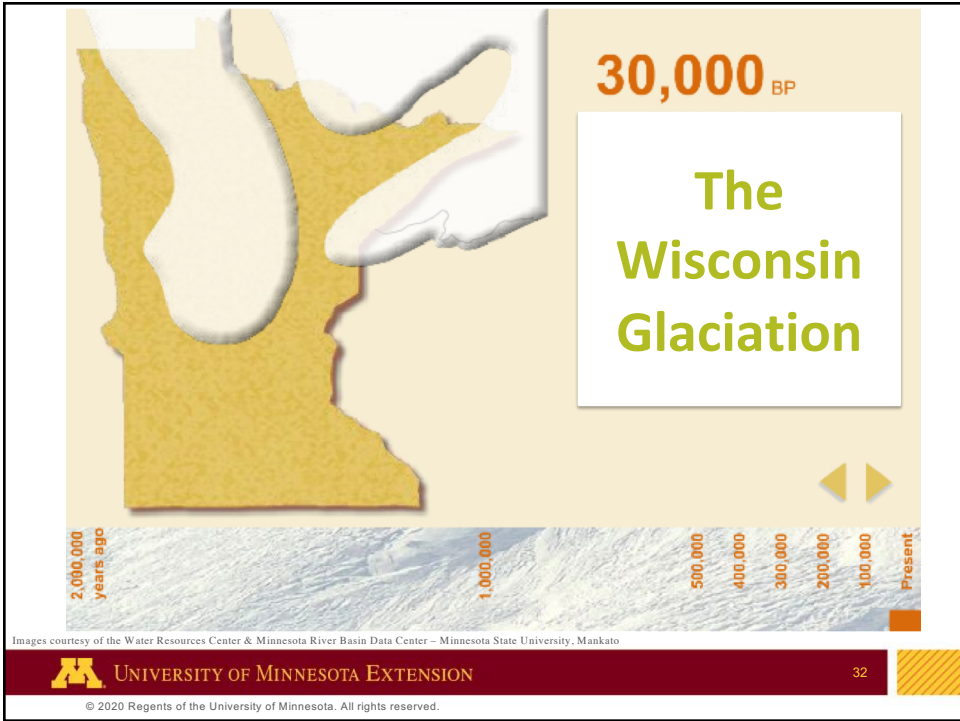
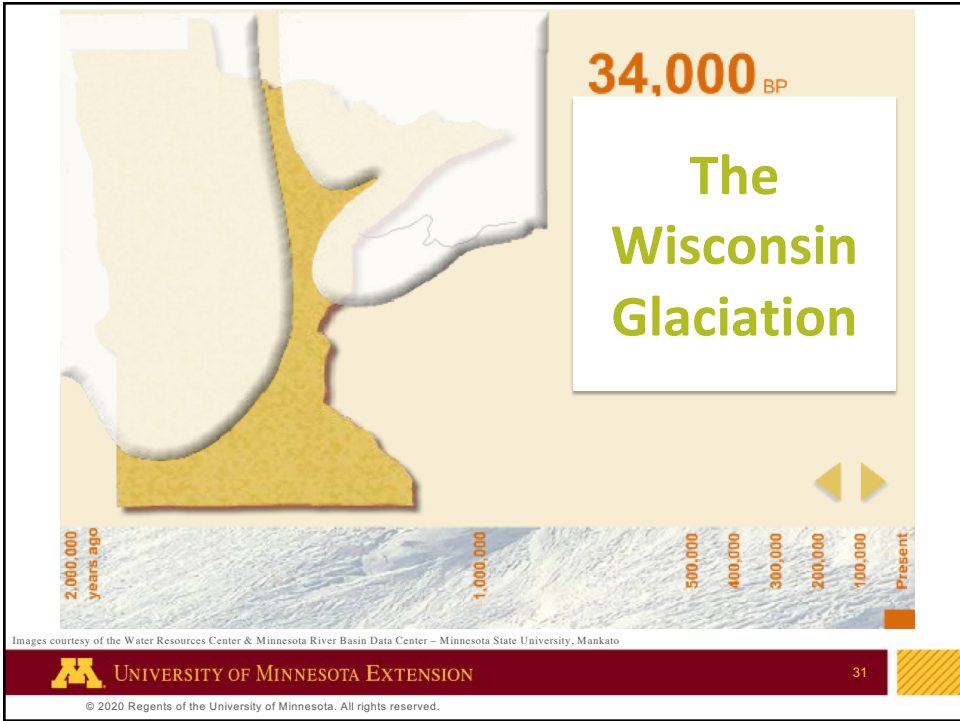
The Wisconsin Glaciation

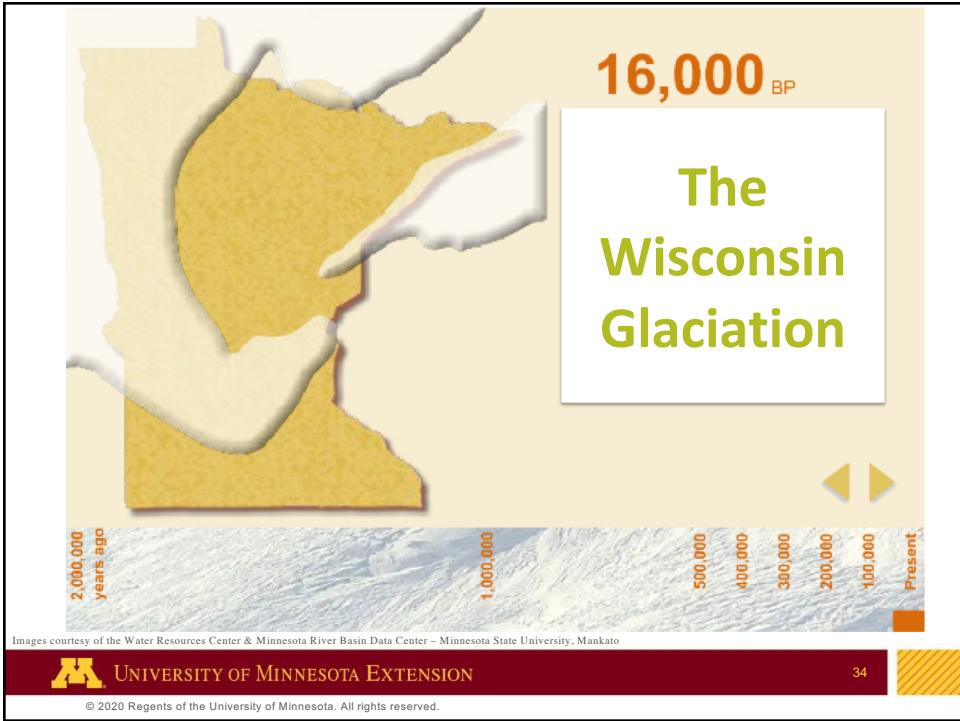
2,000,000 years ago 1,000,000 500,000 400,000 300,000 200,000 100,000 Present

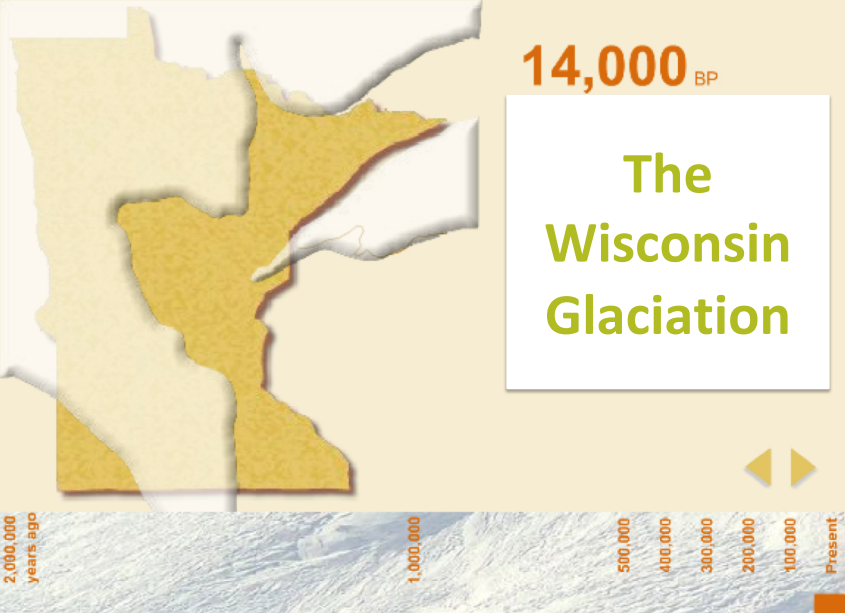
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14,000_{BP}

The Wisconsin Glaciation

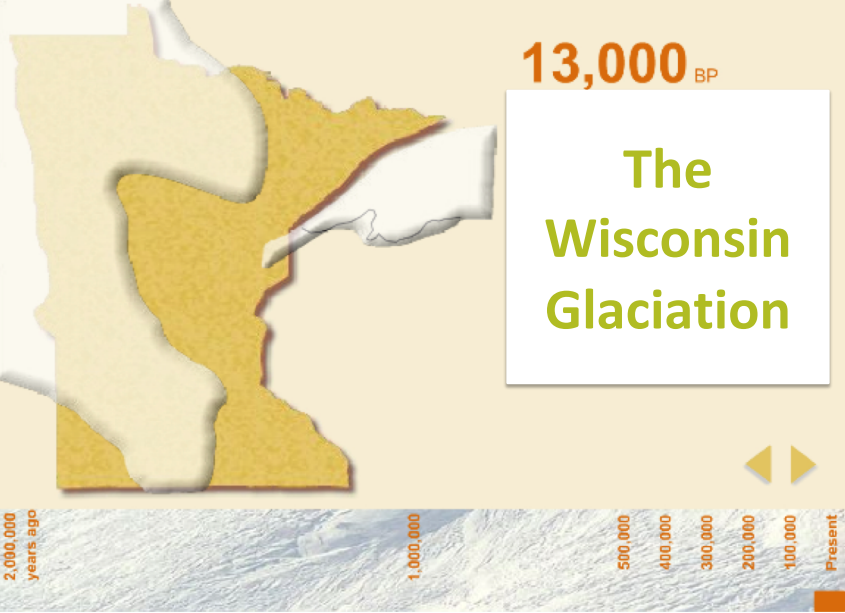
2,000,000 years ago
1,000,000
500,000
400,000
300,000
200,000
100,000
Present

Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

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This slide shows a map of Wisconsin with a white glacial margin line. The area to the west and north of the line is light tan, and the area to the east and south is a darker tan. A white box on the right contains the title 'The Wisconsin Glaciation' and the date '14,000 BP'. Below the map is a timeline from 2,000,000 years ago to the present, with a white arrow pointing to the 14,000 BP mark. Navigation arrows are visible on the right side of the map area.




13,000_{BP}

The Wisconsin Glaciation

2,000,000 years ago
1,000,000
500,000
400,000
300,000
200,000
100,000
Present

Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

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This slide is similar to slide 35, but the white glacial margin line has moved further east and south, indicating a more advanced stage of the Wisconsin Glaciation at 13,000 BP. The white box on the right contains the title 'The Wisconsin Glaciation' and the date '13,000 BP'. The timeline below the map also points to the 13,000 BP mark.

10,500_{BP}

The Wisconsin Glaciation

2,000,000 years ago
1,000,000
500,000
400,000
300,000
200,000
100,000
Present

Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

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Lake Hudson/
Hudson Bay

Lake Agassiz

Lake Superior

Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

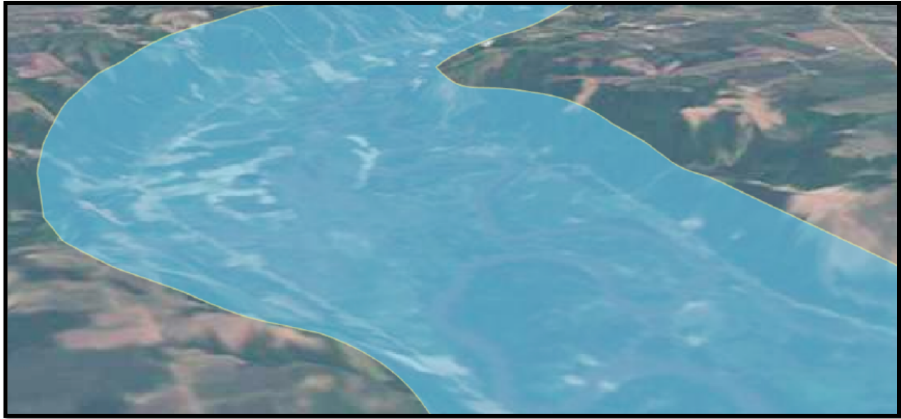
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A map of the state of Minnesota with a yellow background. A blue line traces the western coastline, labeled "Beach lines". Another blue line traces a river path in the southern part of the state, labeled "River Warren".

Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

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An aerial photograph of a river basin. The river and its immediate surroundings are highlighted with a semi-transparent blue overlay. The surrounding landscape shows a mix of green fields and brown patches, likely representing different land uses or vegetation types.

Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

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Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato


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41

This slide features an aerial photograph of a river system. A semi-transparent blue overlay is applied to the river, highlighting its path through a landscape of green fields and brown patches. The river flows from the upper left towards the lower right, with a slight meander. The entire slide is framed by a thin black border.

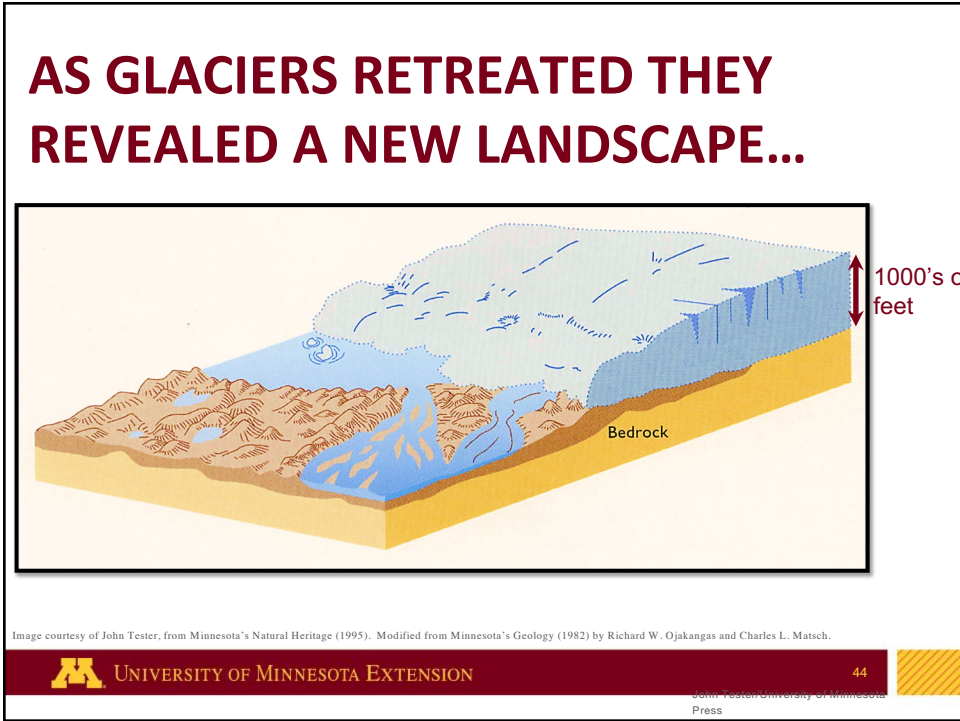
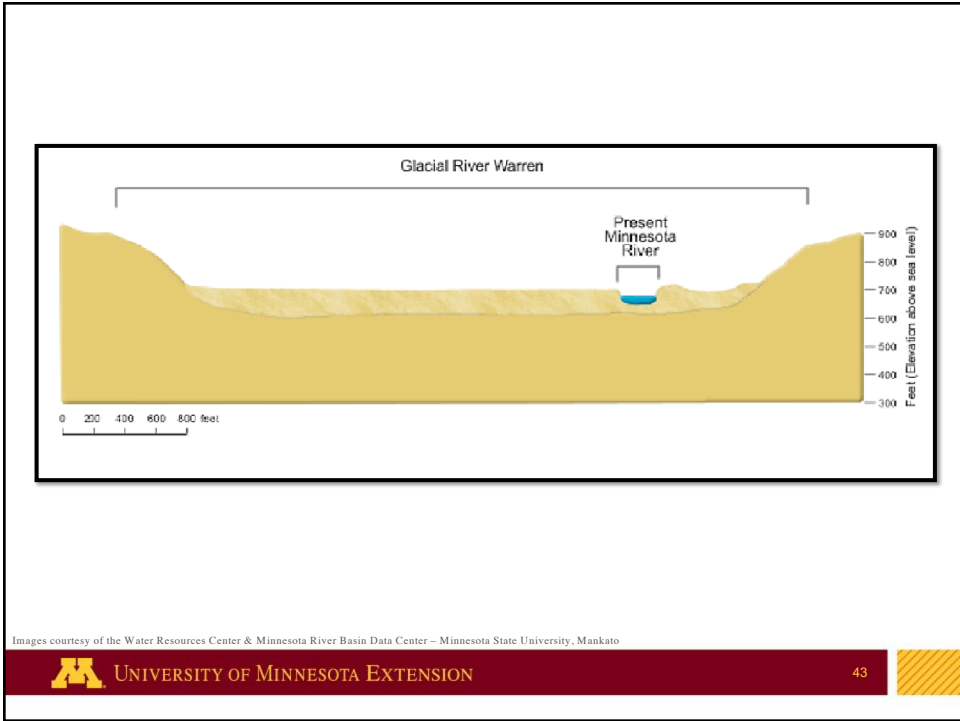


Images courtesy of the Water Resources Center & Minnesota River Basin Data Center – Minnesota State University, Mankato

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This slide features an aerial photograph of the same river system as slide 41. Instead of a blue overlay, the river is outlined with a solid blue line, clearly defining its course against the terrain. The landscape is consistent with the previous slide, showing agricultural fields and natural vegetation. The slide is enclosed in a thin black border.



FORMATIONS LEFT BY GLACIERS

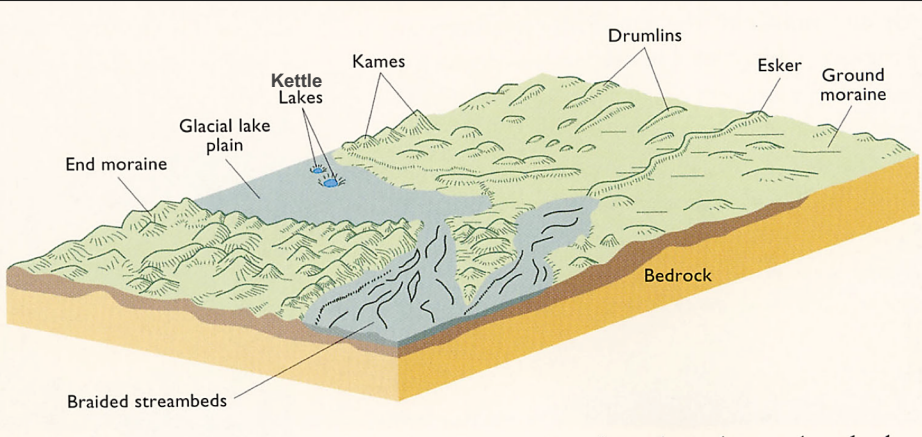
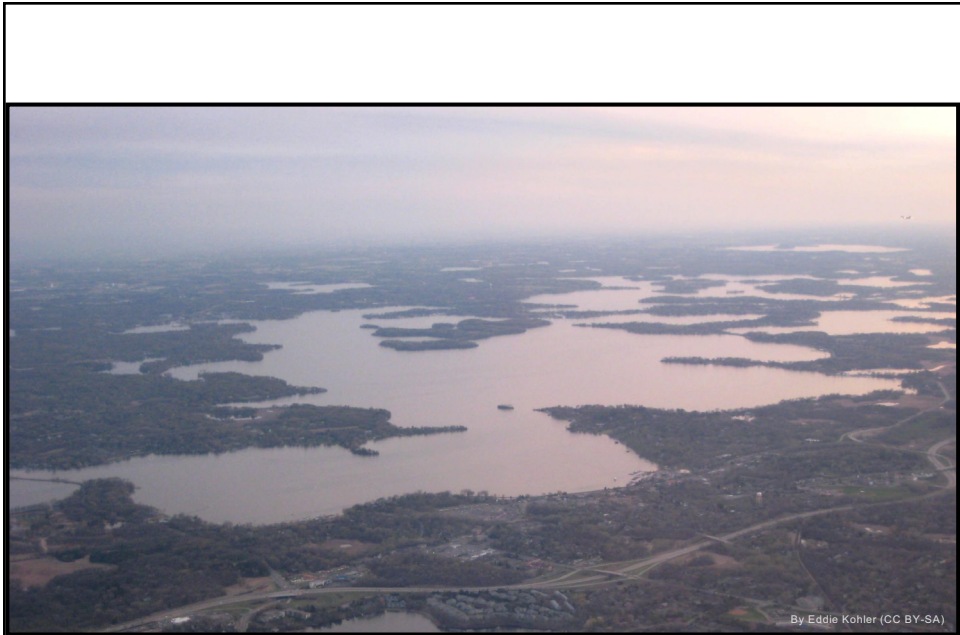
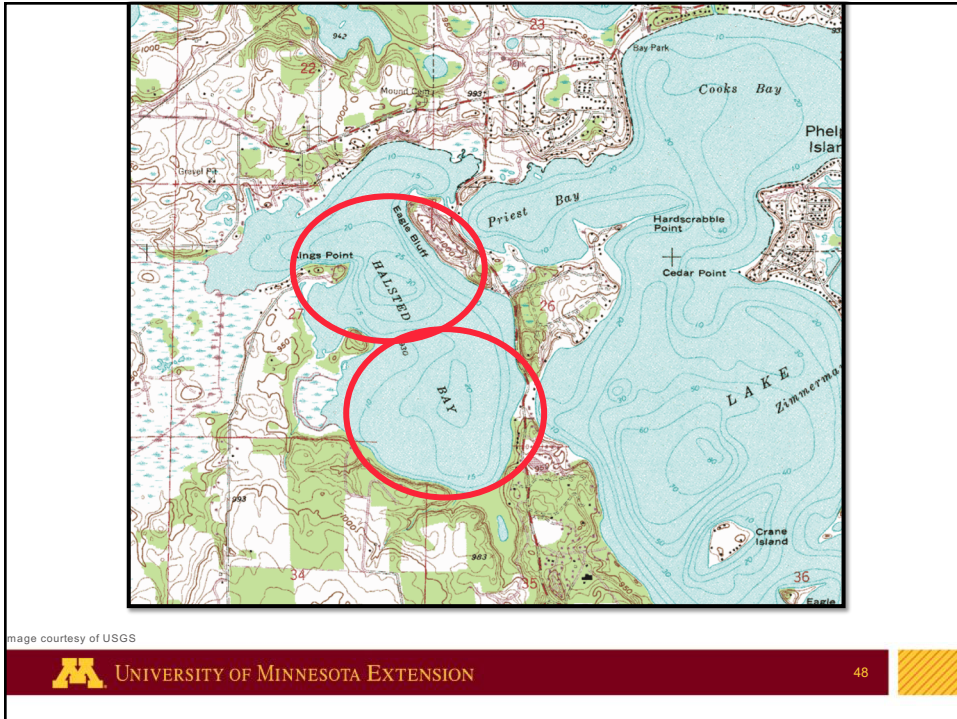
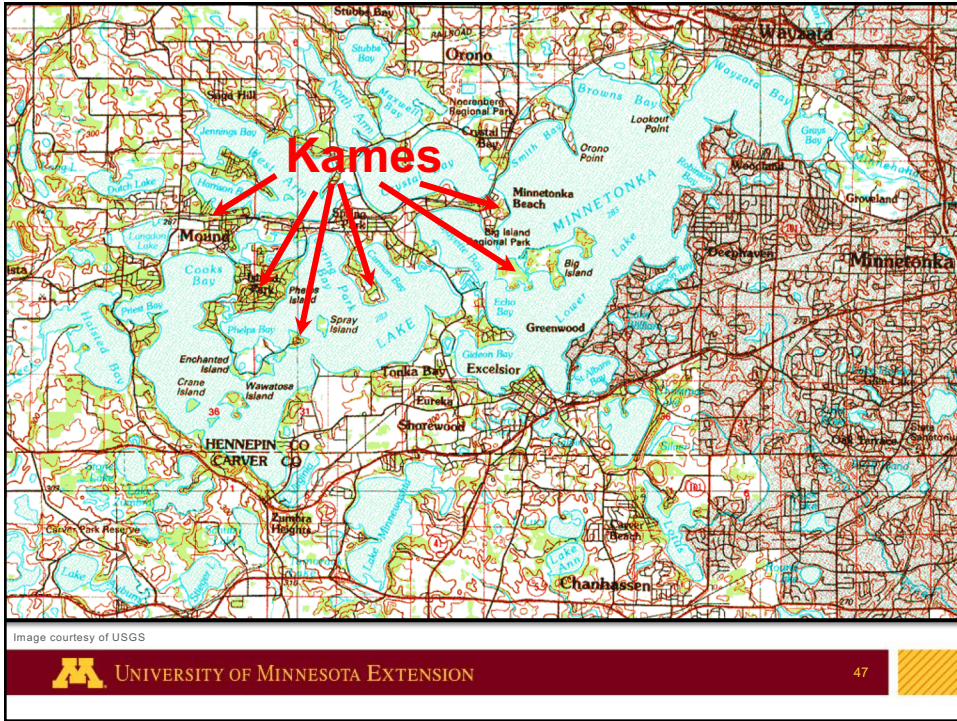
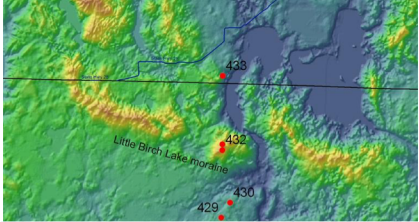



Image courtesy of John Tester, from Minnesota's Natural Heritage (1995). Modified from Minnesota's Geology (1982) by Richard W. Ojakangas and Charles L. Matsch.

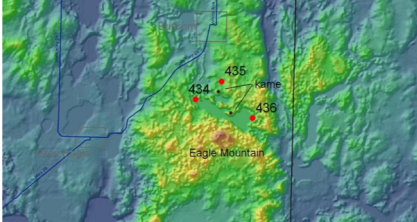



By Eddie Kohler (CC BY-SA)







Looking north from Stearns County, towards Todd County. The high ground ahead is called the Little Birch Lake moraine, an accumulation of sediment deposited at the recessional margin of Wadena-lobe glacial ice as it retreated to the north. #429

Looking southeast across Mound Lake towards a feature called The Mound. The Mound is a kame, a conical-shaped hill composed of sand and gravel deposited in contact with glacial ice. This kame was deposited by Superior-lobe ice. #434




Images courtesy of Minnesota Geological Survey


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Geology
Glaciers
Climate

+

MN Landscape & Biomes

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WHAT IS CLIMATE?

Climate is what we expect,
weather is what we get.

-- Rocky Mountain National Park Interpretive Center

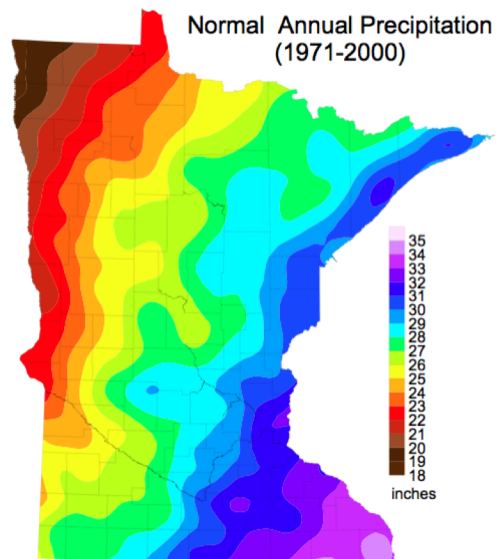
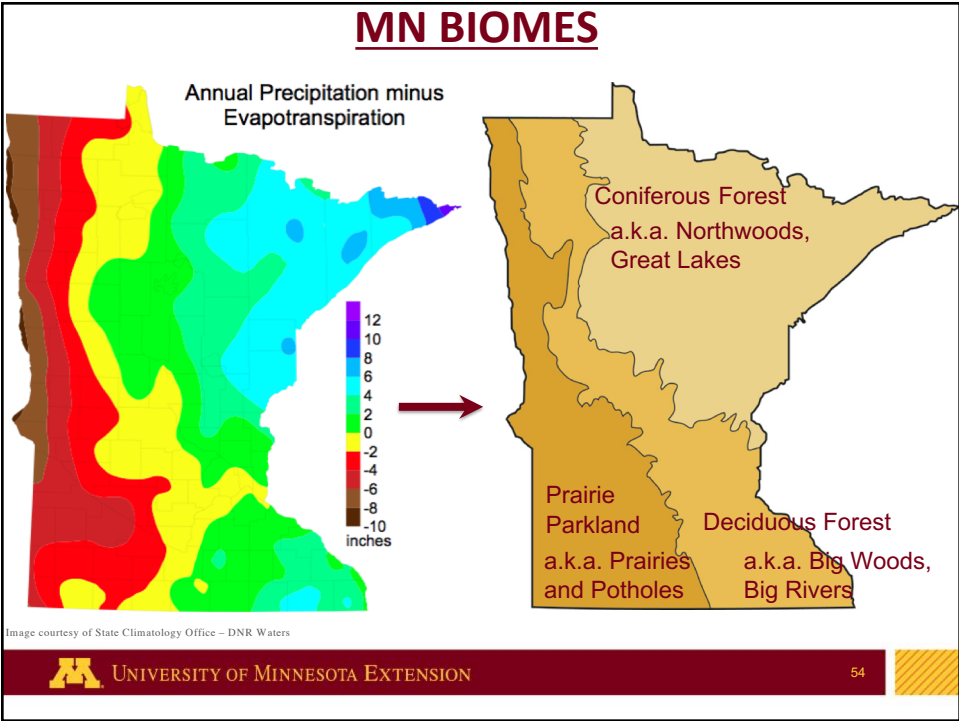
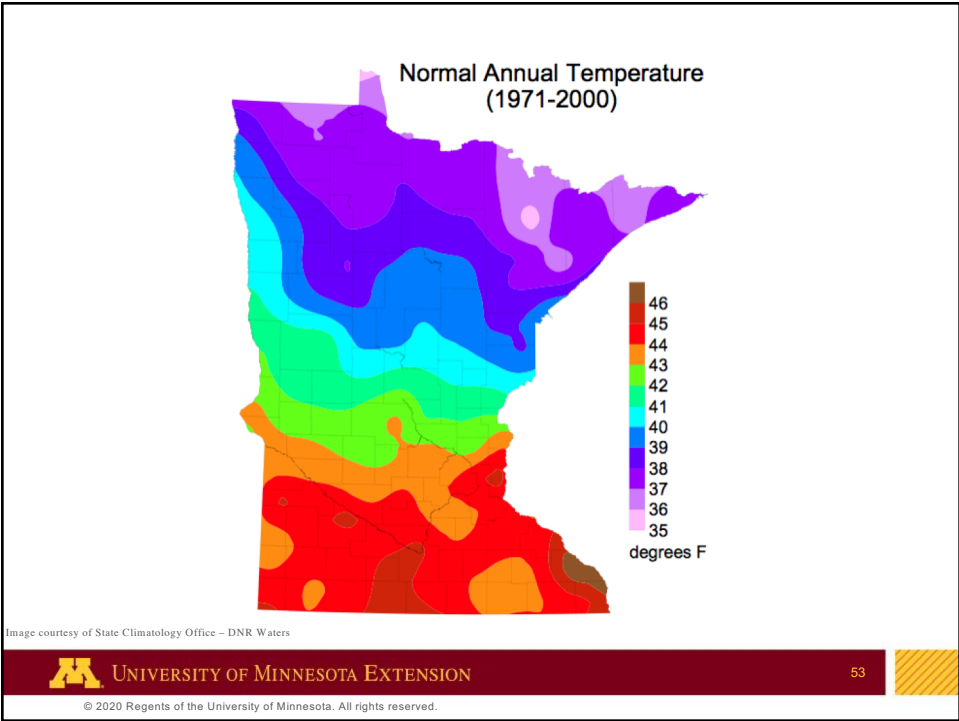


Image courtesy of State Climatology Office – DNR Waters



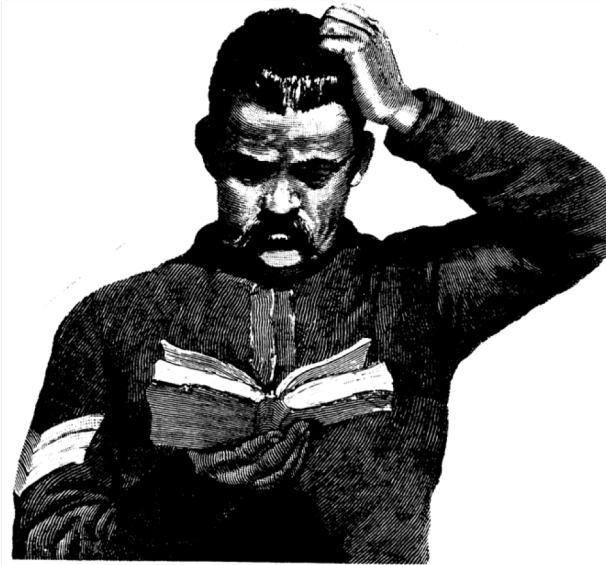
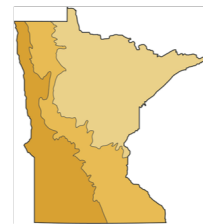



Plate tectonics and rock formation led to a landscape that was scraped and shifted around by glaciers and now endures regimes of precipitation and temperature which create our biomes.




Geology
Glaciers
Climate

+

MN Landscape & Biomes



Schlax (CC BY-SA)


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ACKNOWLEDGMENTS

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Driven to DiscoverSM

Minnesota Master Naturalist Program

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320-589-1711 or 888-241-4532
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