

Why are Glaciers in Antarctica important to People who live in Virginia?

Dr. Ellen Cowan
Department of Geology
Appalachian State University

**Antarctica is a long way from Virginia
And it is nothing like Virginia...**



Antarctica is at the South Pole and is covered by huge glaciers called ice sheets

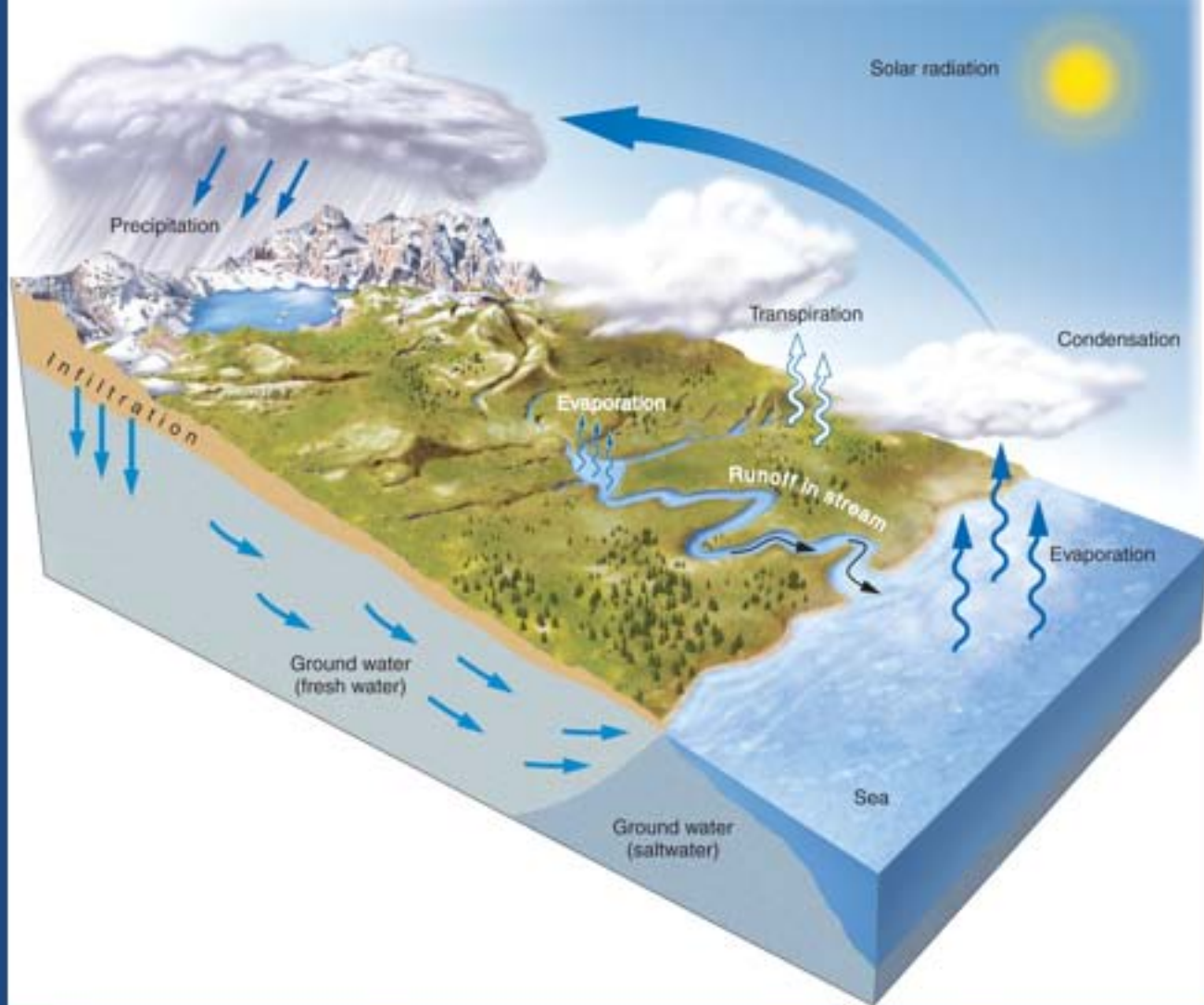


Virginia was never covered by an ice sheet even in the last Ice Age about 18,000 years ago.



Antarctica is the coldest, windiest, driest continent on Earth. No animals live on the continent and nobody can visit without special clothes and a warm place to stay.





The connection between Antarctica and Virginia is global.

The Cryosphere (all frozen water on Earth)



Cross Section of Antarctica's Ice Sheets



Photo courtesy of the National Science Foundation



Ice Sheet

An ice sheet is a broad, thick sheet of fresh water ice covering a large area of land for a long period of time. Earth's largest ice sheet covers the Antarctic continent.

Photo courtesy of the National Science Foundation



Glaciers

A glacier forms when snow accumulates over time, turns to ice, and begins to flow outward and downward under the pressure of its own weight.

Photo courtesy of the National Science Foundation



Ice Shelf

An ice shelf is ice that is attached to land but extends out and floats in the sea. Ice shelves form when an ice sheet reaches the land and extends across the water.



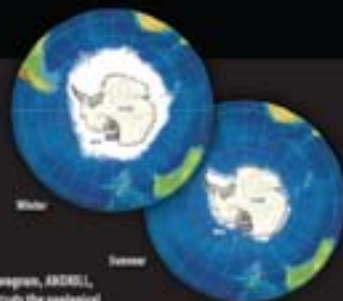
Iceberg break away from the ice shelf.

The Ross Ice Shelf, the largest in the world, is a floating extension of the even more massive West Antarctic Ice Sheet.



Sea Ice

This sea ice forms by freezing ocean water around Antarctica. The sea ice has not dramatically reduced since Antarctic spots in the sea ice melt early in the summer.



Antarctica's ICE ON THE MOVE

The international research program, **ISEGILL**, recovers sediment cores to study the geological history of Antarctica's climate and ice.















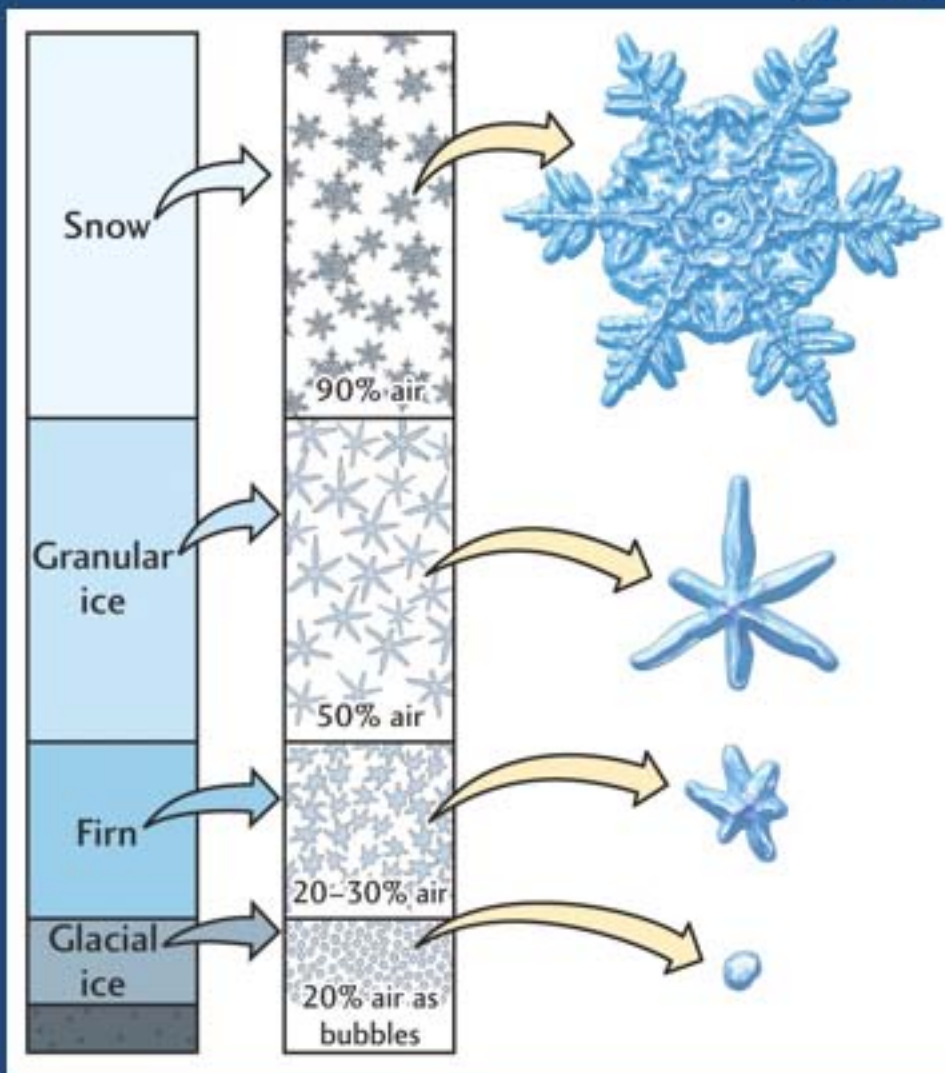




What is important about the cryosphere in Antarctica?

- Ice sheets trap the atmosphere in snow that fell long ago**
- Glaciers and ice sheets store water on land so that the ocean doesn't over flow**

•How do Ice sheets trap the atmosphere in snow that fell long ago?

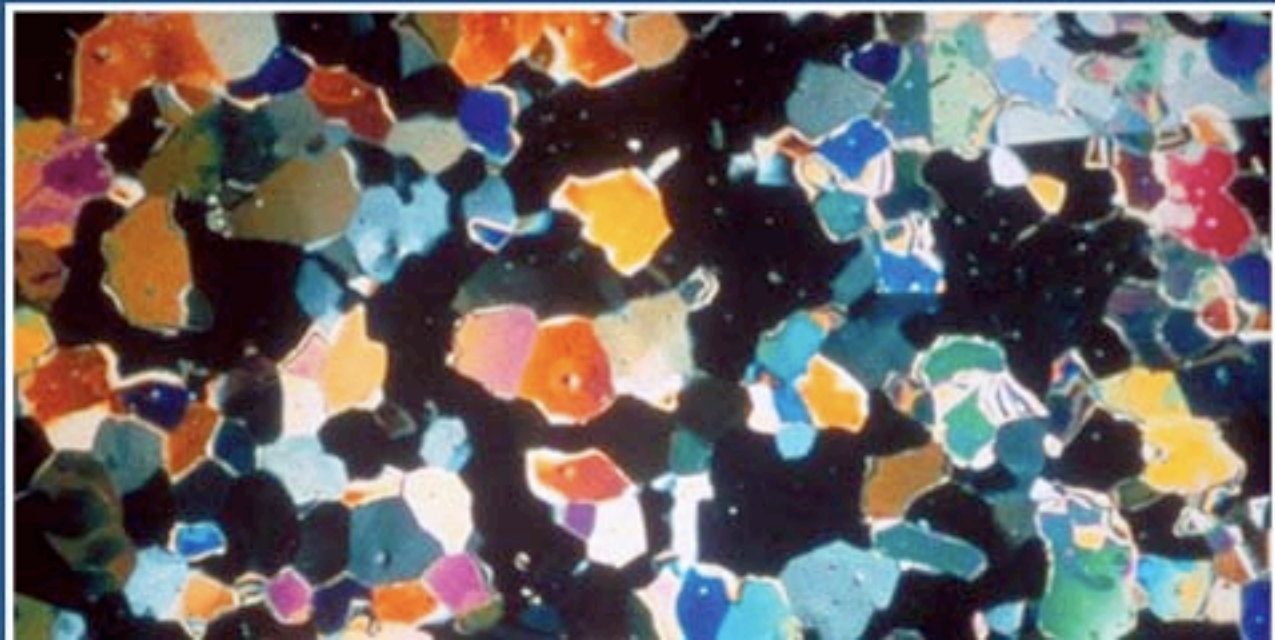


Snow is 90% air. It compacts and recrystallizes to form glacial ice. Air bubbles are found within interlocking ice crystals.





Microscope slide of glacial ice. Tiny spots are air bubbles.



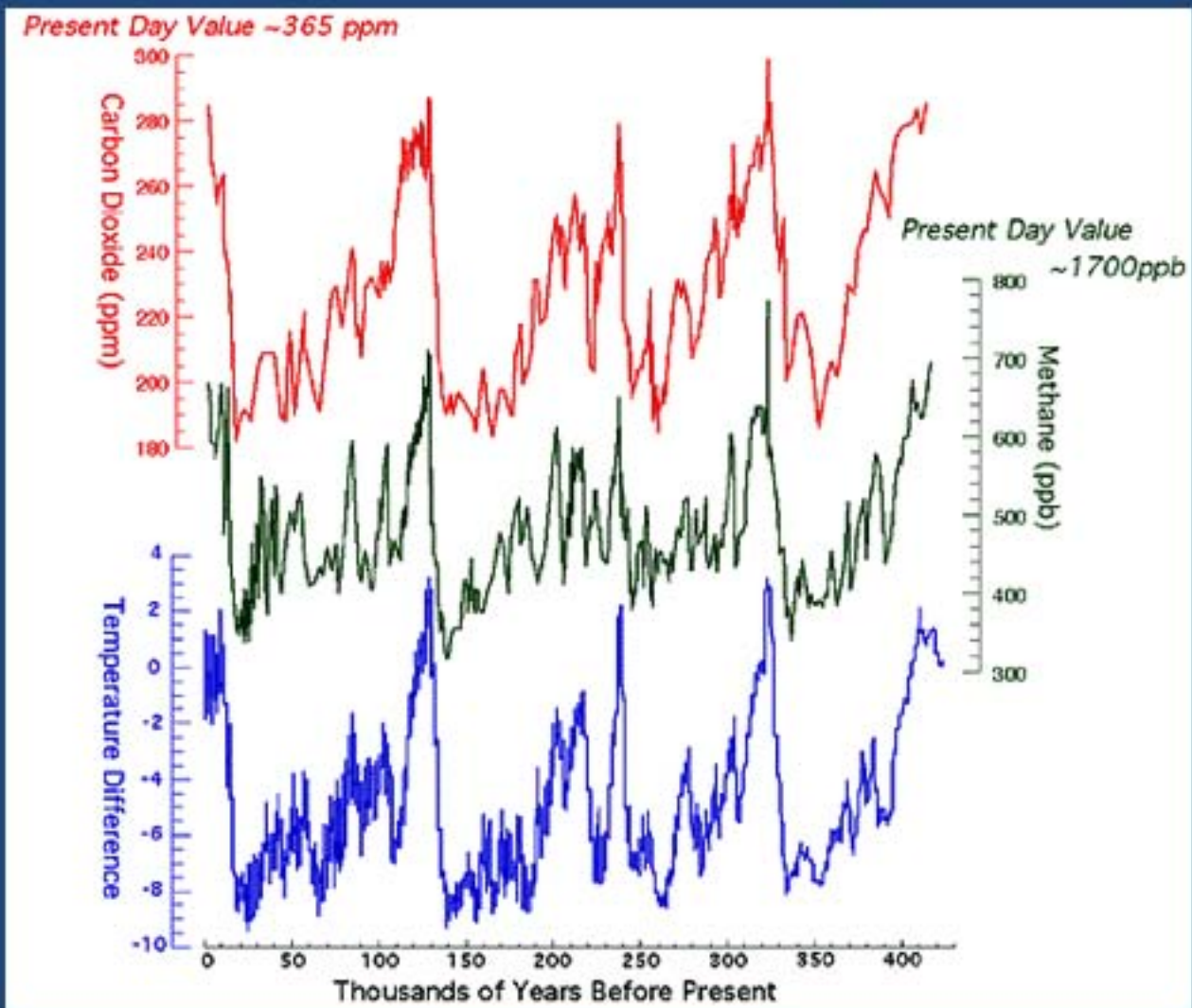


- Collect the ice from Antarctica
- Date the ice layers
- Measure the gases in a chemistry laboratory



Results:

Graph of data from the Vostok Ice core covering the last 420,000 years.

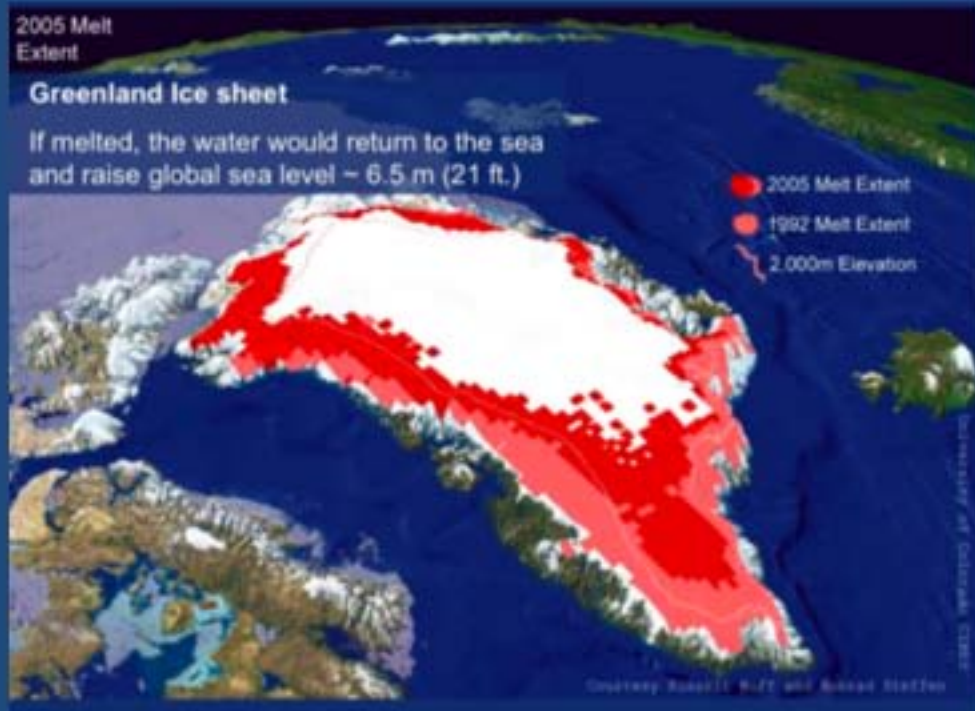




- How much water is stored in Antarctica?

Melting the West Antarctic Ice Sheet could raise sea levels 11 feet (3.3 m) and melting the East Antarctic Ice Sheet could raise sea level 198 feet (65 m).

Greenland



If Greenland ice sheet melts = 21 ft (6.5 m)
global sea level rise



The United States after a rise in sea level of 200 ft (66 m)

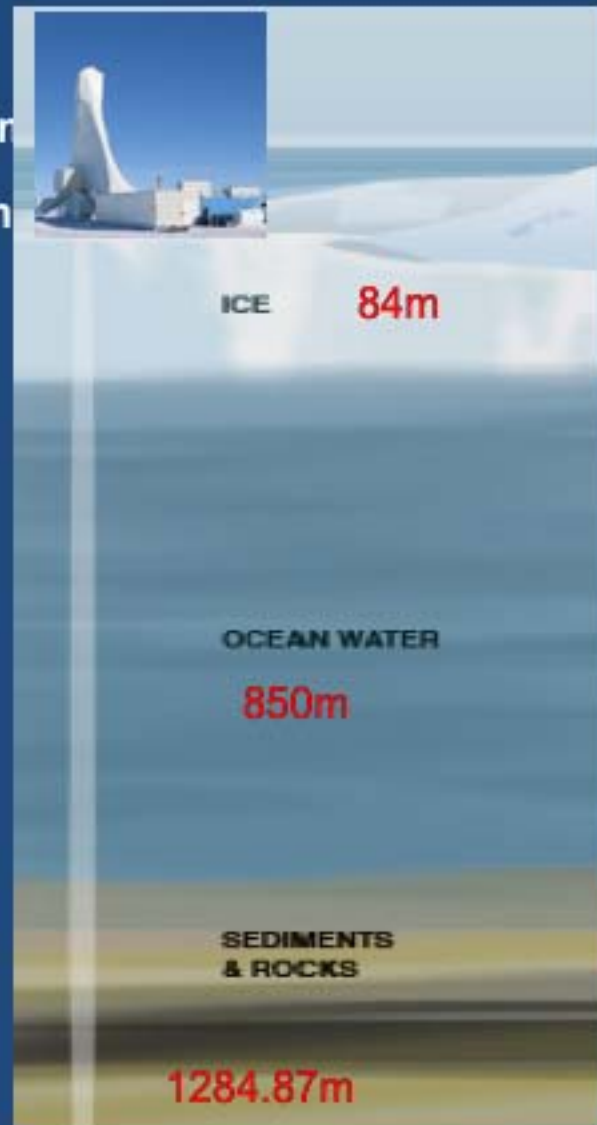
(from <http://www.johnstonsarchive.net/environment/waterworld.html>)

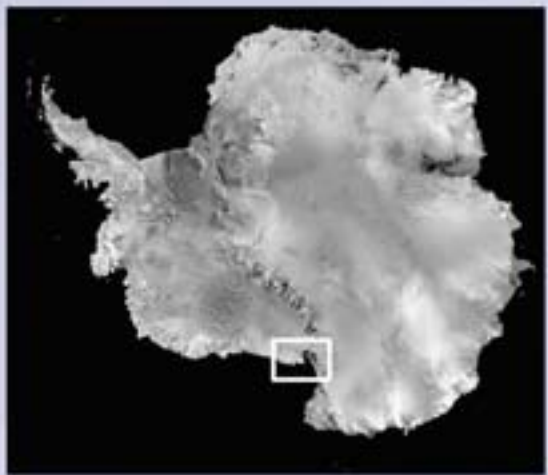
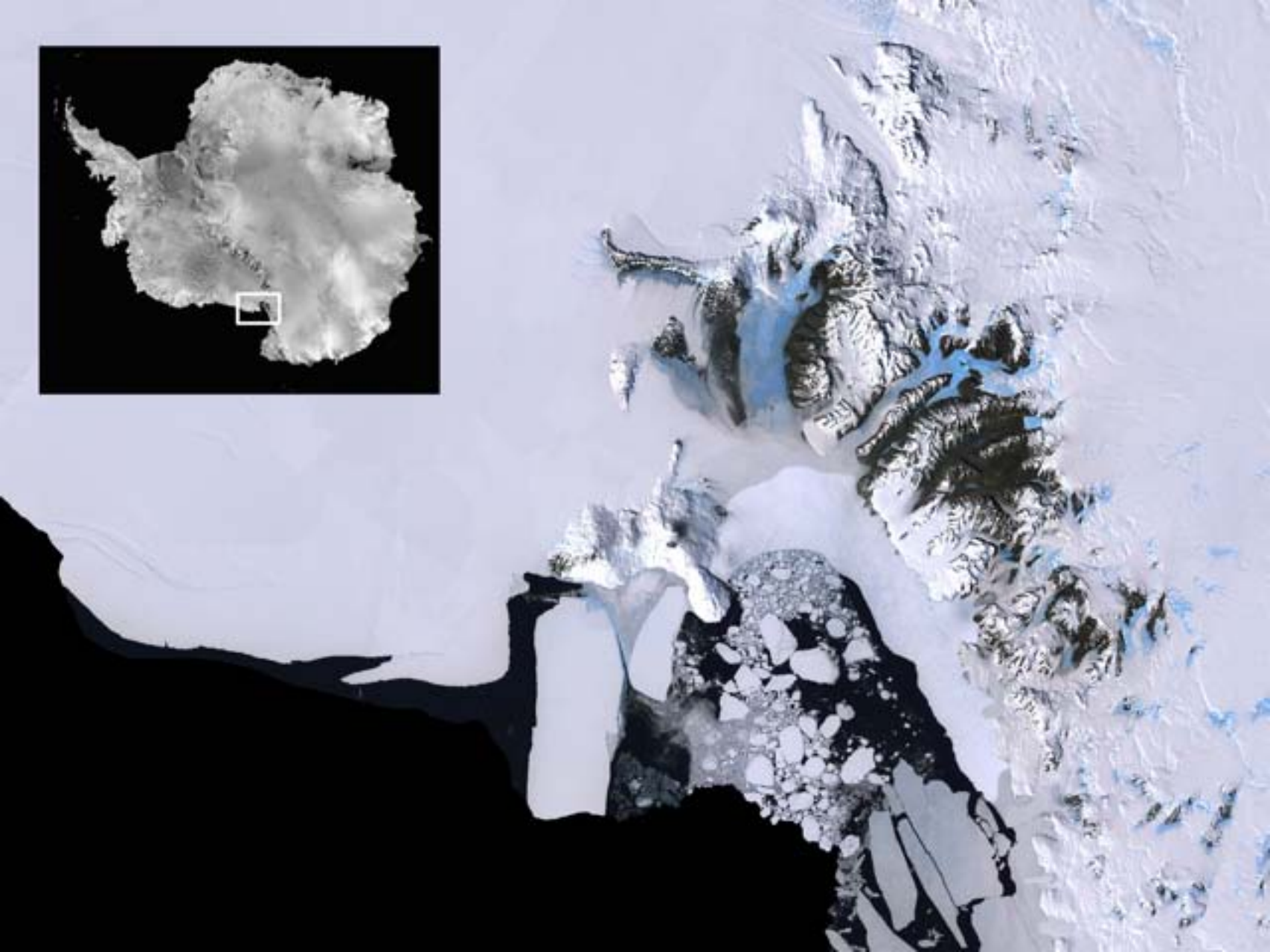
In the past when the Earth was warmer, did the cryosphere in Antarctica melt and cause sea level to rise?

We can answer this question by drilling into the sea floor to collect rock cores.

ANtarctic geological DRILLing

- First geological drilling from ice shelf as a platform
- First combining technology of ice hot-water drilling and geological drilling
- Longest geological rock core in Antarctica





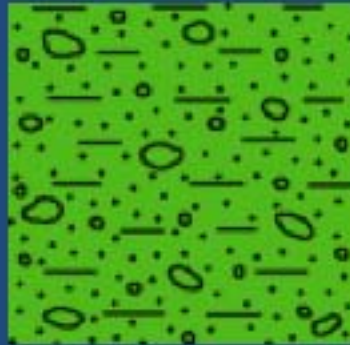


Drilling from the top of the ice shelf.

Examples of Rock Cores

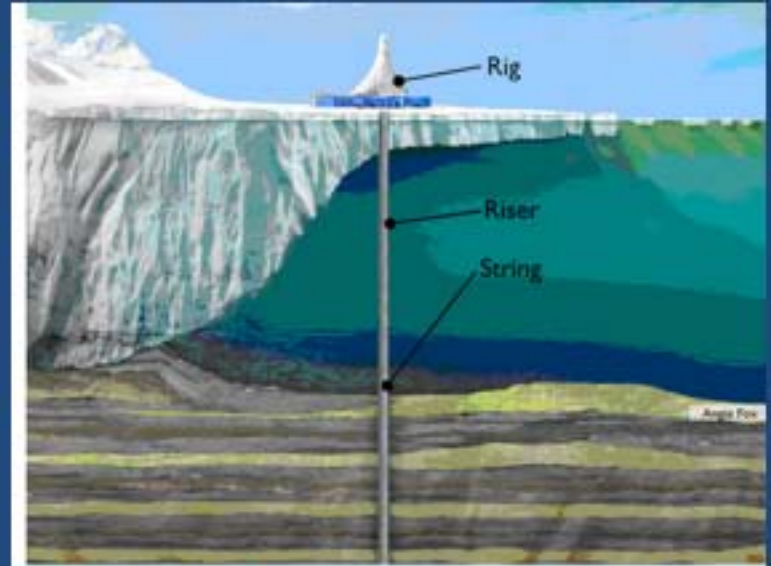
These rocks
were
deposited
under the
glacier.





Diamictite

Diamictite is composed of coarse, angular and well-rounded clasts (rocks) of many types, embedded in a mixture of mud. It is described as poorly sorted. Diamictite is created in subglacial environments, meaning that it is deposited under the ice sheet where the ice meets the land. The clasts and sand grains may show evidence of breakage and rolling. Where in the picture will this layer be created?

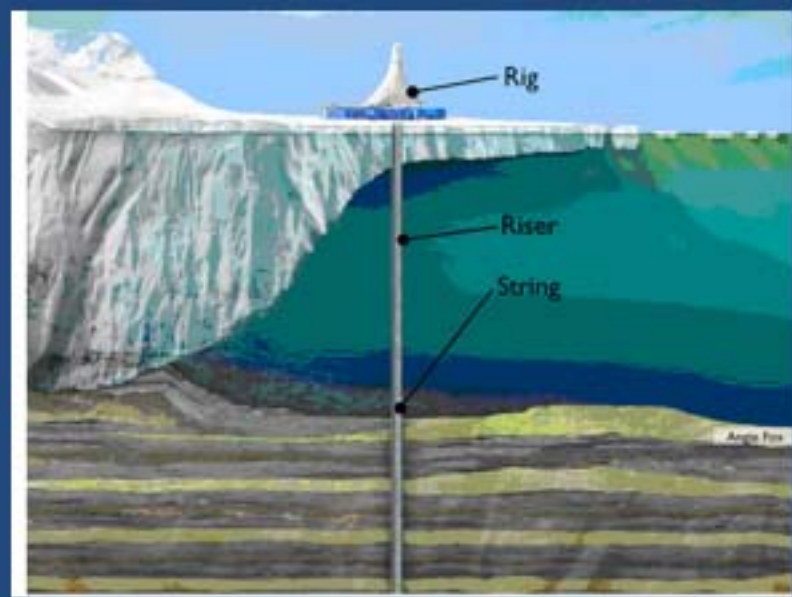


Sediment rate = fast

Card #2



**Mudstone
with clasts**



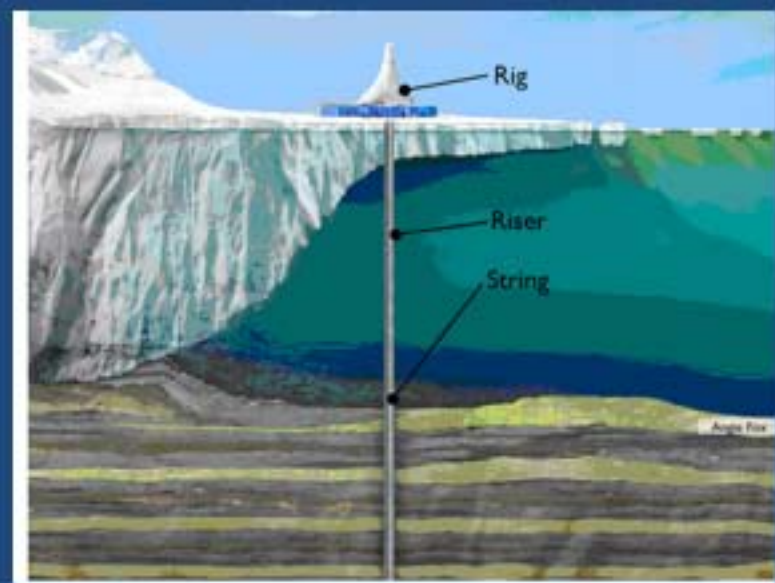
Mudstone embedded with small rocks (clasts) indicates that an ice shelf covers the ocean. Glaciers pick up stones as they move across the land and become an ice shelf over the water. When the underside melts it releases rocks and mud that settle to the sea floor. Since the ocean has been under the ice shelf away from sunlight for a long time, there will be few diatoms in this layer. Where in the picture will this layer be created?

Card #1

Sediment rate = slow



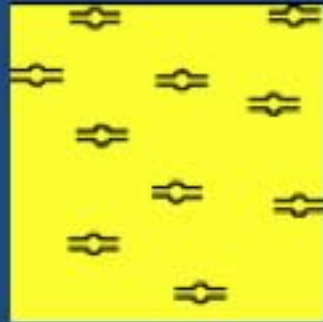
Mudstone



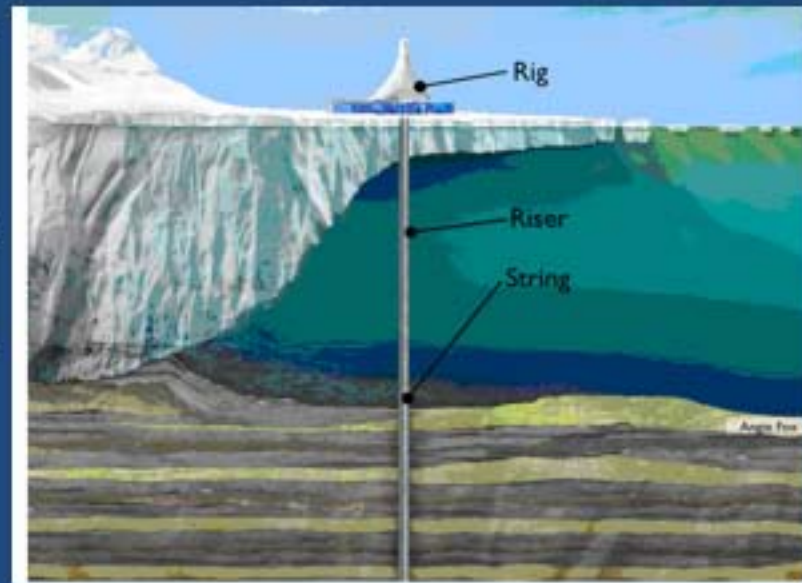
Mudstone is deposited by ocean currents that transport fine-grained silt and clay. There are no diatoms because this layer is deposited under the ice shelf and the overlying ocean does not have direct contact with sunlight. There are no clasts because the rocks in the ice shelf have already melted out and fallen to the sea floor closer to the ice sheet. Where in the picture will this layer be created?

Card #4

Sediment rate = slow



Diatomite



Diatomite is composed of the remains of diatoms, whose silica shells (SiO_2) make up the layers of this sediment. Diatoms are single celled algae found all over the world in hundreds of species and varieties. Diatom species are temperature sensitive, so their presence is a clue to past ocean temperatures. Where diatomite is deposited, the ocean is open to the atmosphere and sunlight (not covered by sea ice) so these organisms can thrive. Where in the picture will this layer be created?

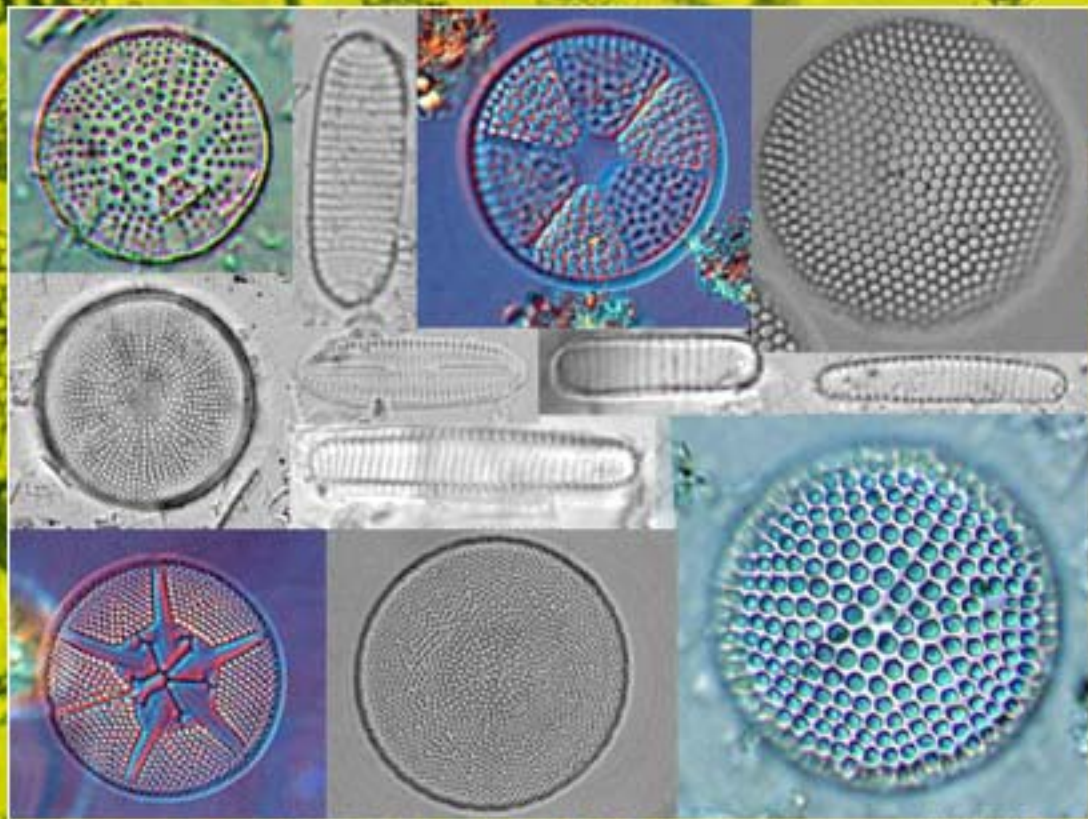
Sediment rate = slowest

Card #3

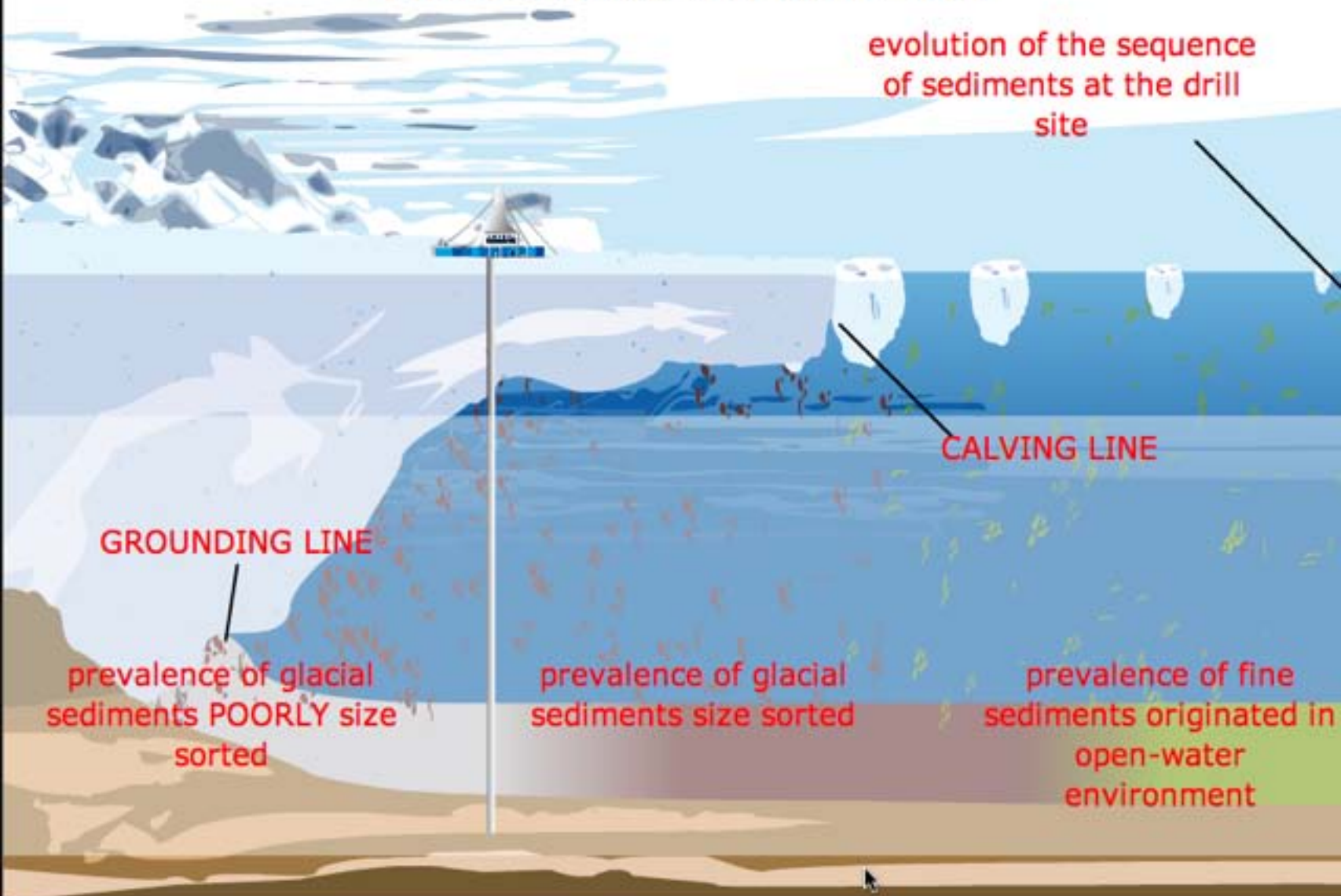
Single-celled fossils made of natural glass (called silica)

Indicates that the ice sheet is gone

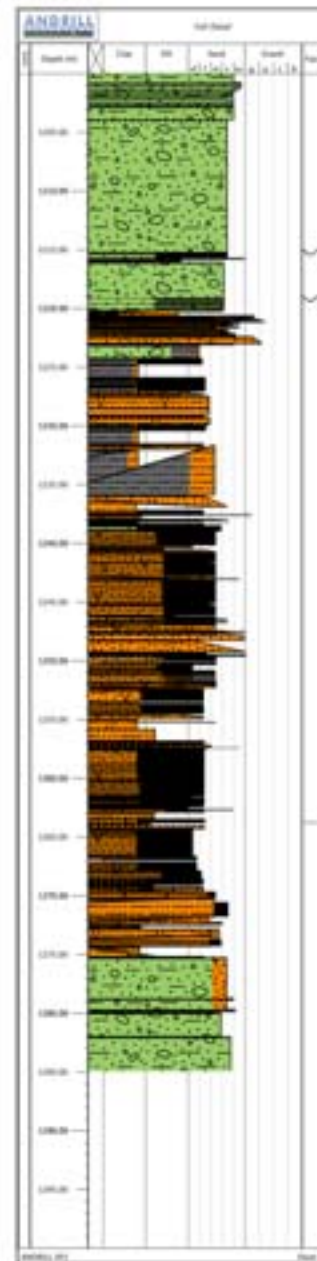
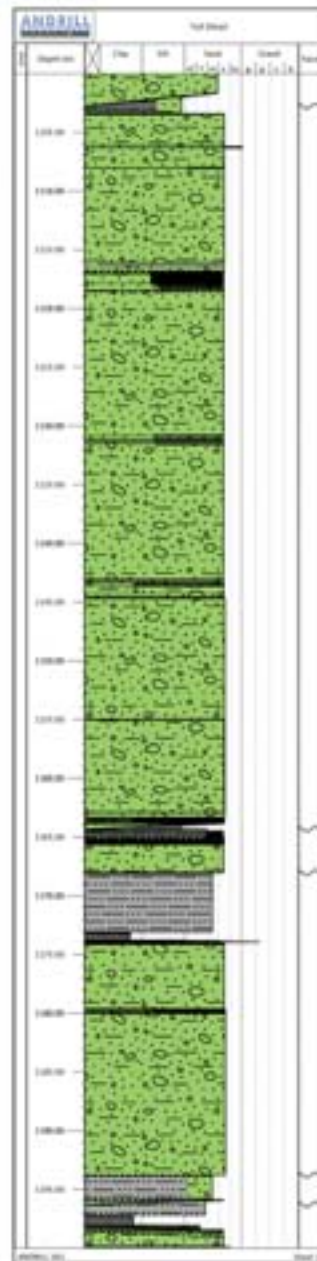
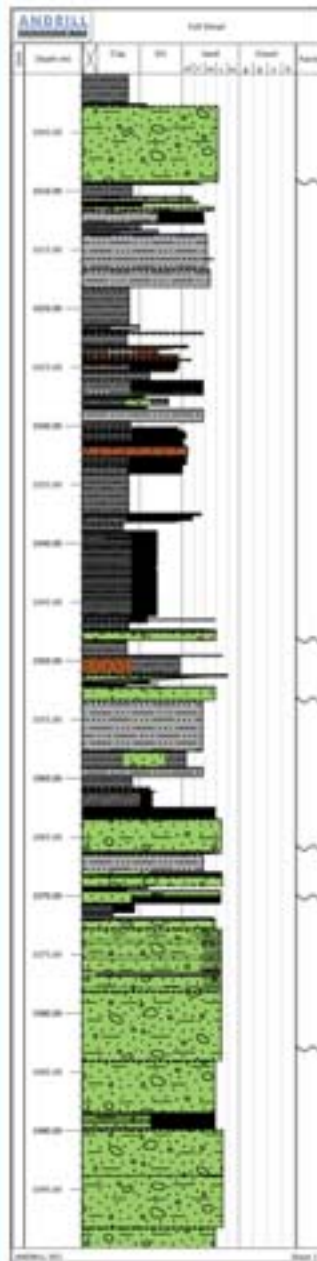
Diatomite: ~ 400 million fossils/g



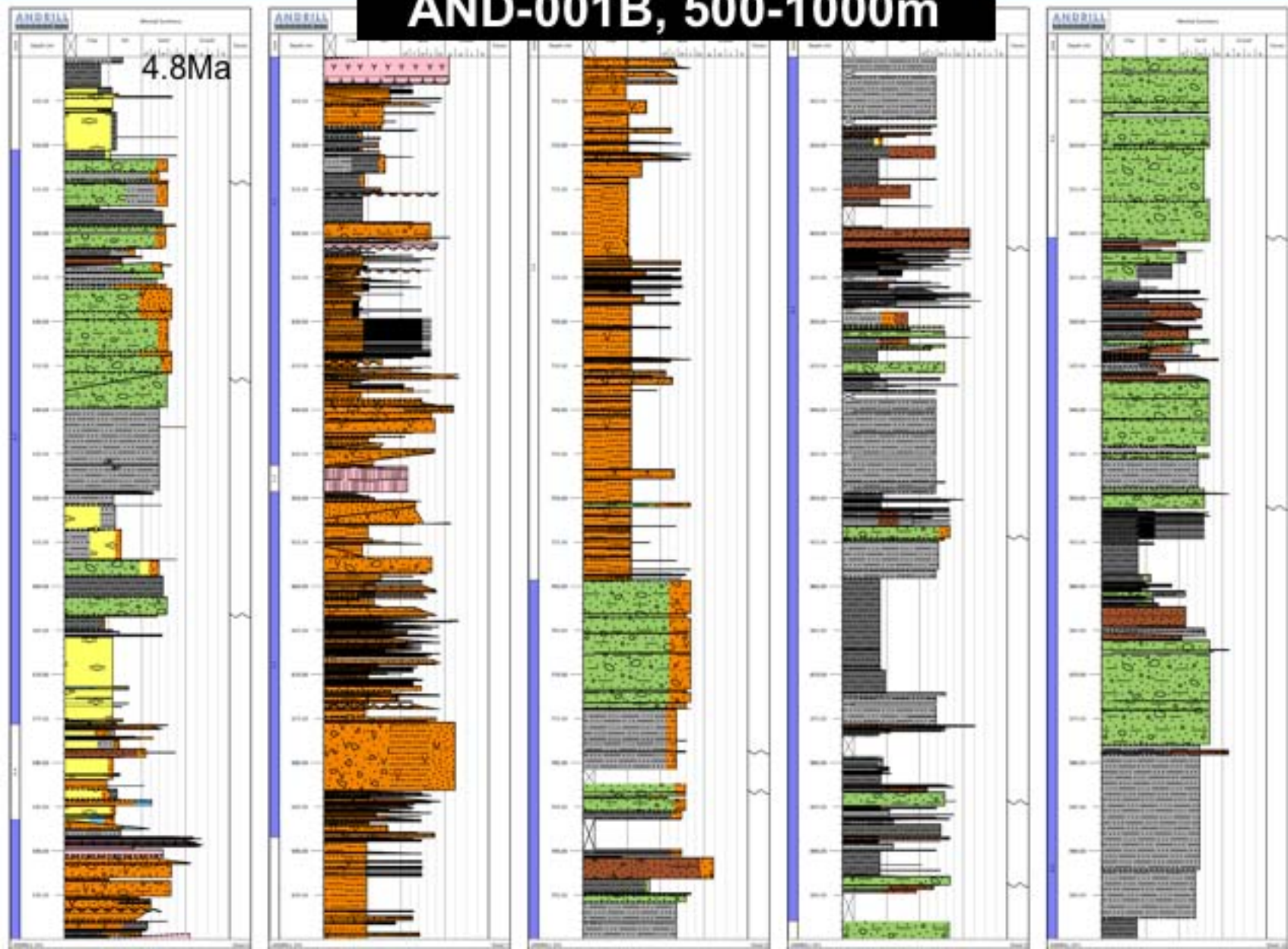
Advance and retreat of the ice-shelf



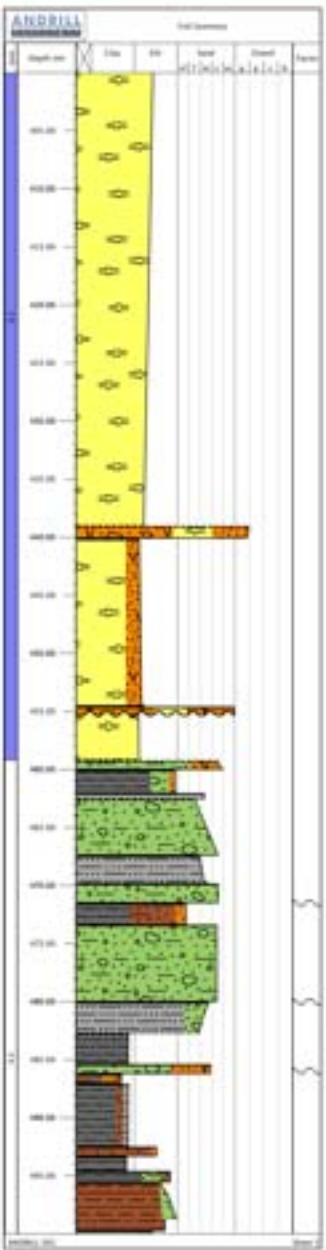
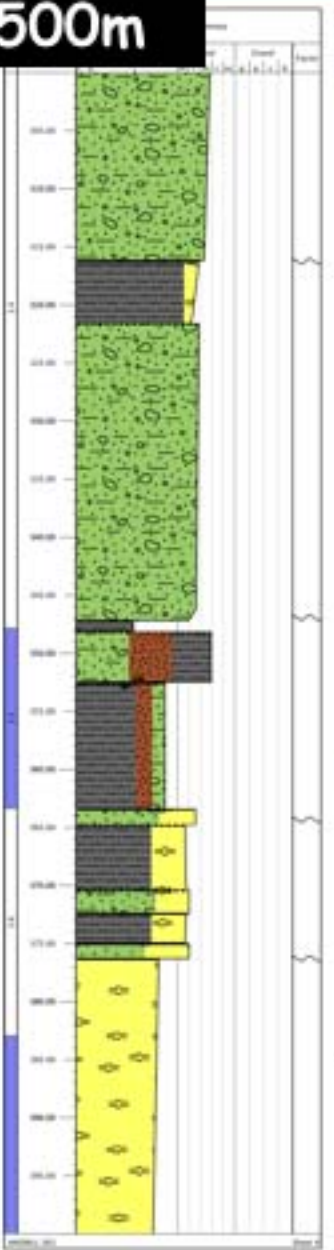
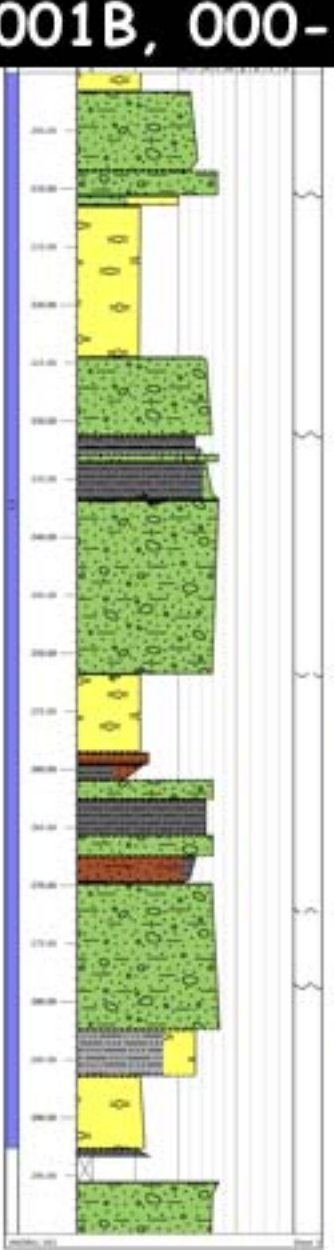
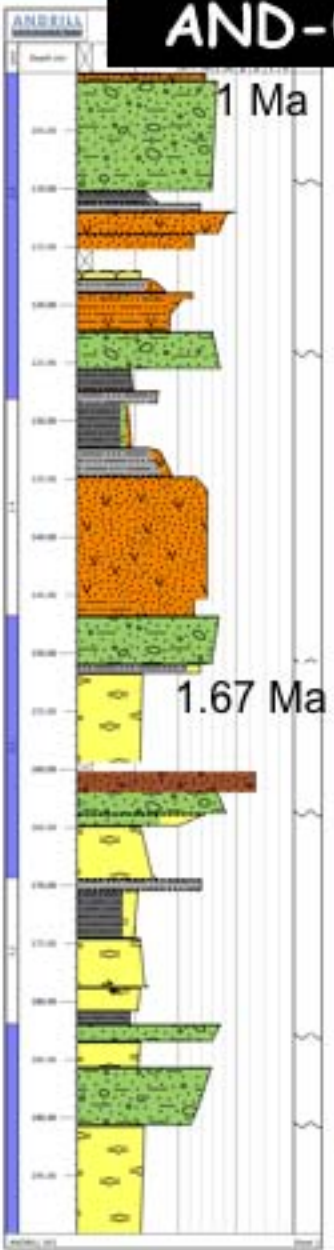
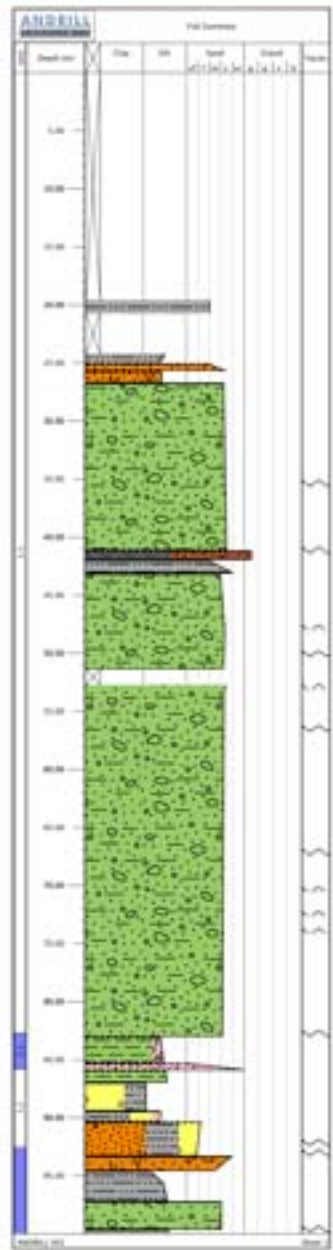
**AND-001B,
1000-1284.87m
13.5 million years ago**

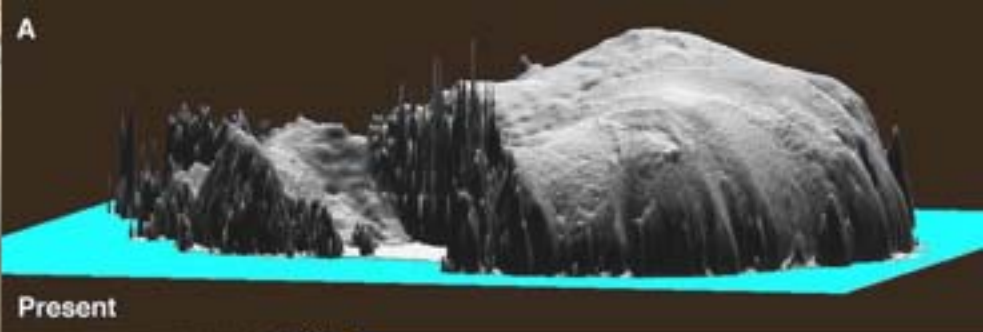


AND-001B, 500-1000m

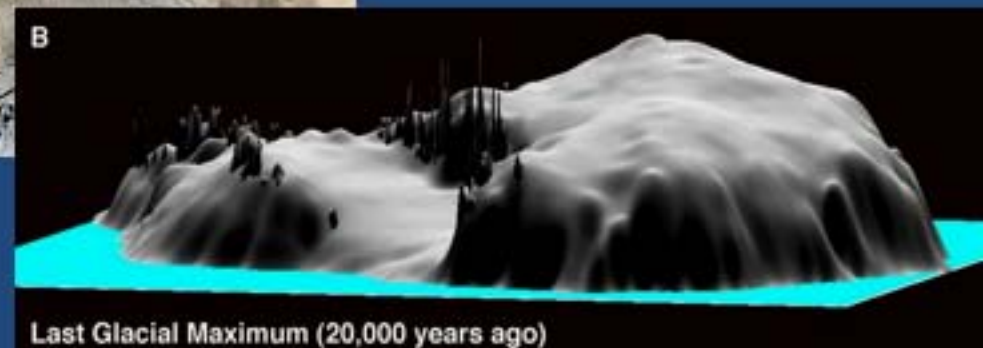


AND-001B, 000-500m





From ANDRILL we learn that the cryosphere in West Antarctica is not permanent. During warm periods the ice sheet melted away causing sea level to rise.



What could this mean for the future?

- Today many scientists are working to understand the impacts of climate change on the cryosphere.
- We will all need to work together to reduce carbon dioxide emissions and to lower the amount of sea level rise.



Why is cryosphere in Antarctica important to people who live in Virginia?

- Ice sheets trap the atmosphere in snow that fell long ago
- Glaciers and ice sheets store water on land so that the ocean doesn't over flow

