

Younger Dryas Climate Change

The YDB impact is proposed to have initiated abrupt climate change 12,800 years ago

- That change is called the “Younger Dryas” because it was the youngest in a succession of cooling episodes.
- “Dryas” is the name of a distinctive, cold-loving flowering plant that spread widely during the Younger Dryas cooling episode
- The proposed scenario is that the YDB impact into Canada fractured parts of the huge continental ice sheet, causing meltwater flooding into the Atlantic
- Those freshwater floods changed ocean circulation, which are like flowing “ocean rivers,” carrying massive amounts of sea water
- When ocean circulation changed, the climate became considerably colder, mainly in Europe and North America, but it also affected South America.

NOTE: this website is a brief, non-technical introduction to the YDB impact hypothesis. For in-depth information, go to “Publications” to find links to detailed scientific papers.

Younger Dryas Cooling

Scenario:

- YDB impact occurred
- YD cooling started
- Temperatures plunged
- Extinctions peaked

Changes in the Ice Sheet



Covered by ice

About 13,500 years ago, prior to the YDB impact, a huge ice sheet covered nearly all of Canada and part of the northern United States.

Migrations

For thousands of years, Paleo-Indians, ancestors of today's Native Americans, had been moving south along the West Coast (gold arrow). From there, they spread across North and South America.

Changes in the Ice Sheet



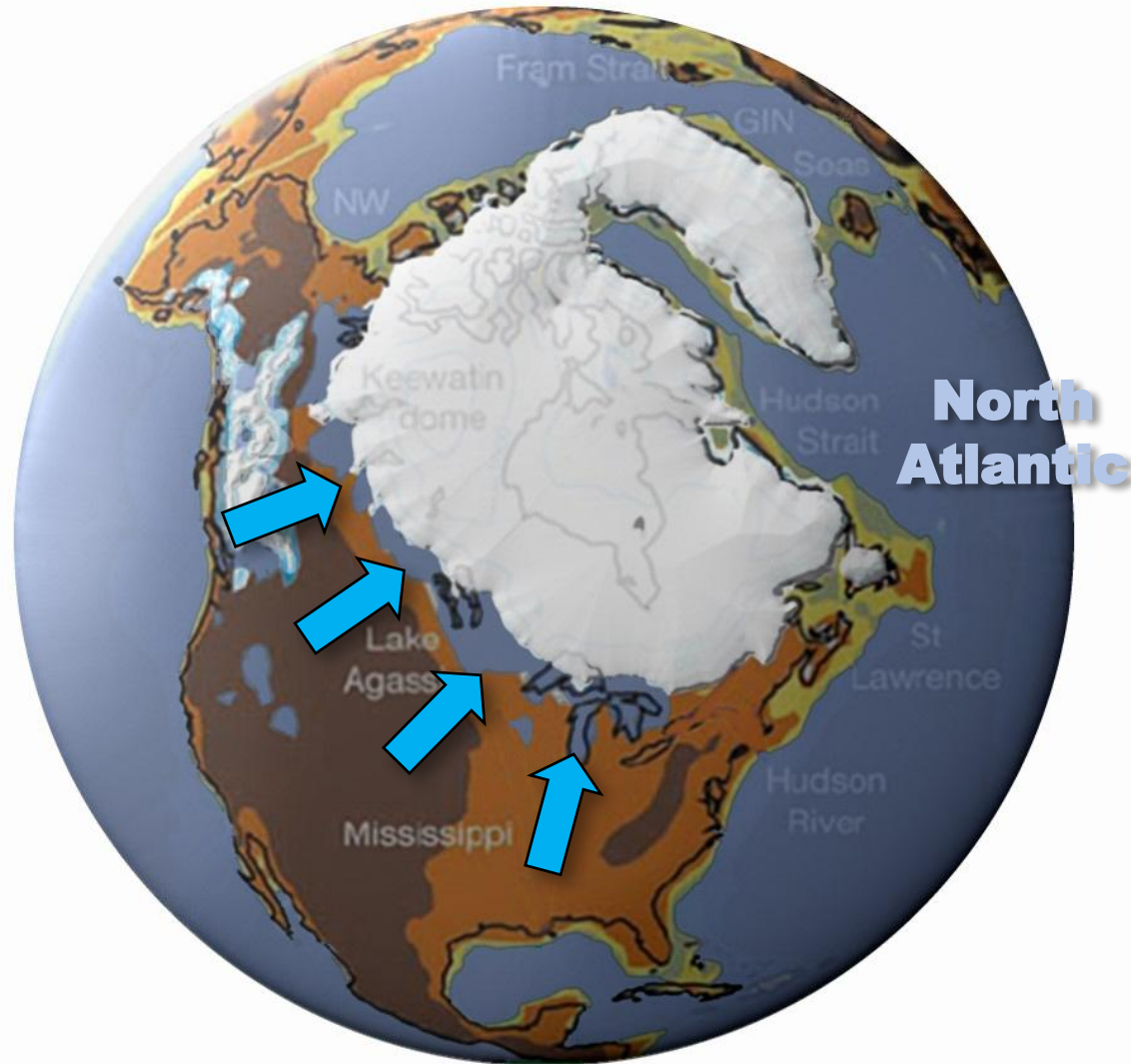
Breaking the ice

Evidence suggests the YDB impact broke up the center of the huge ice sheet (blue arrow), sending massive rafts of icebergs and meltwater floods into the oceans.

Migrations

At the time of the impact, Paleo-Indians had already begun moving down an ice-free corridor (right gold arrow) that had opened up in the plains of western Canada.

Meltwater Floods



Pre-impact glacial lakes

Before 12,800 years ago, huge glacial lakes (blue arrows) bordered the ice sheet in North America. The largest is called Glacial Lake Agassiz – it was larger than any modern freshwater lake.

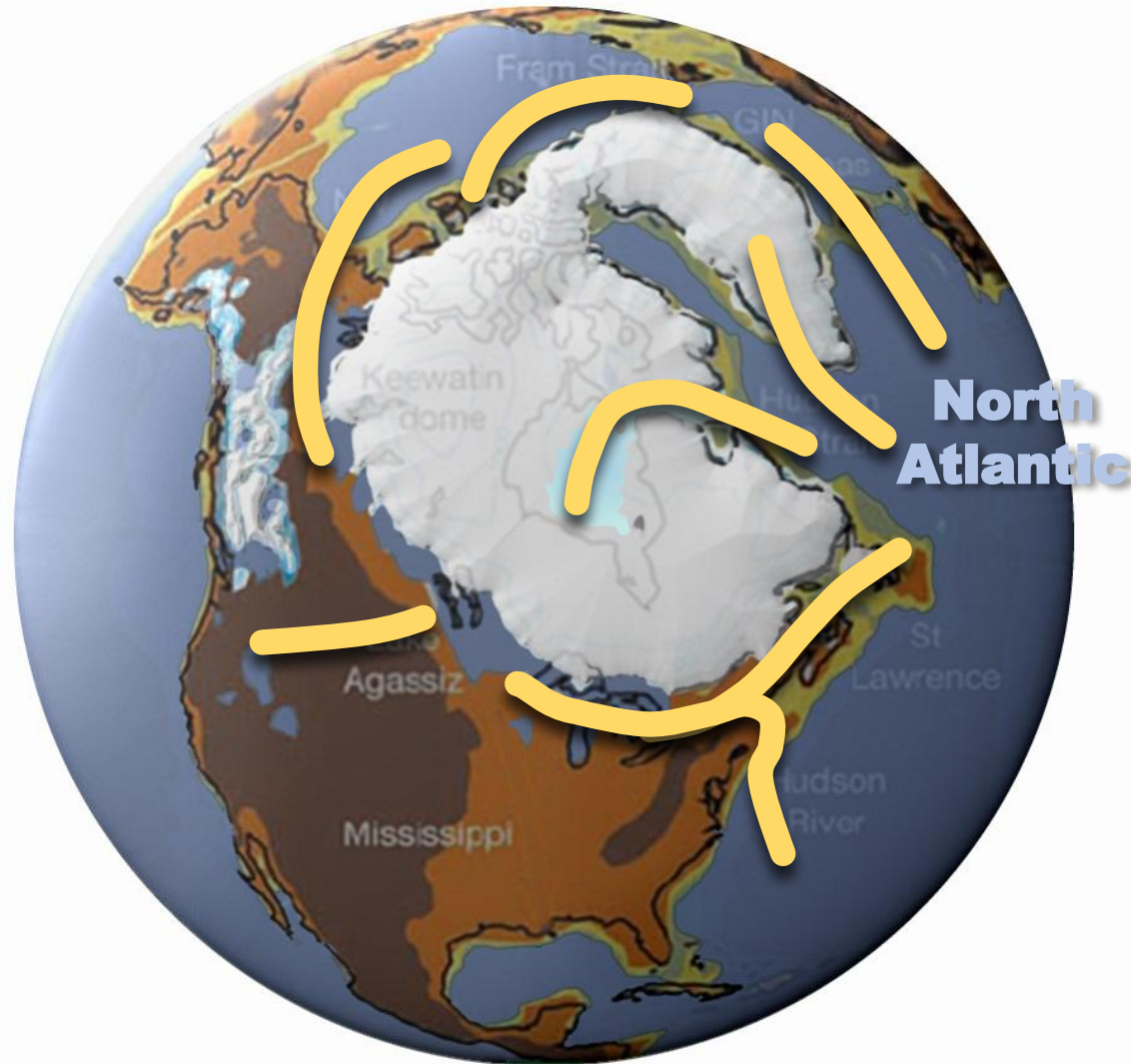
Meltwater Floods



Pre-impact meltwater flow

Before 12,800 years ago, nearly all the water in those glacial lakes drained south through the Mississippi River valley into the Gulf of Mexico.

Meltwater Floods



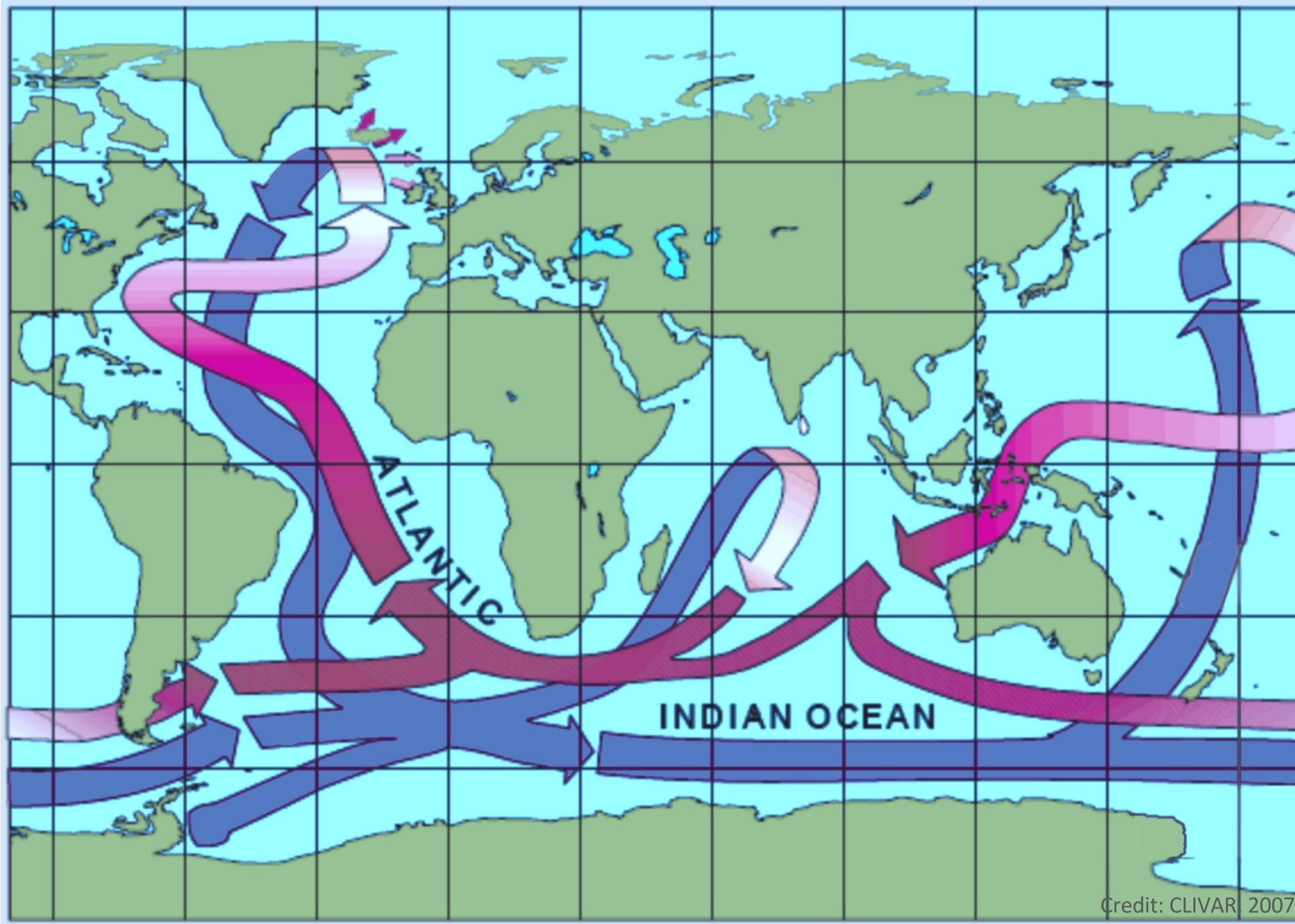
Meltwater floods

Then, 12,800 years ago, the YDB impact exploded in or over the ice sheet, blocking the flow of meltwater south into the Mississippi River Valley. That forced meltwater floods to flow north, west, and east into the Arctic, Pacific, and Atlantic Oceans.

Ocean Circulation

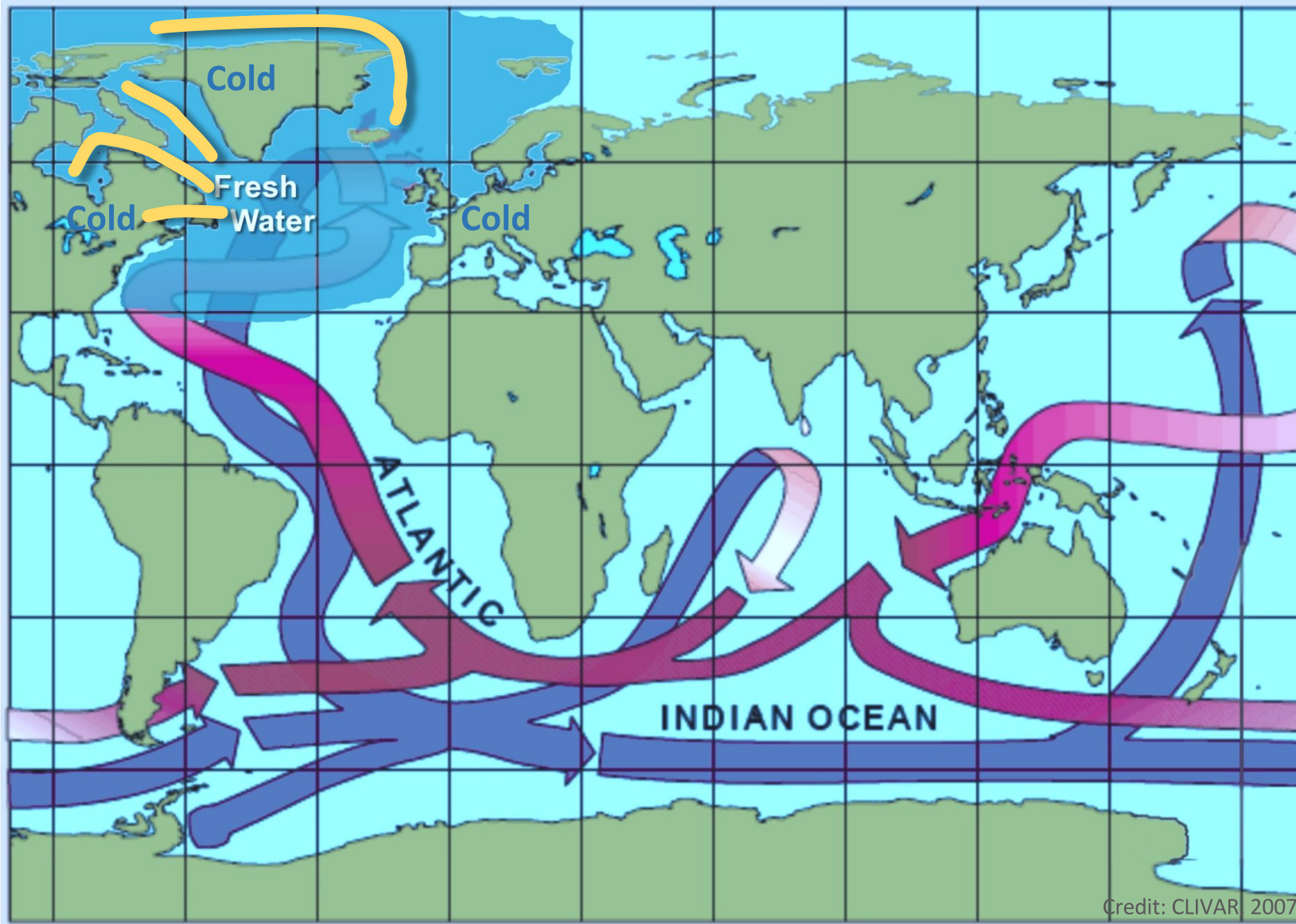
Cold freshwater flooding into the North Atlantic caused major changes in the ocean, leading to the shutdown of ocean circulation. Because of massive amount of inertia in the ocean system, circulation did not switch back to its old state for about 1,100 years.

Ocean circulation before the YDB impact 12,800 years ago.

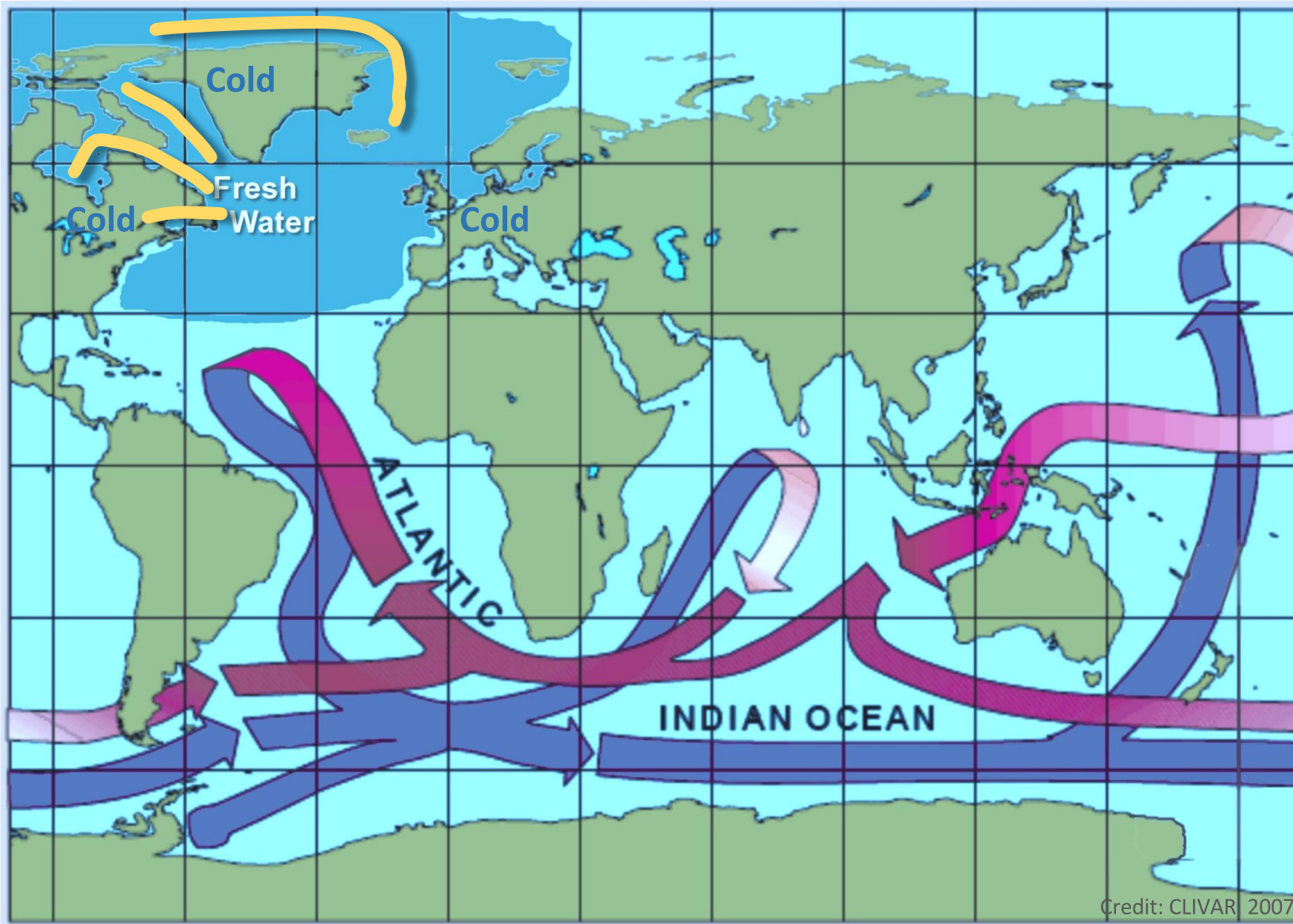


Red is warmer water; blue is colder water

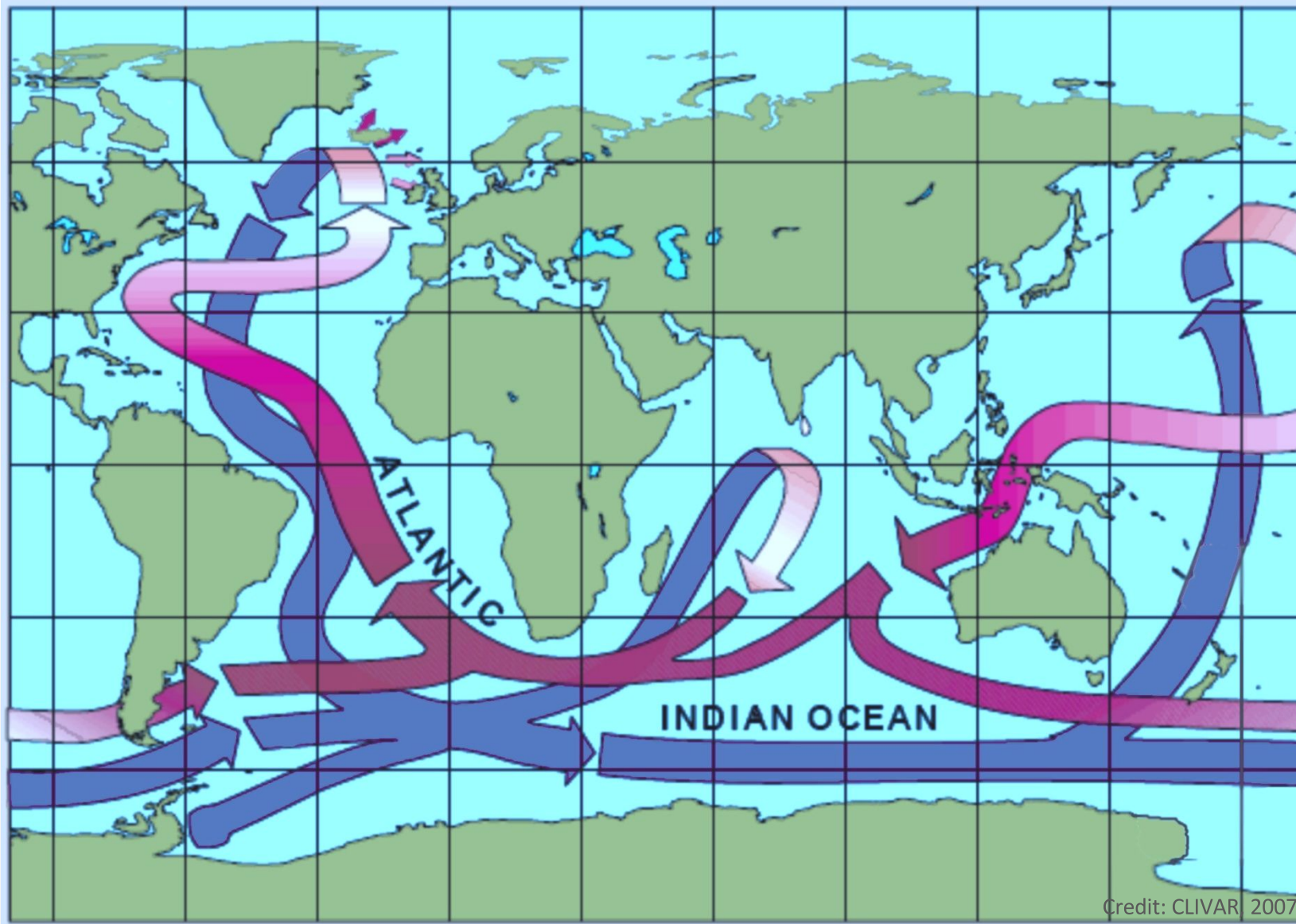
After the YDB impact, water flooded into the North Atlantic



Cold freshwater shut down circulation and changed the climate



Ocean circulation returned to normal after about 1,100 years



Ocean circulation switched at the start of the Younger Dryas and stayed that way for about 1,100 years, because when such huge amounts of water begin to move in a new direction, they strongly tend to keep going that same direction.

Glacial Lake Hind

Why did the huge glacial lakes suddenly drain?

- The largest lake complex, Glacial Lake Agassiz-Ojibway, contained nearly 10 times more water than all of the Great Lakes and the world's largest freshwater body, Lake Baikal
- One of the main causes of lake drainages is that the impact shattered ice dams on the glacial lakes along the lower margin of the Canadian ice sheet, releasing massive floods that poured into the northern oceans
- Within weeks, the enormous volumes of meltwater and icebergs may have raised the levels of the Earth's oceans by 2 to 4 meters (up to 13 feet)
- In Glacial Lake Hind, near Lake Agassiz, we found evidence of the failure of its ice dam about 12,800 years ago, at the same time the YDB impact deposited melted spherules, nanodiamonds and iridium into the lake (Firestone et al., 2007)

Glacial Lake Hind Manitoba, Canada

Ice Dam

Deep-water Lake

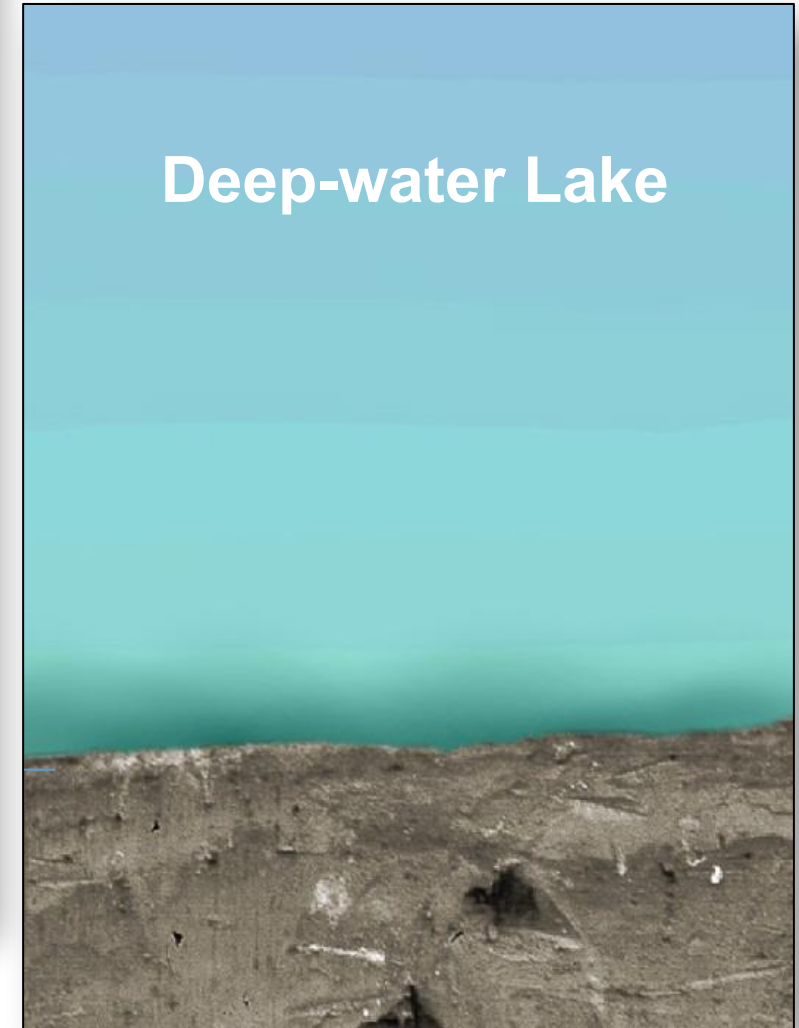
Prior to 12,800 yrs ago

Credit: NOAA.gov

Prior to 12,800 yrs ago, Glacial Lake Hind formed
when ice dammed the lake outlets

(These images are an artist's concept of what happened)

Deep-water Lake



Credit: Boyd, Running, Havholm, 2003

Actual sediment profile

Glacial Lake Hind

Ice Dam Failed

Comet impact 12,800 yrs ago

Credit: NOAA.gov

At 12,800 yrs ago, the YDB impact deposited spherules, nanodiamonds, and iridium into the lake and at the same time, blew out the ice dam, nearly draining the entire lake



YDB layer contains mud with spherules & diamonds

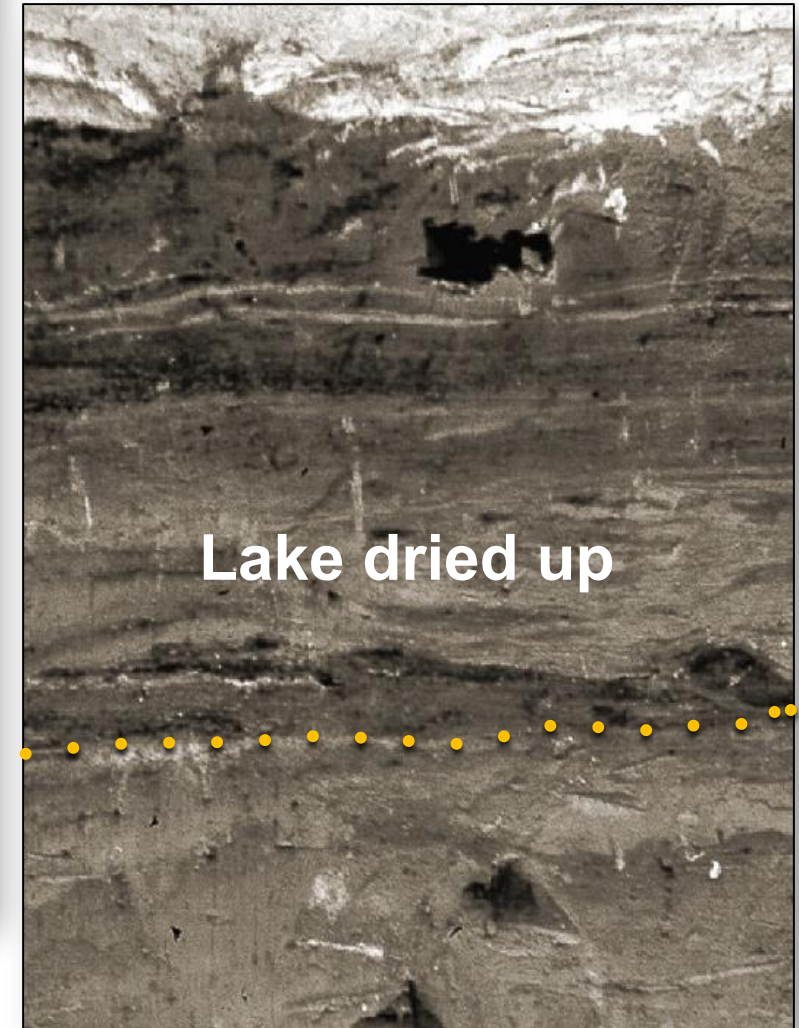
Credit: Boyd, Running, Havholm, 2003
Actual sediment profile

Souris River

Today's
Souris
River

Credit: water.weather.gov

Today, Glacial Lake Hind is gone. Only meadows and the Souris River remain.



Credit: Boyd, Running, Havholm, 2003

Actual sediment profile