

Introduction: Bathymetry through Time

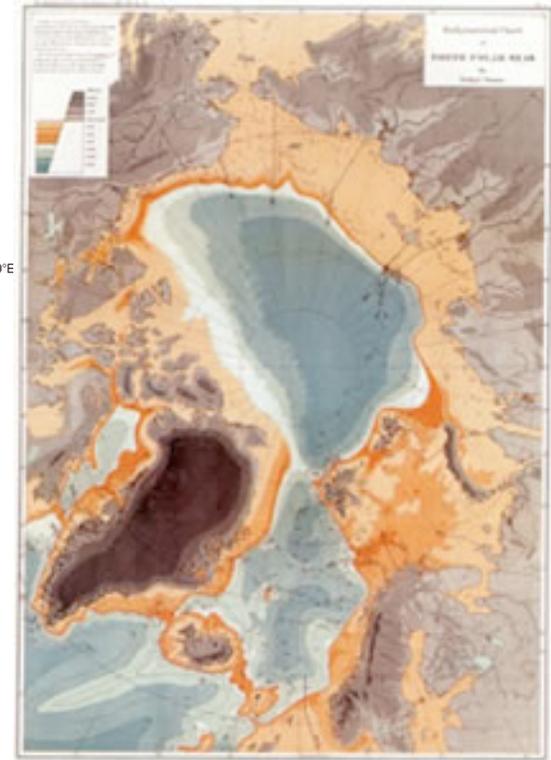
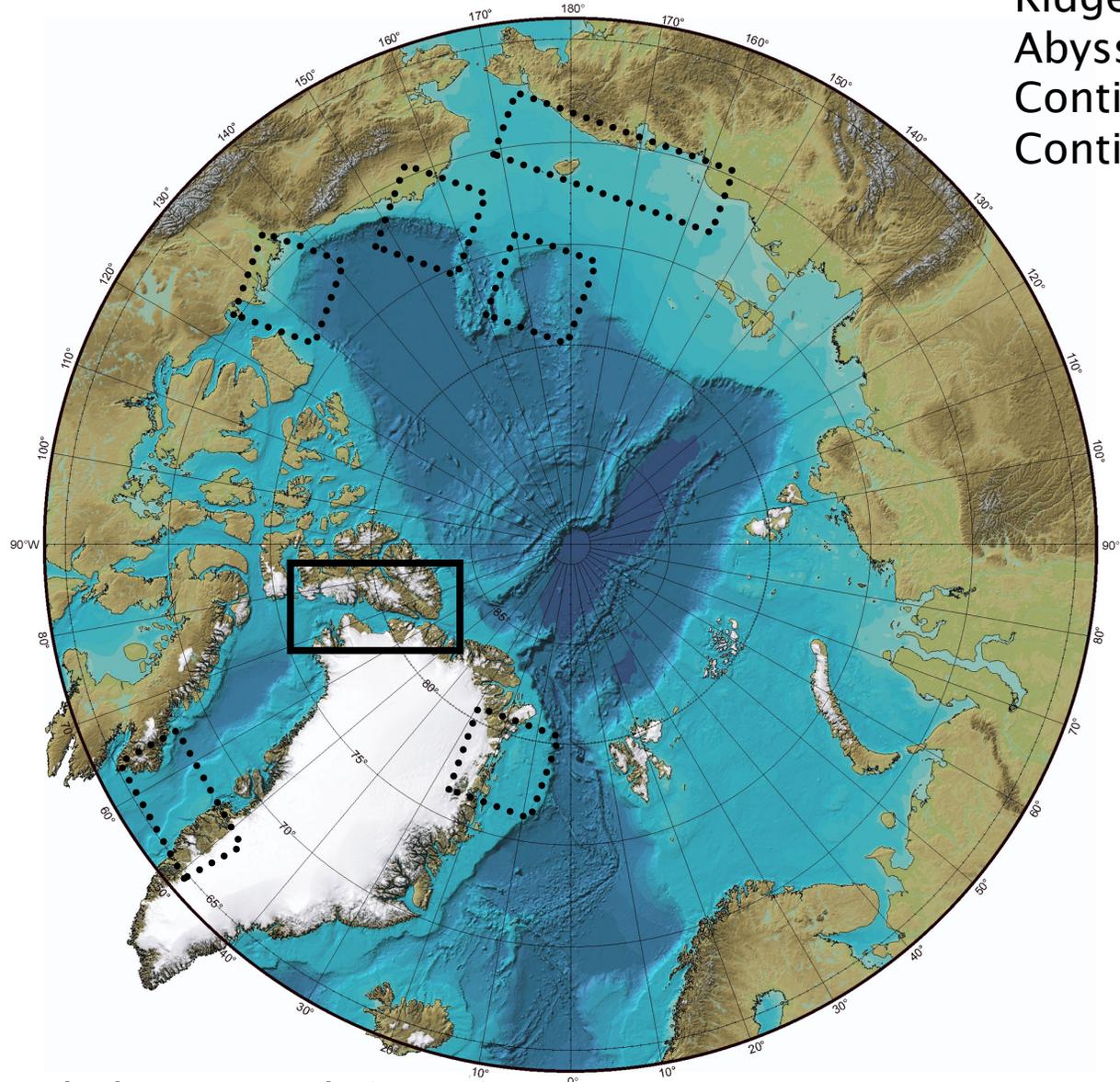
Present Ice Sheet: Greenland

Past Ice Sheets: Cycles of Glaciation

Ocean Bathymetry: Shelves, Basins, Ridges

Bathymetry and Oceanography: Example(s)

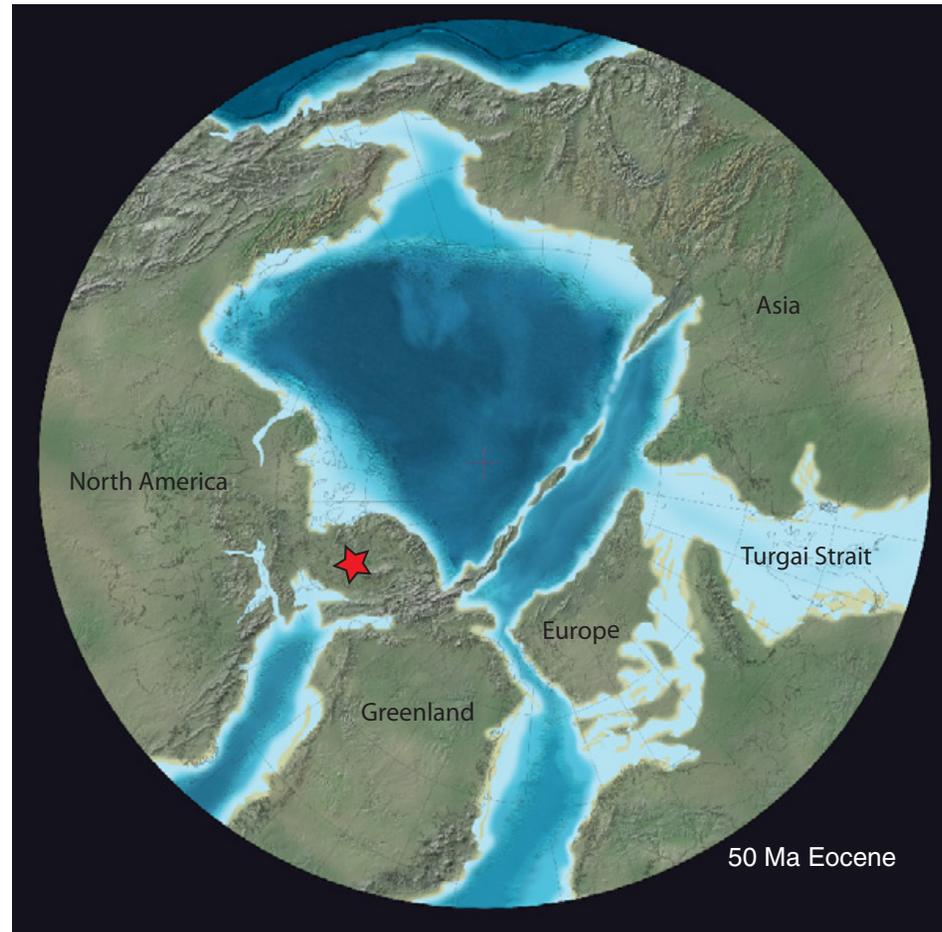
Continental Shelves:	53%
Ridges:	16%
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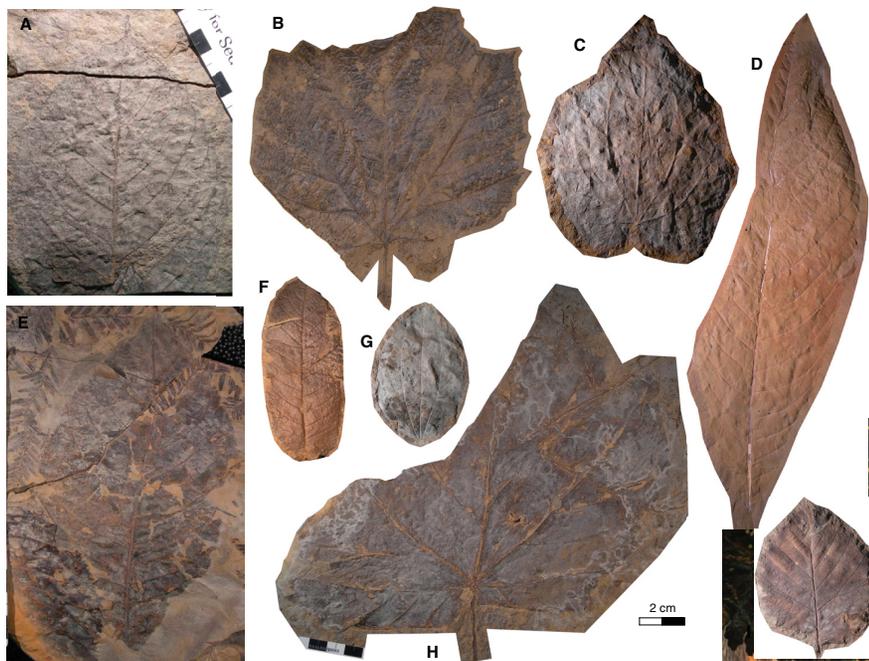


Jakobsson et al. (2008)

Nansen (1907)

Figure 3. Paleogeographic reconstruction of polar region during the Eocene, courtesy of R. Blakey (Northern Arizona University), with the general location of the early Eocene fossil localities on central Ellesmere Island identified by the red star. During the early–middle Eocene, these sites were located at $\sim 77^\circ\text{N}$ paleolatitude (Irving and Wynne, 1991). The Turgai Strait is shown open. Some reconstructions show this closed in the early to middle Eocene (e.g., Brinkhuis et al., 2006; Barke et al., 2011).





Life at the top of the greenhouse Eocene world— A review of the Eocene flora and vertebrate fauna from Canada's High Arctic

Jaelyn J. Eberle^{1,2} and David R. Greenwood²

¹University of Colorado Museum of Natural History, Geological Sciences, 265 UCB, Boulder, Colorado 80309, USA

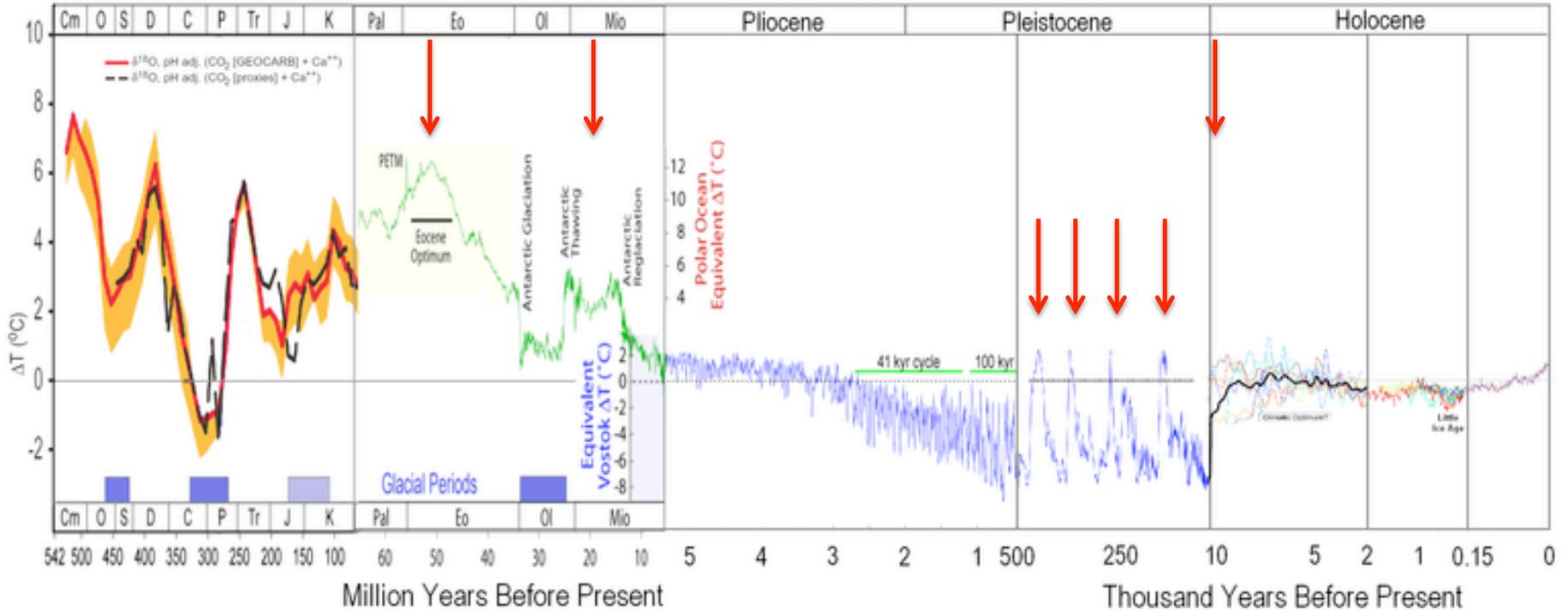
²Department of Biology, Brandon University, 270-18th Street, Brandon, Manitoba R7A 6A9, Canada



Geological Society of America
Bulletin, 124, 3–23, 2012.

Figure 7. Reconstruction of Eocene High Arctic rain forest environment with hippo-like *Coryphodon* in the foreground; inset shows detail of Eocene Arctic tapir *Thuliadanta*. Both images are courtesy of the American Museum of Natural History (© AMNH/D. Finnin).

Temperature of Planet Earth



← dinosaurs →

← →

500K years

← →

Ice cores

5,000K years

← →

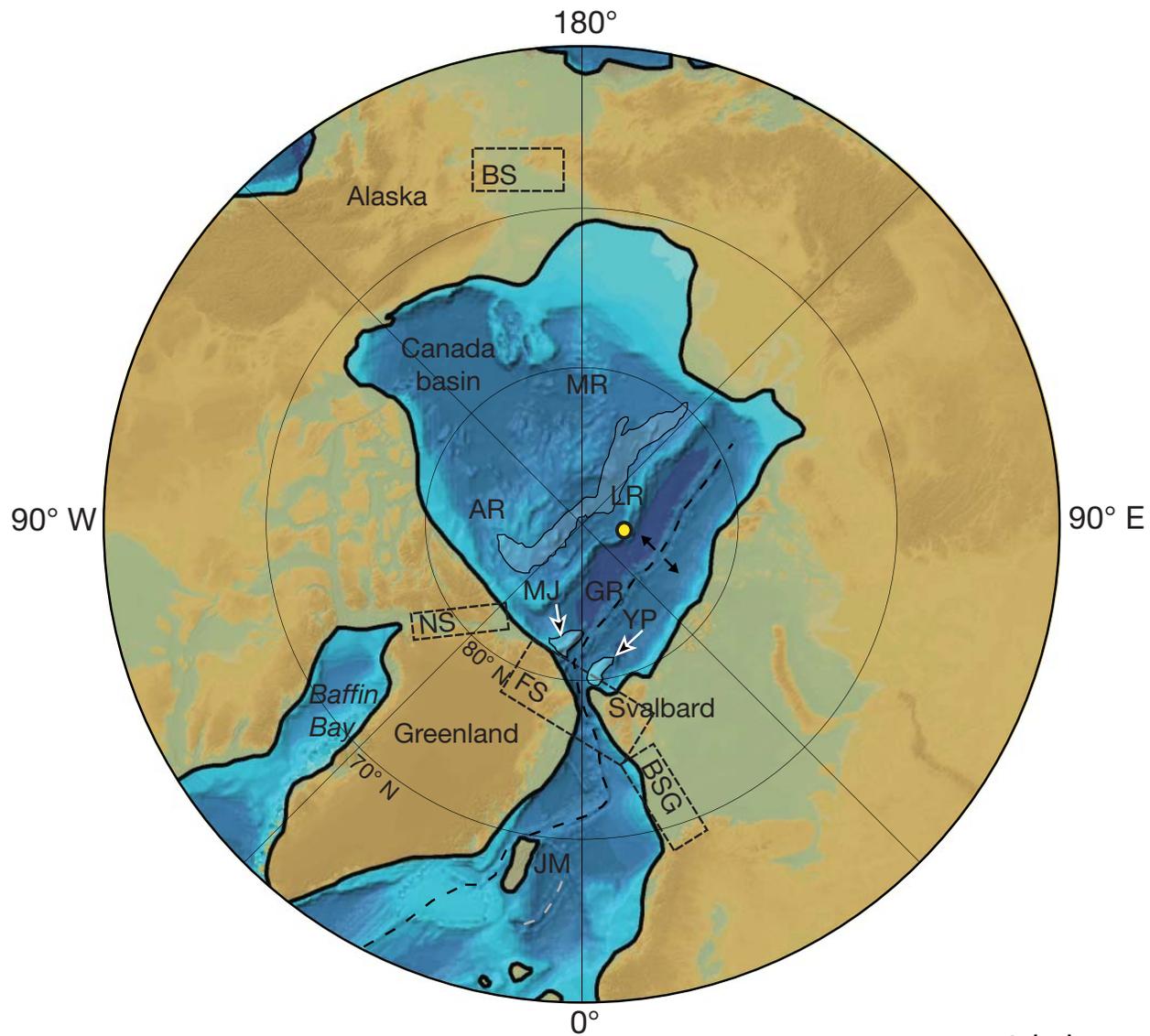
Sediment cores

10K years

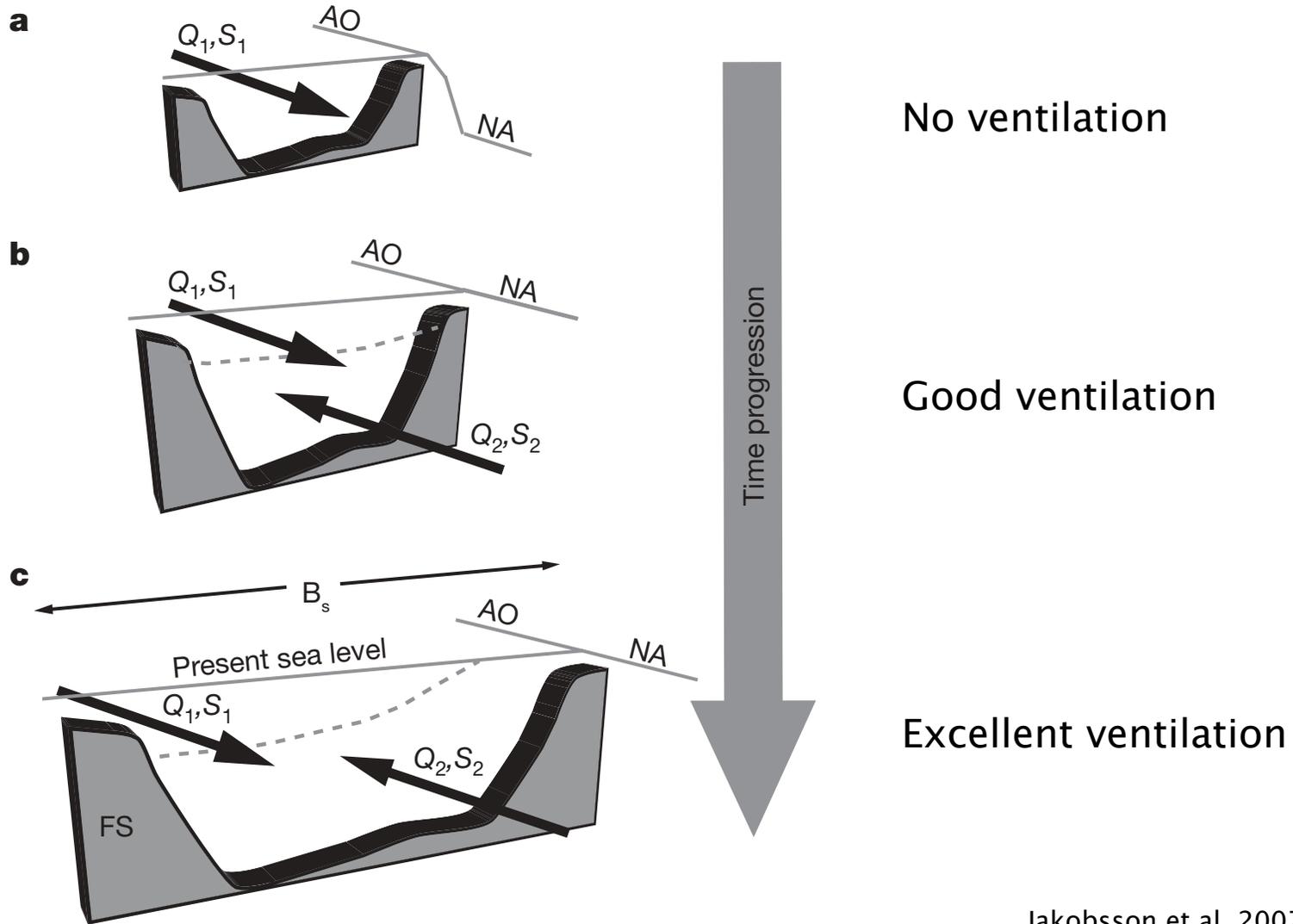
← →

agriculture

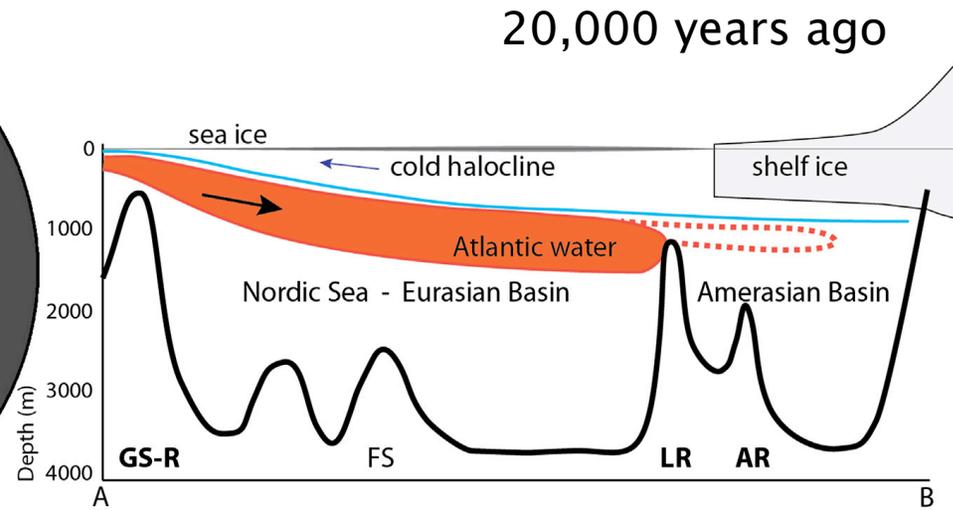
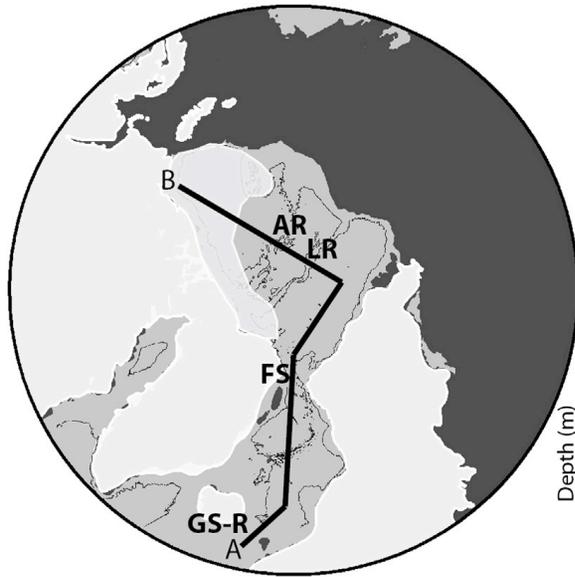
Opening of Fram Strait: About 20 Mil. Years ago



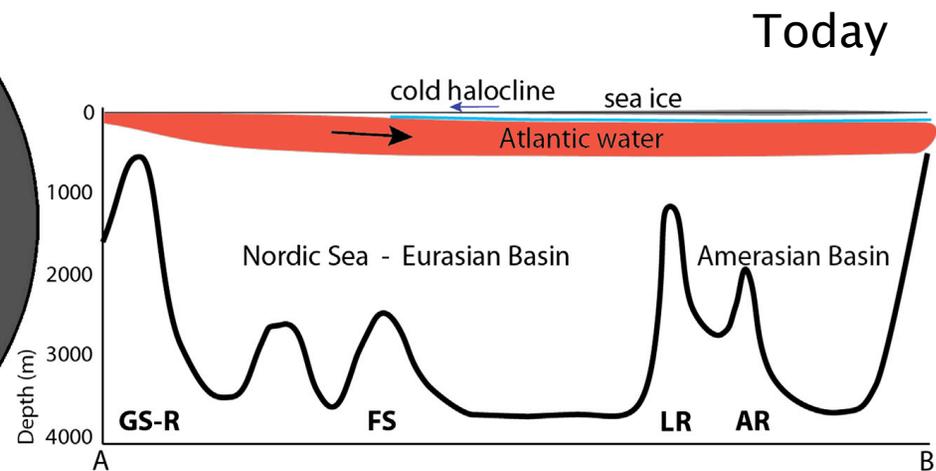
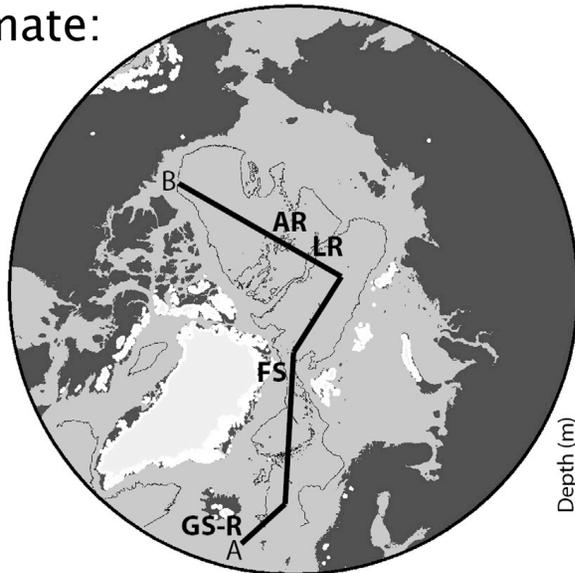
Fram Strait Widening Over Geological Time



Cold Climate:



Warm Climate:



Introduction: Bathymetry through Time

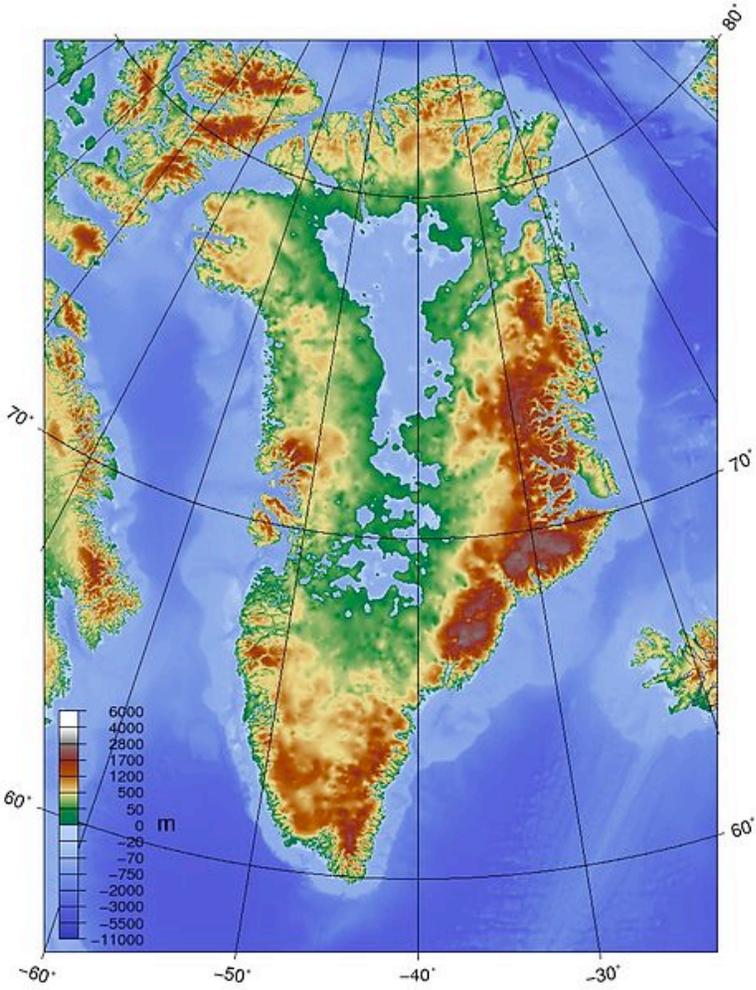
Present Ice Sheet: Greenland

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Ocean Bathymetry: Shelves, Basins, Ridges

Bathymetry and Oceanography: Example(s)

Modern Greenland Ice Sheet

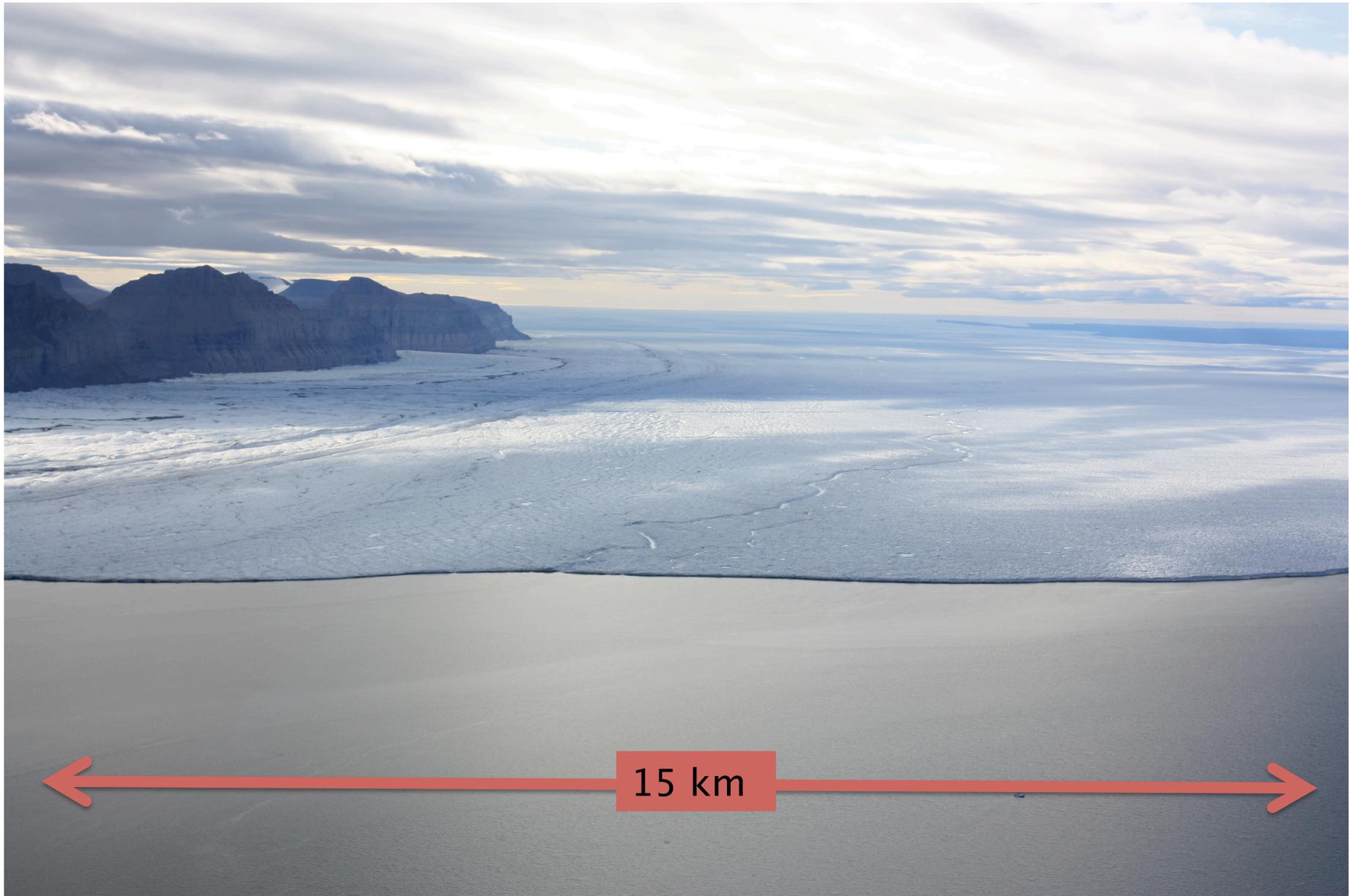


Summit Camp Tue Sep 2 13:24:00 2014



<http://www.summitcamp.org/status/webcam/>

Petermann Gletscher: Outlet of the Greenland Ice Sheet



AIR

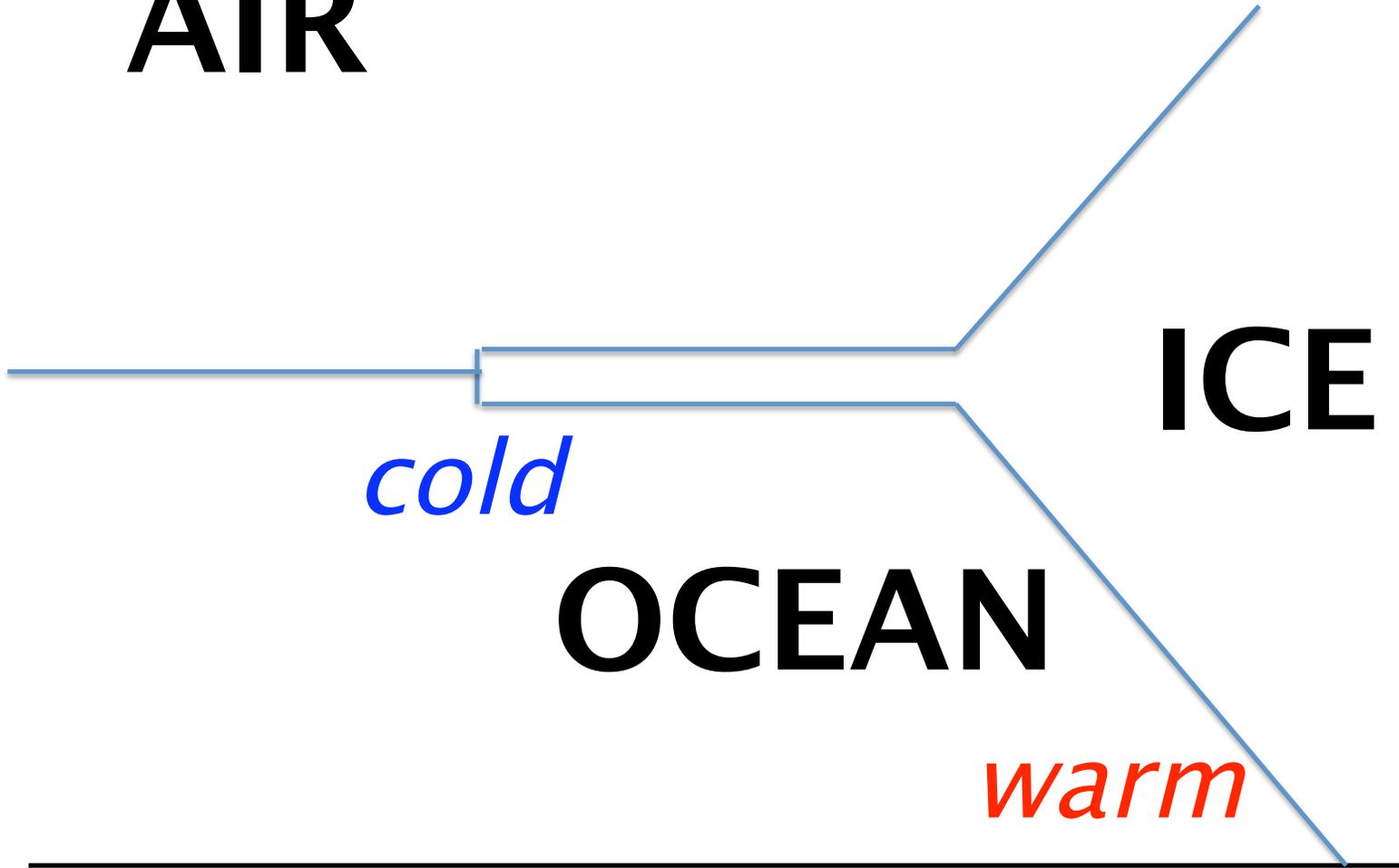
ICE

cold

OCEAN

warm

ROCK

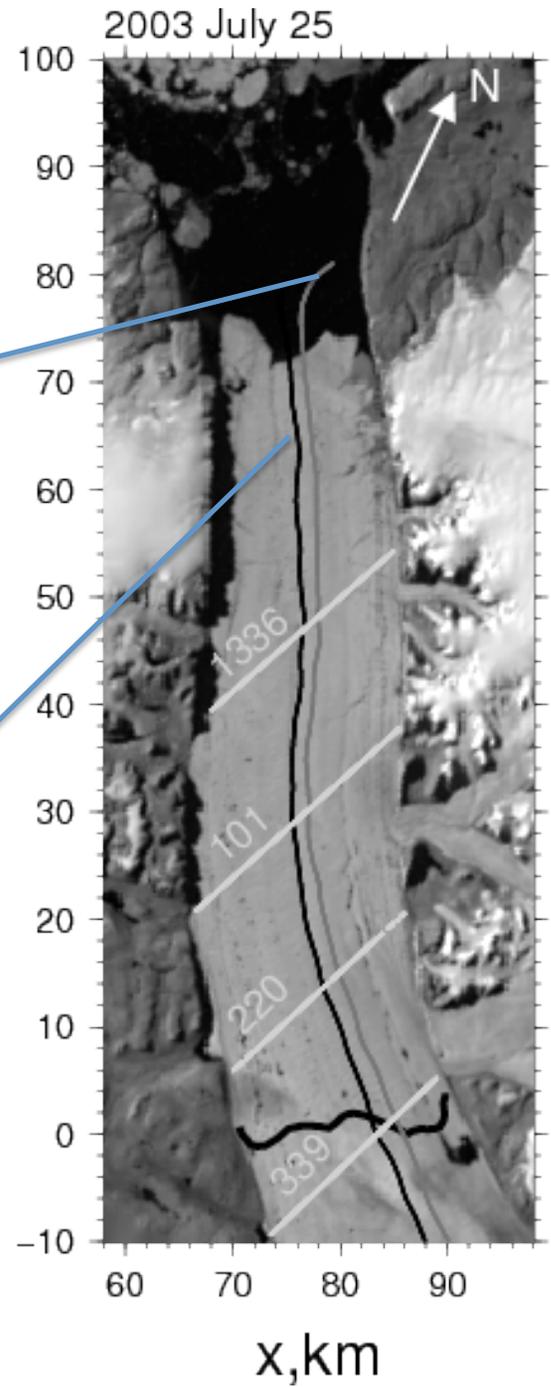
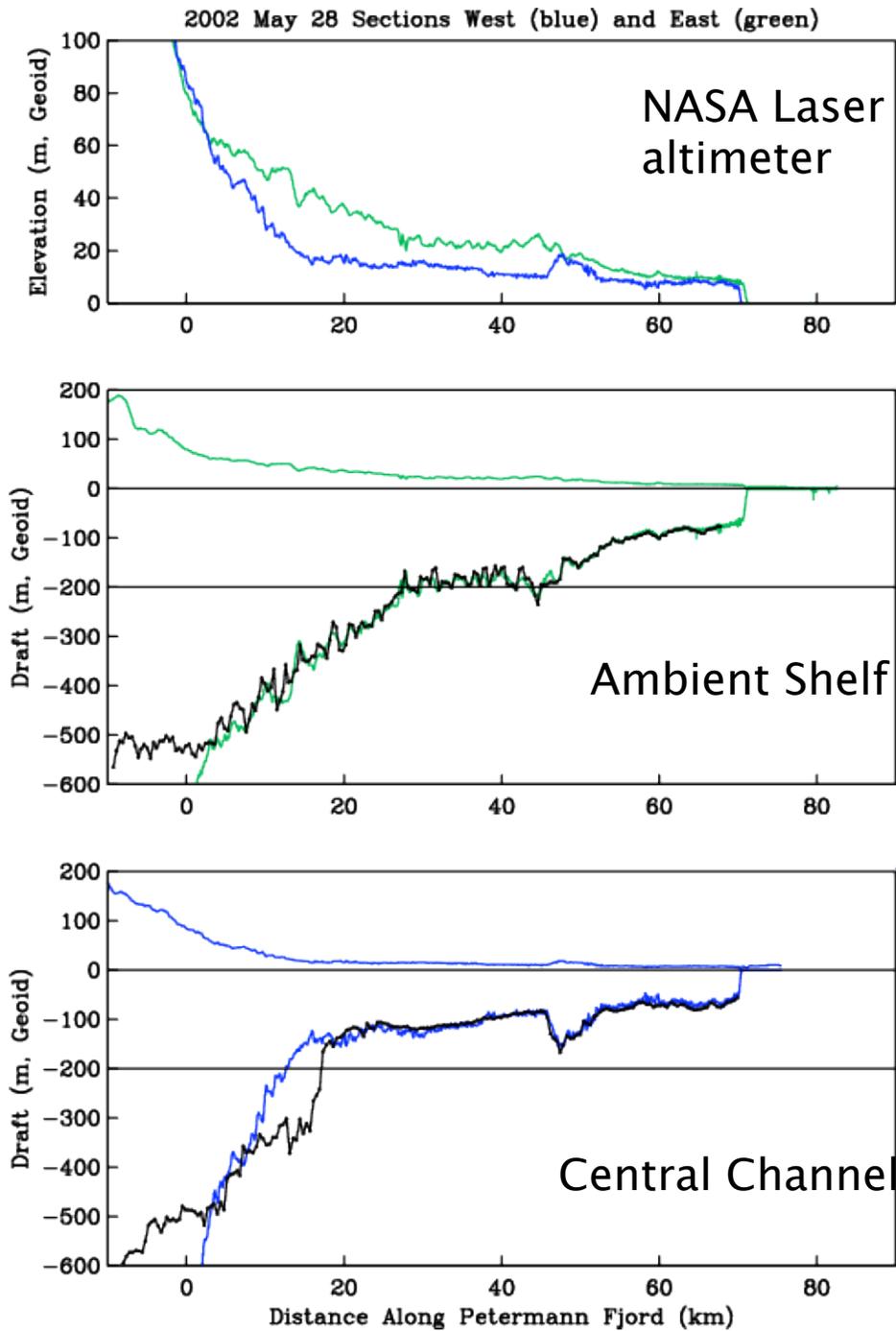




Petermann Glacier Ice Island 2012

200-m thick
2 x Manhattan by area

CCGS Henry Larsen, 2012



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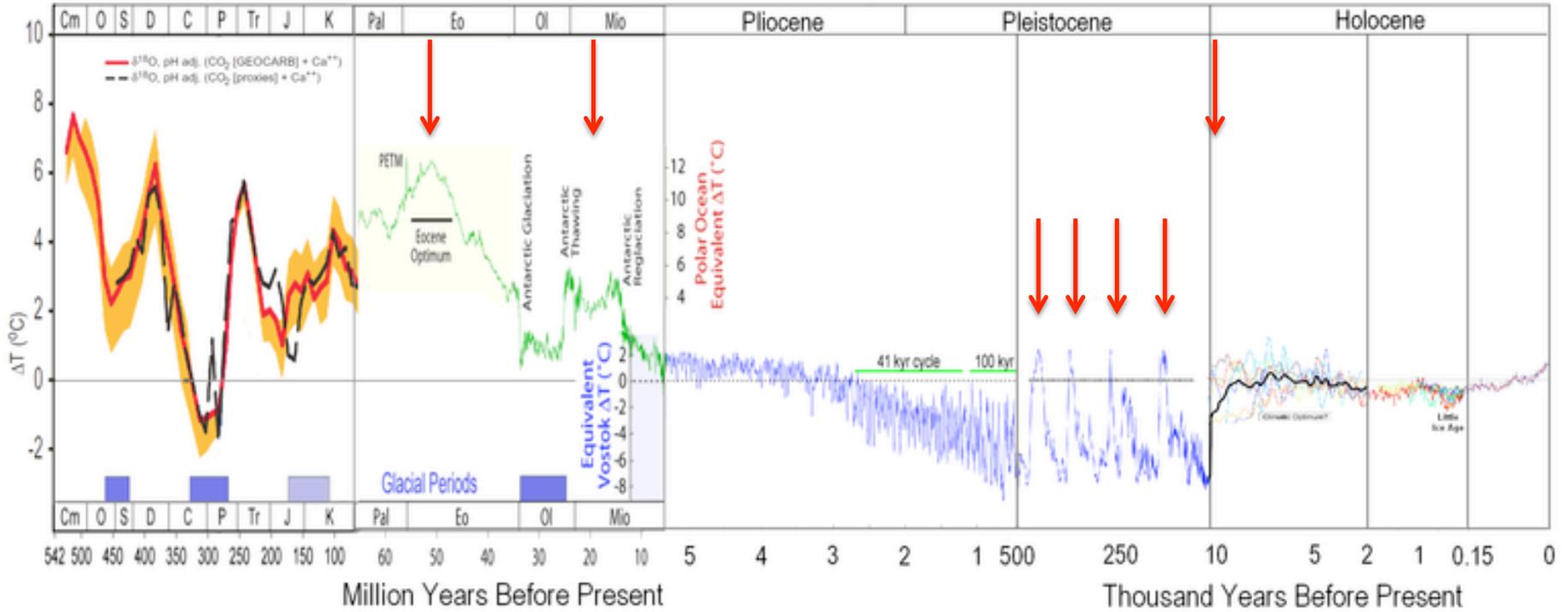
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Temperature of Planet Earth



dinosaurs



500K years



Ice cores

5,000K years



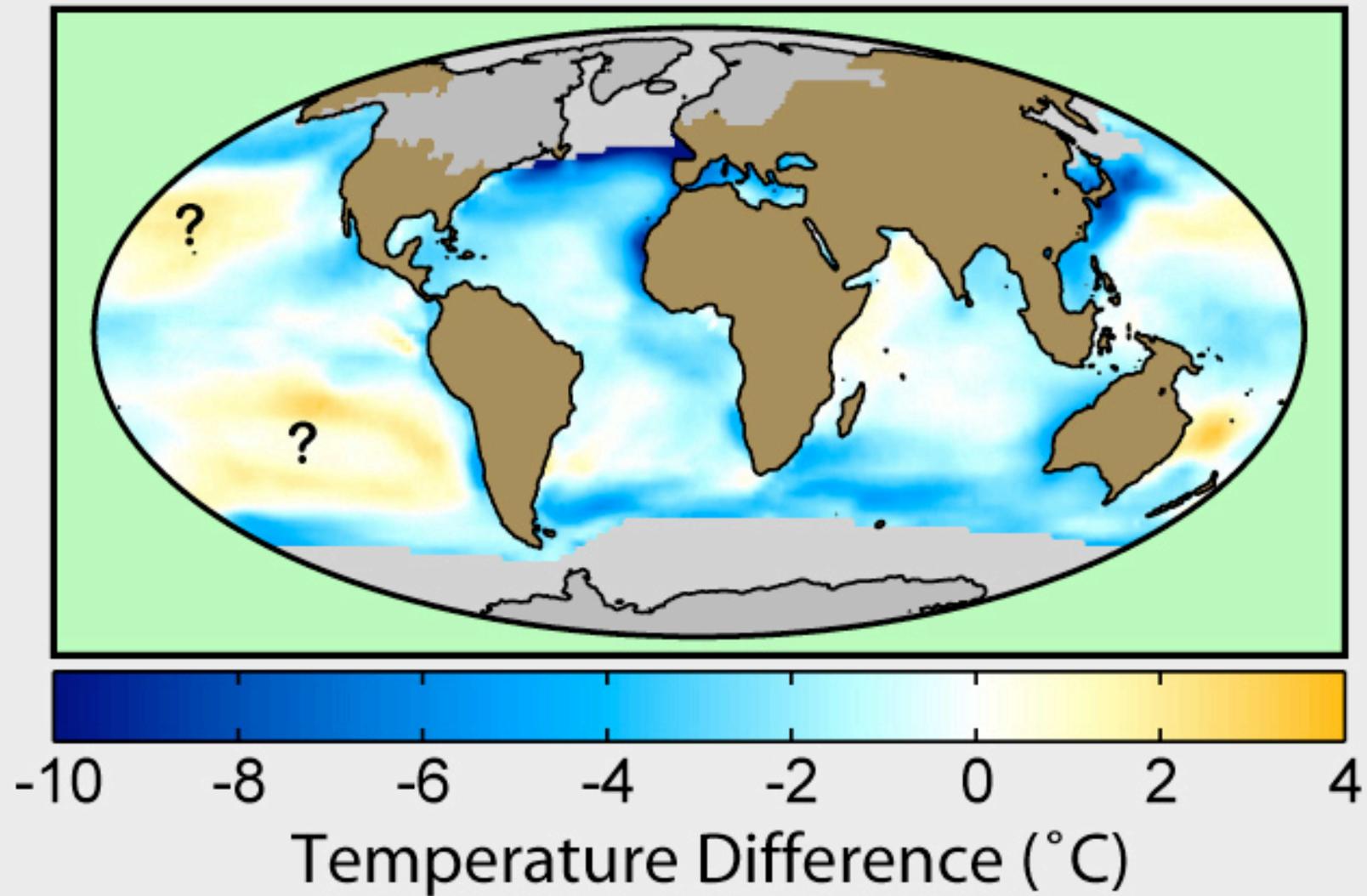
Sediment cores

10K years

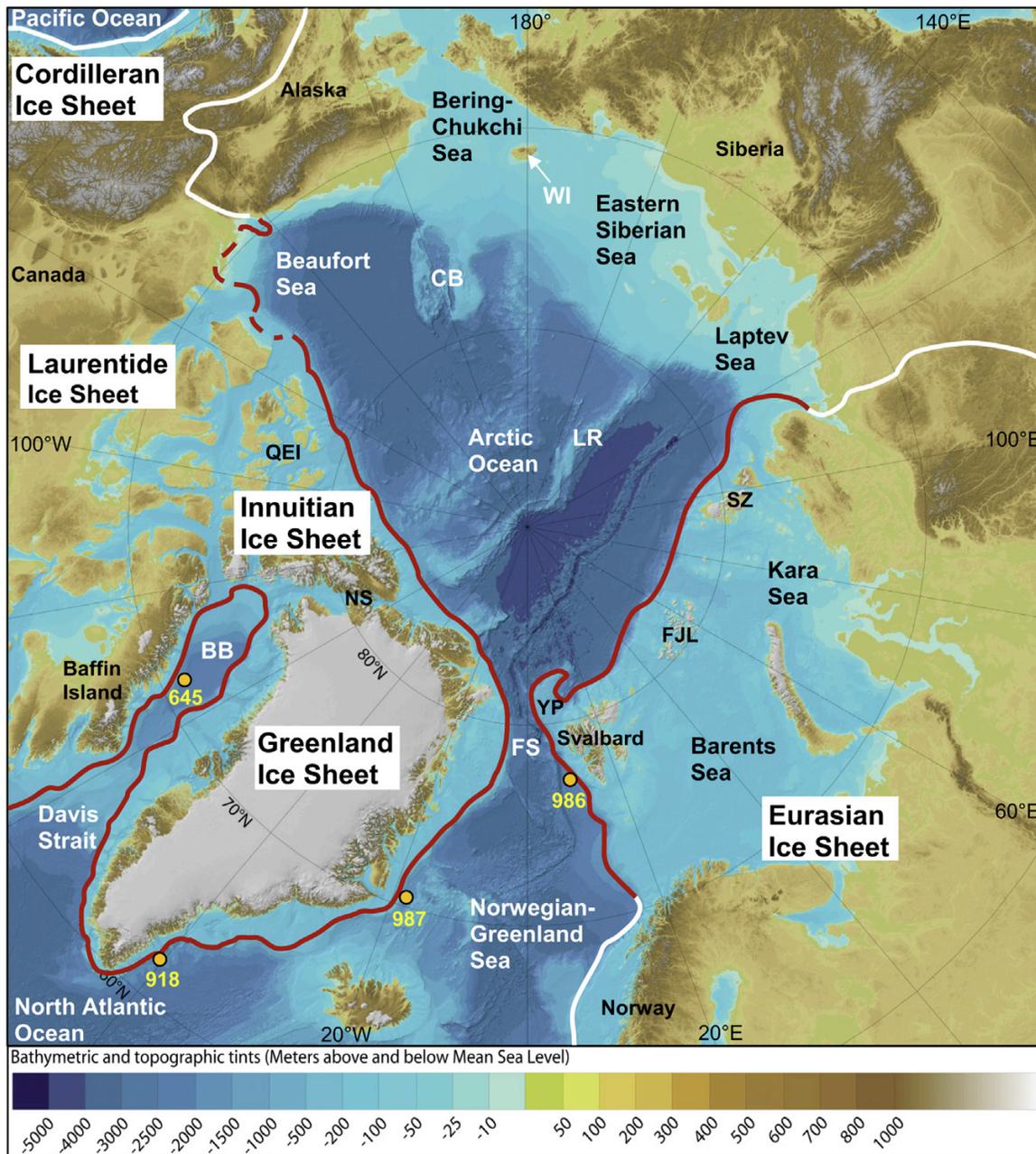


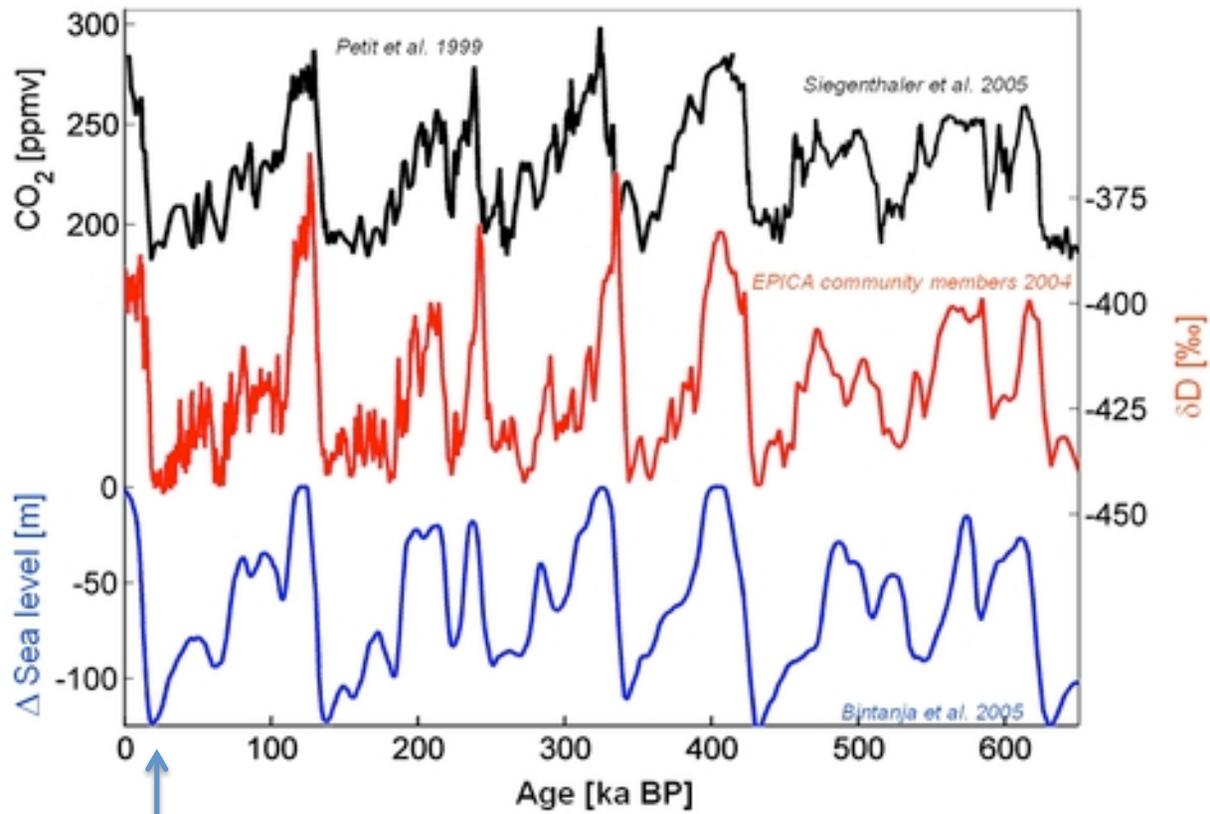
agriculture

CLIMAP: The Last Glacial Maximum



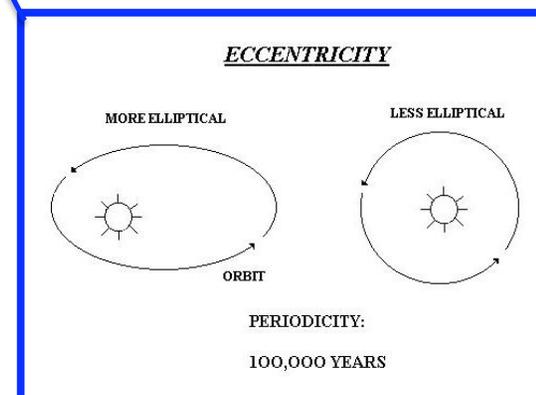
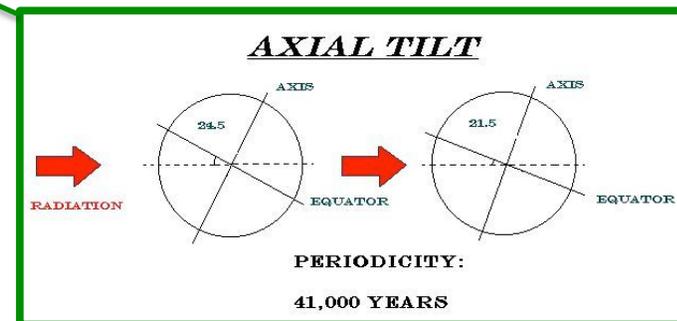
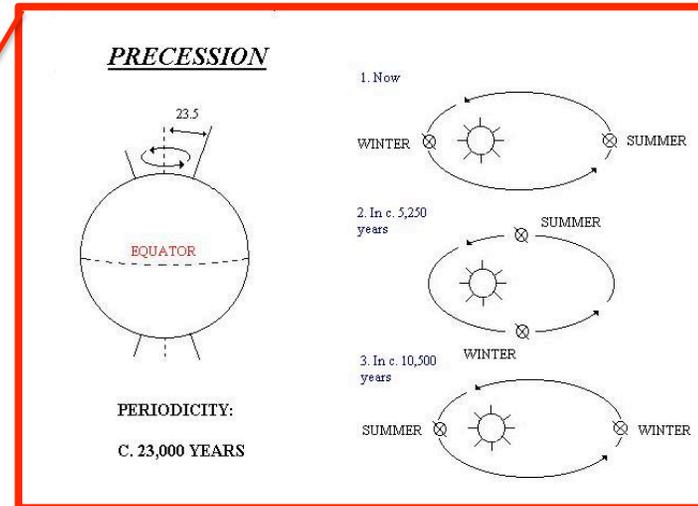
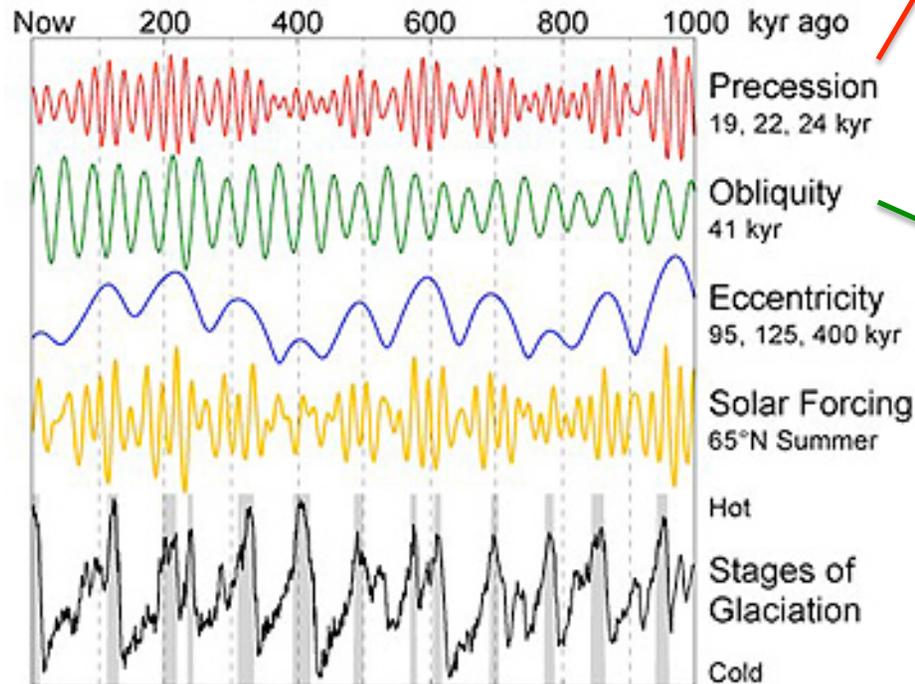
Ice Sheet Grounding Line

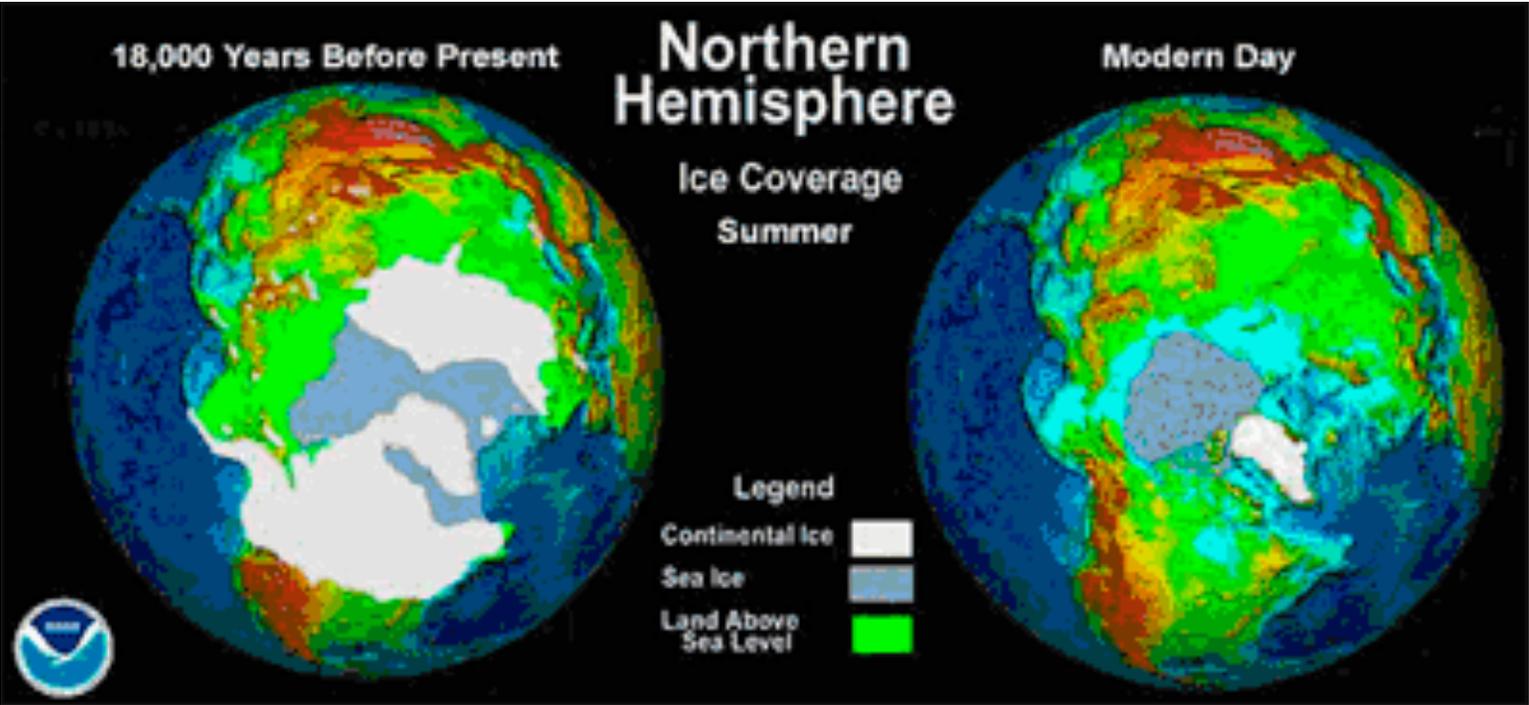


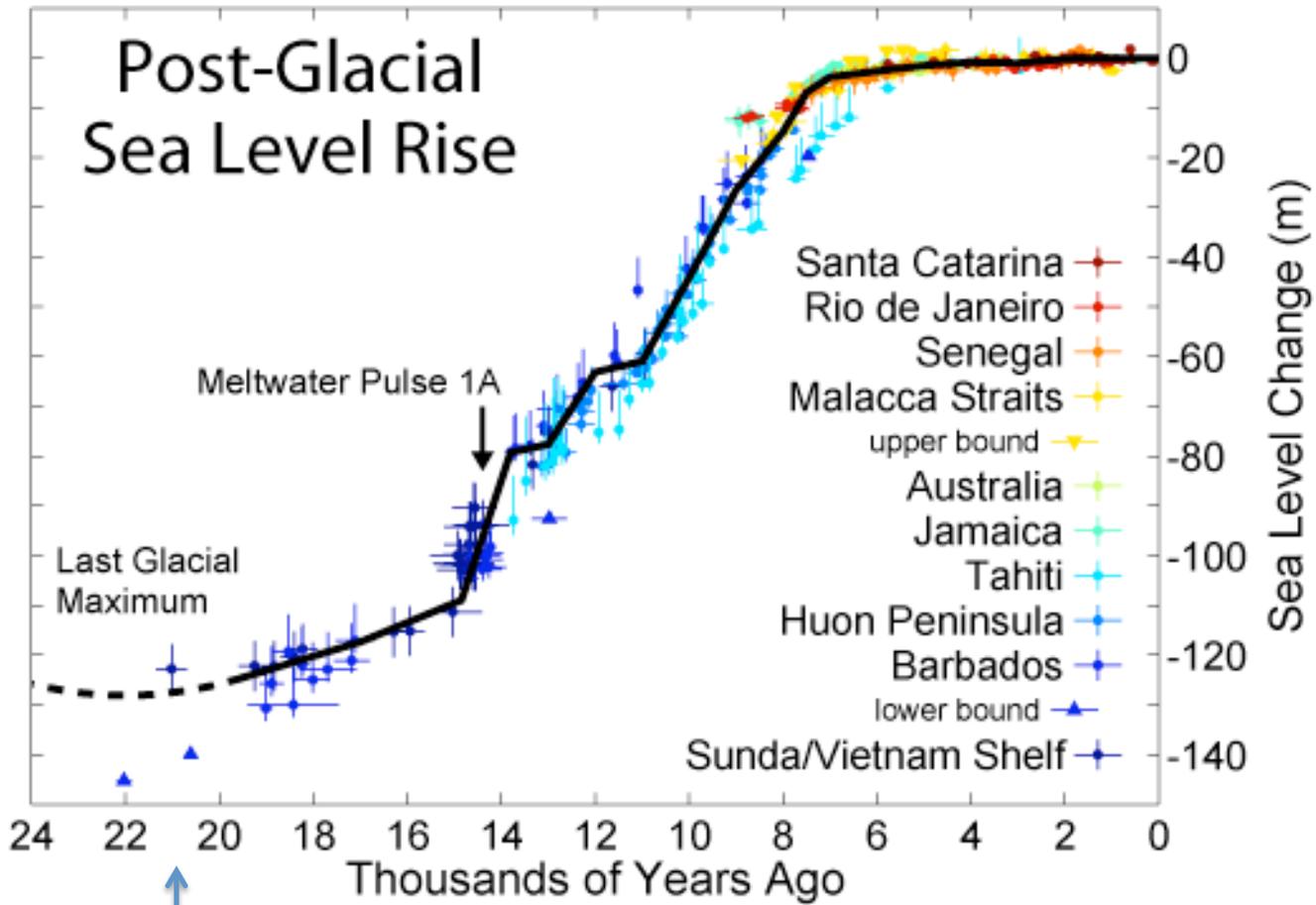


Last Glacial
Maximum

Milankovitch Cycles







Last Glacial Maximum

60 m in 2,000 years
 =
 3 cm/year

Introduction: Bathymetry through Time

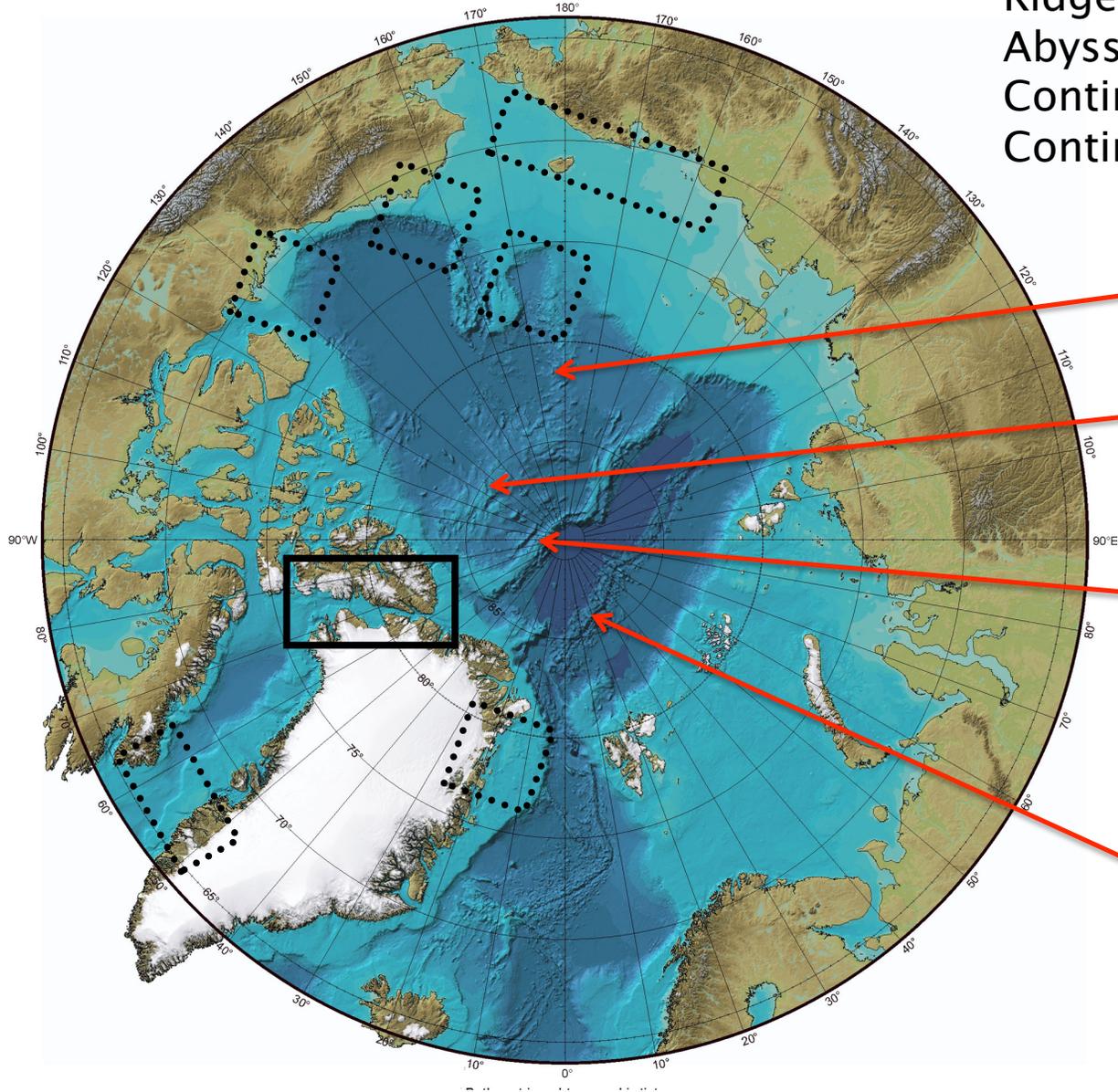
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Bathymetry and Oceanography: Example(s)

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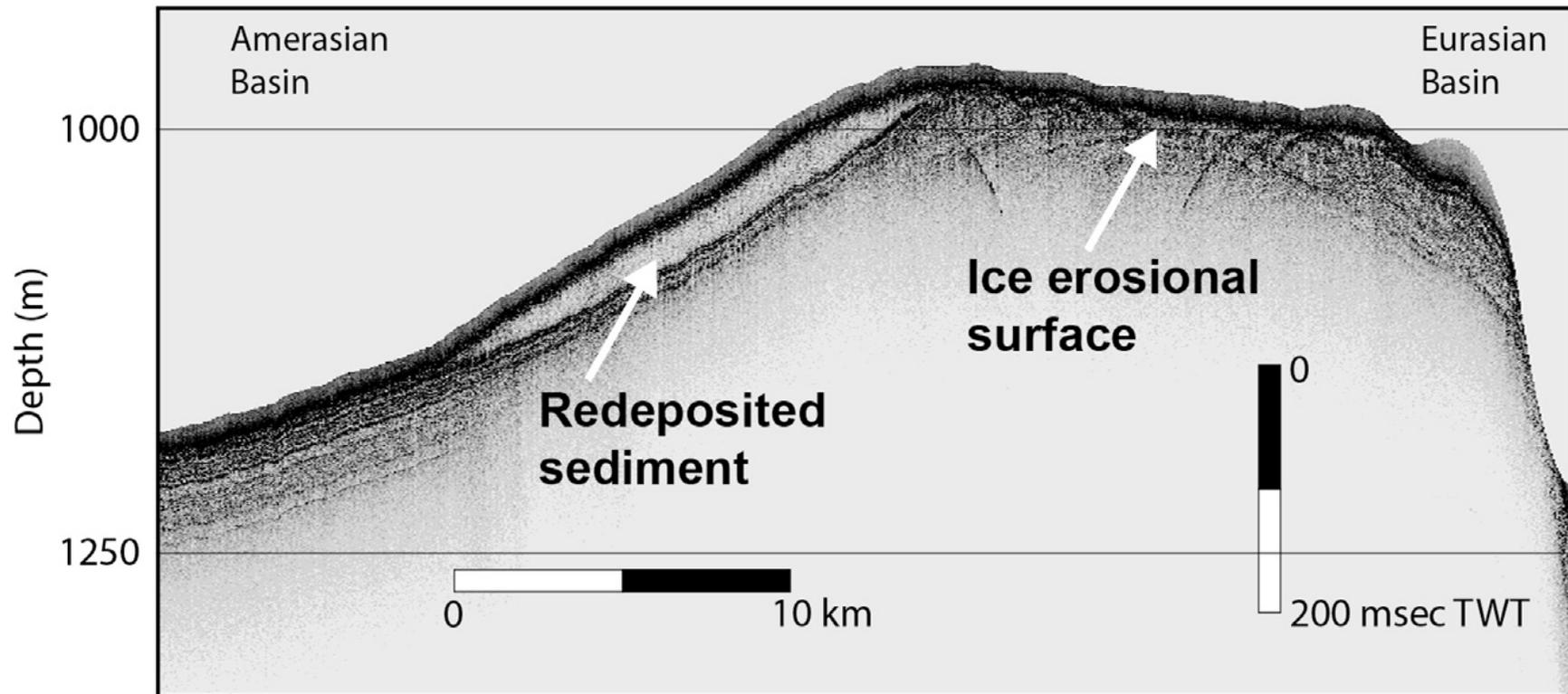
Mendeleev Ridge

Alpha Ridge

Lomonosov Ridge

Gakkel Ridge

Sub-bottom profiling of Lomonosov Ridge



Multi-beam Sonar Data of Bottom: Ice Sheet Scratches --> Flow Direction

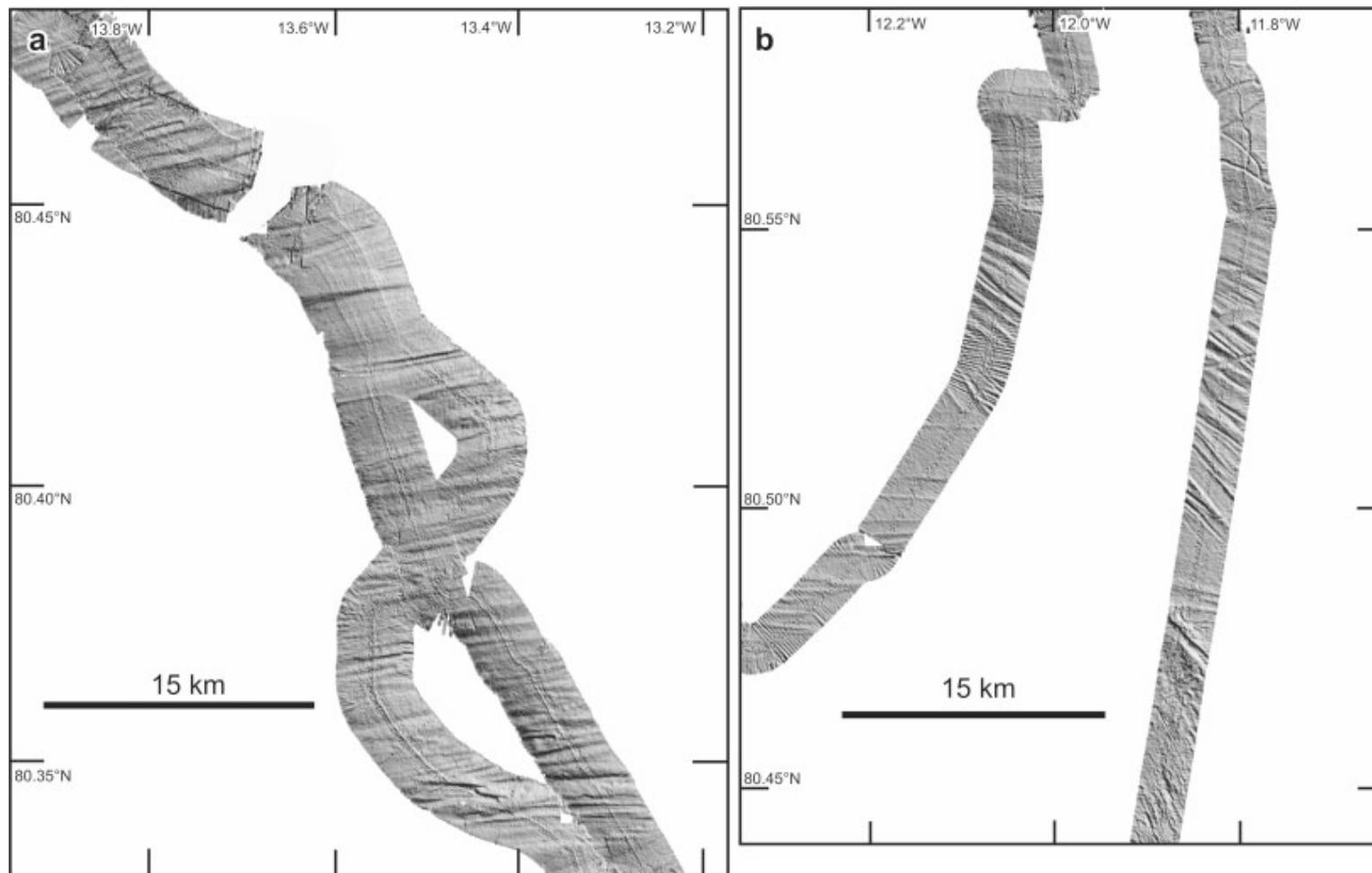
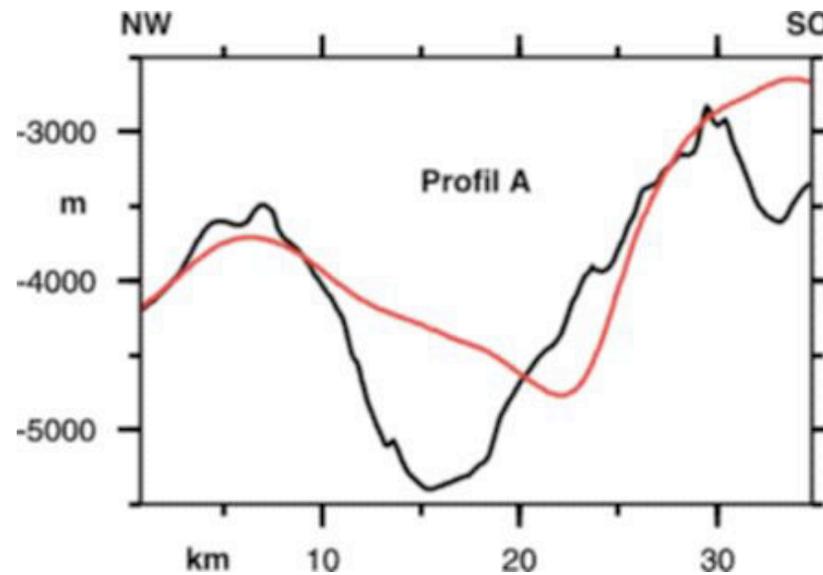
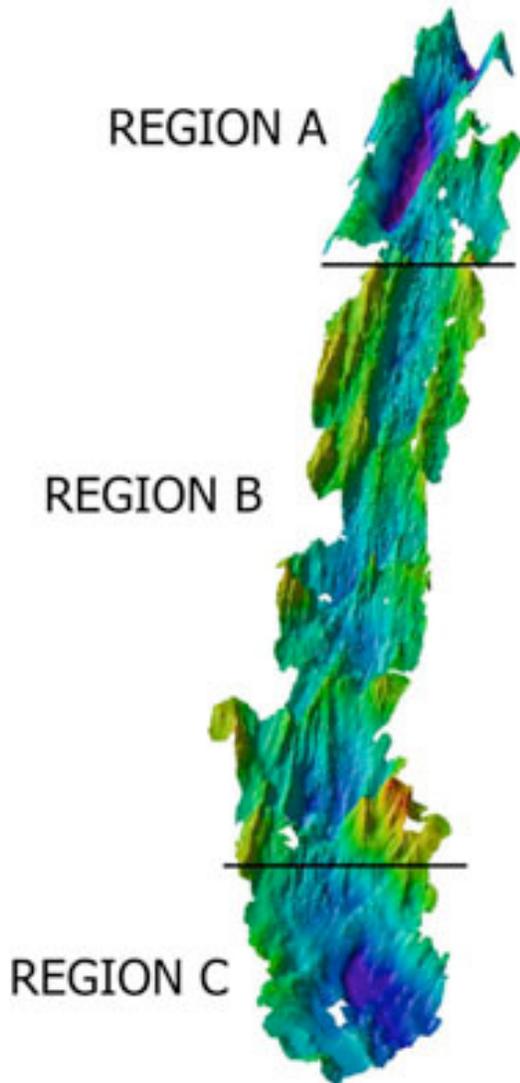
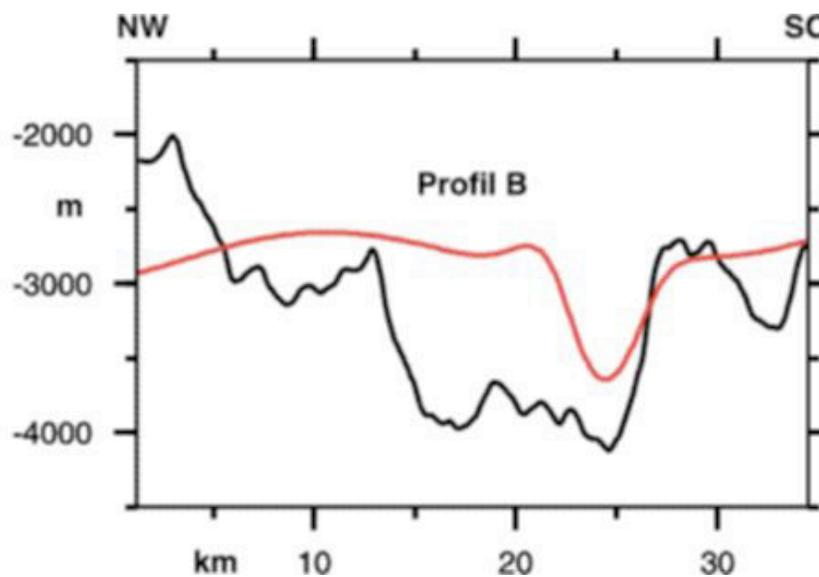


Figure 2 (a, b) EM120 shaded swath imagery from Westwind Trough showing well-developed lineations and mega-scale glacial lineations

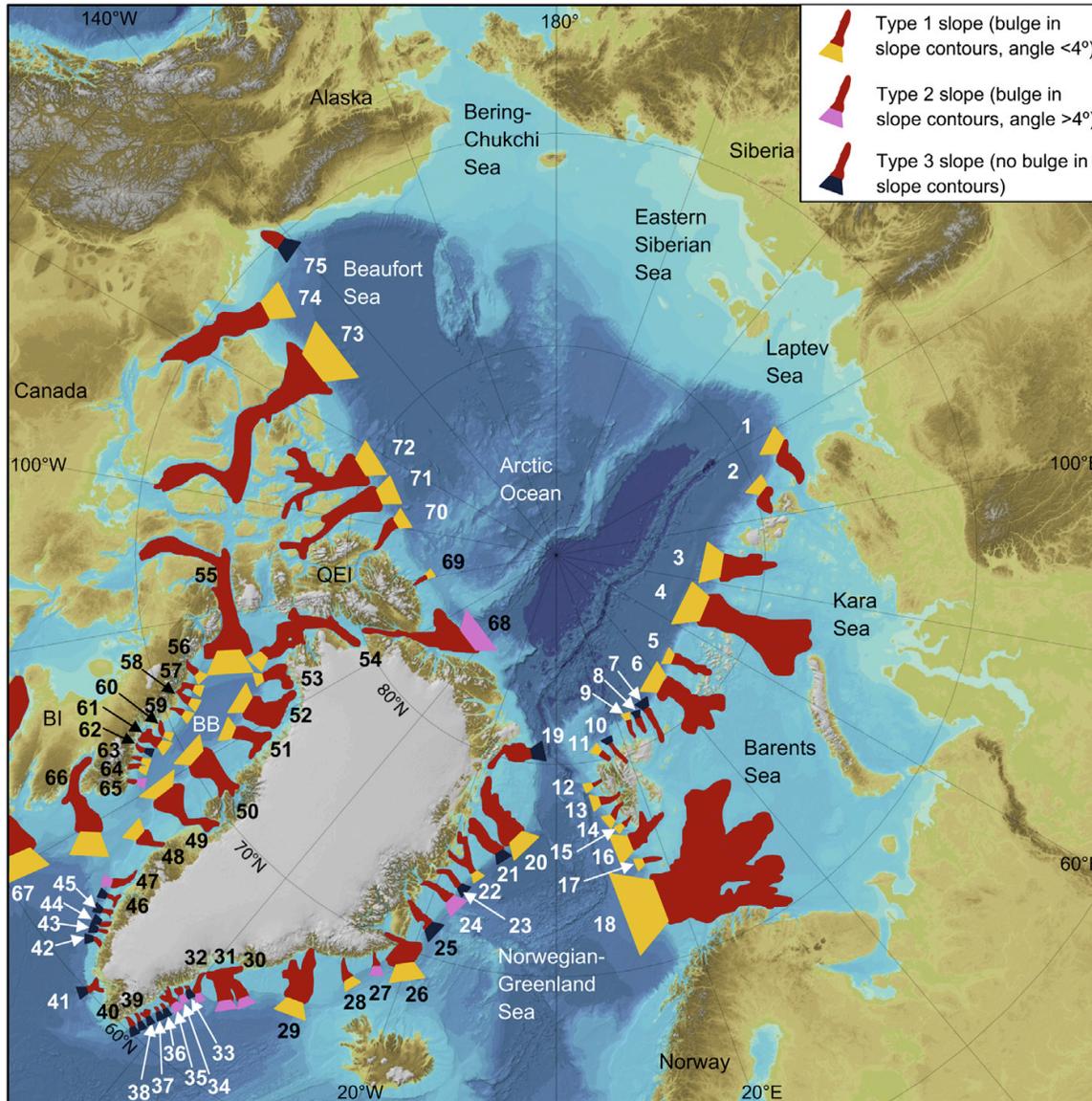
Gakkel Ridge:



Red: Old
Black: New



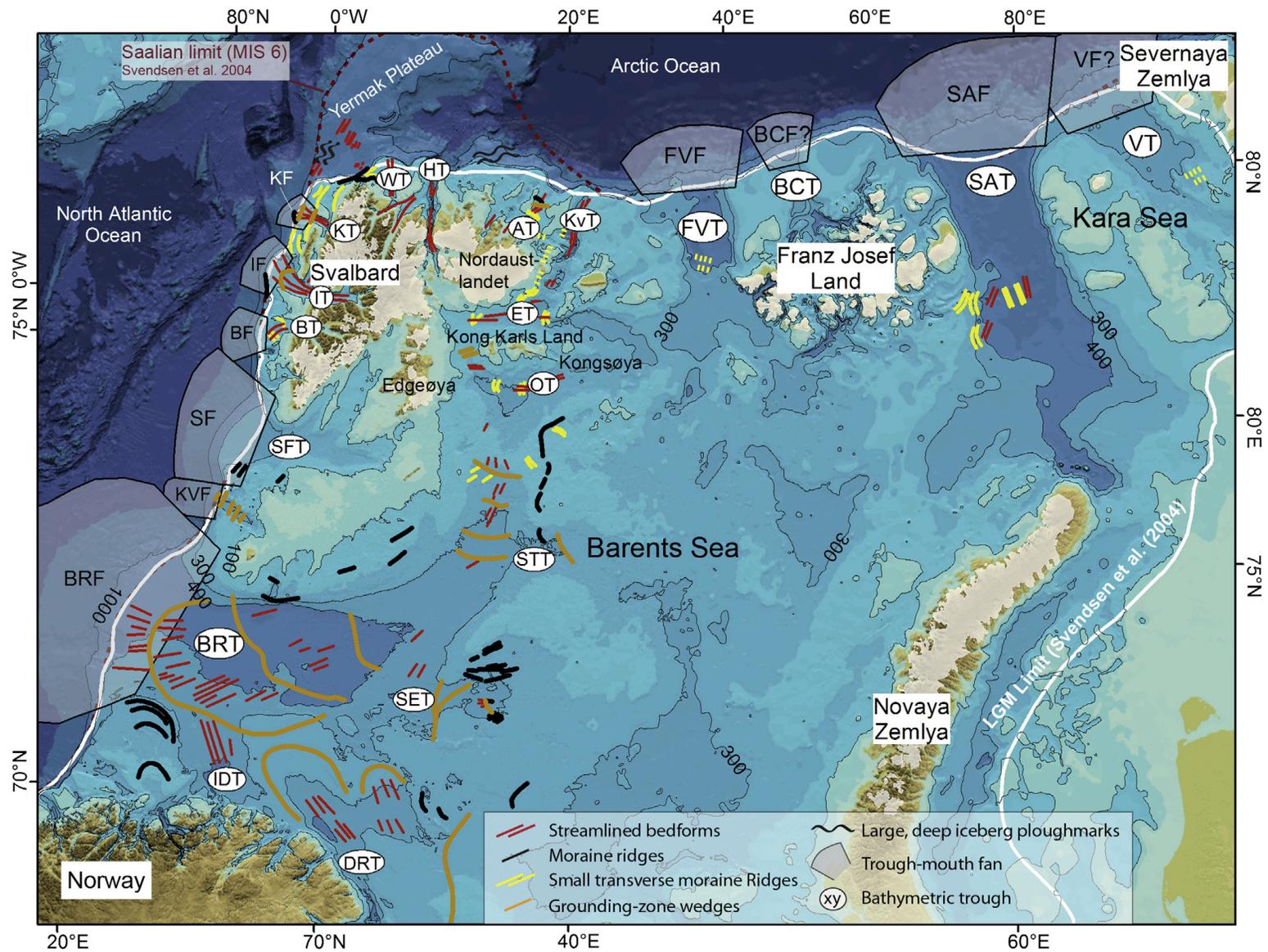
Alfred-Wegener
Institute

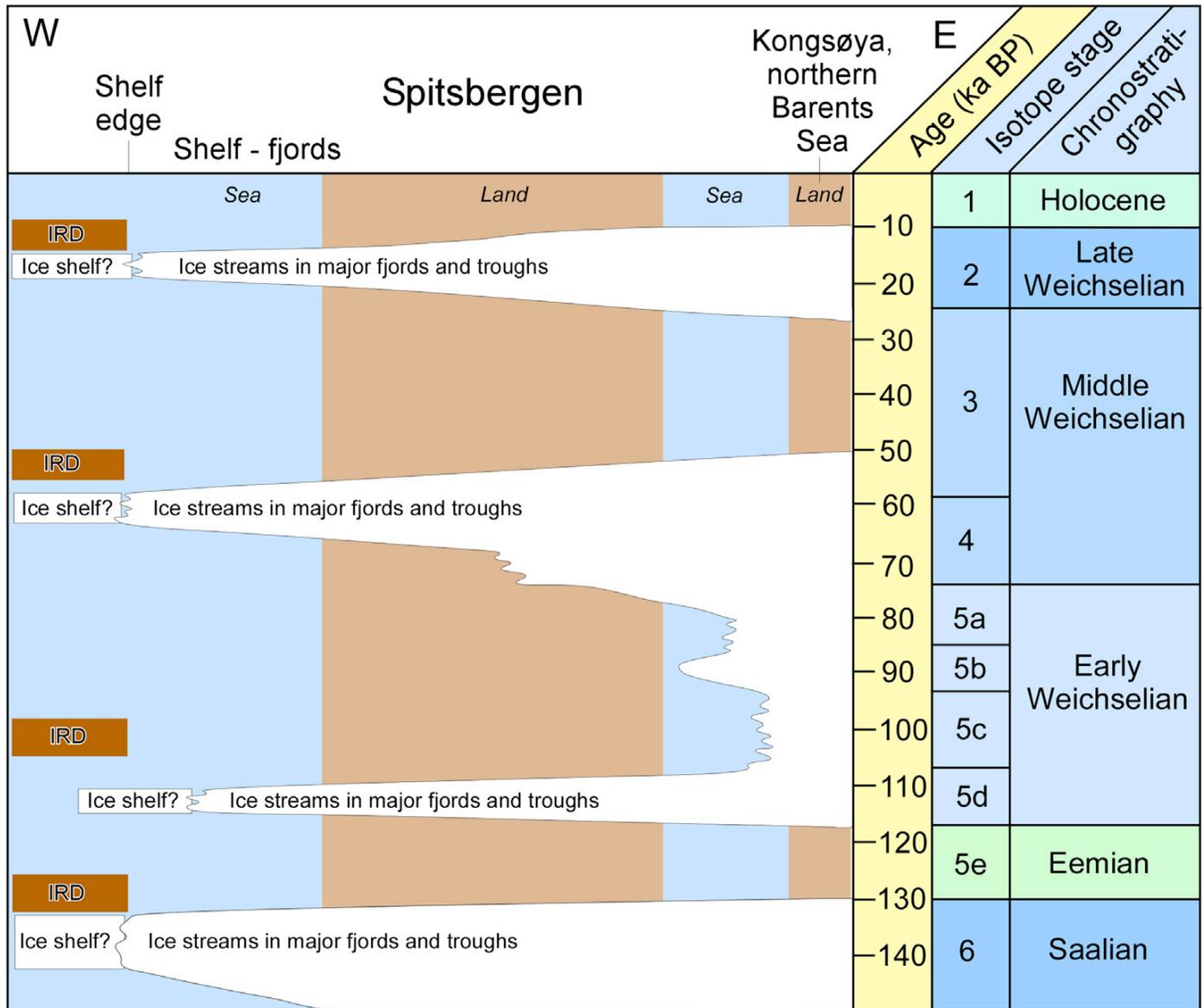


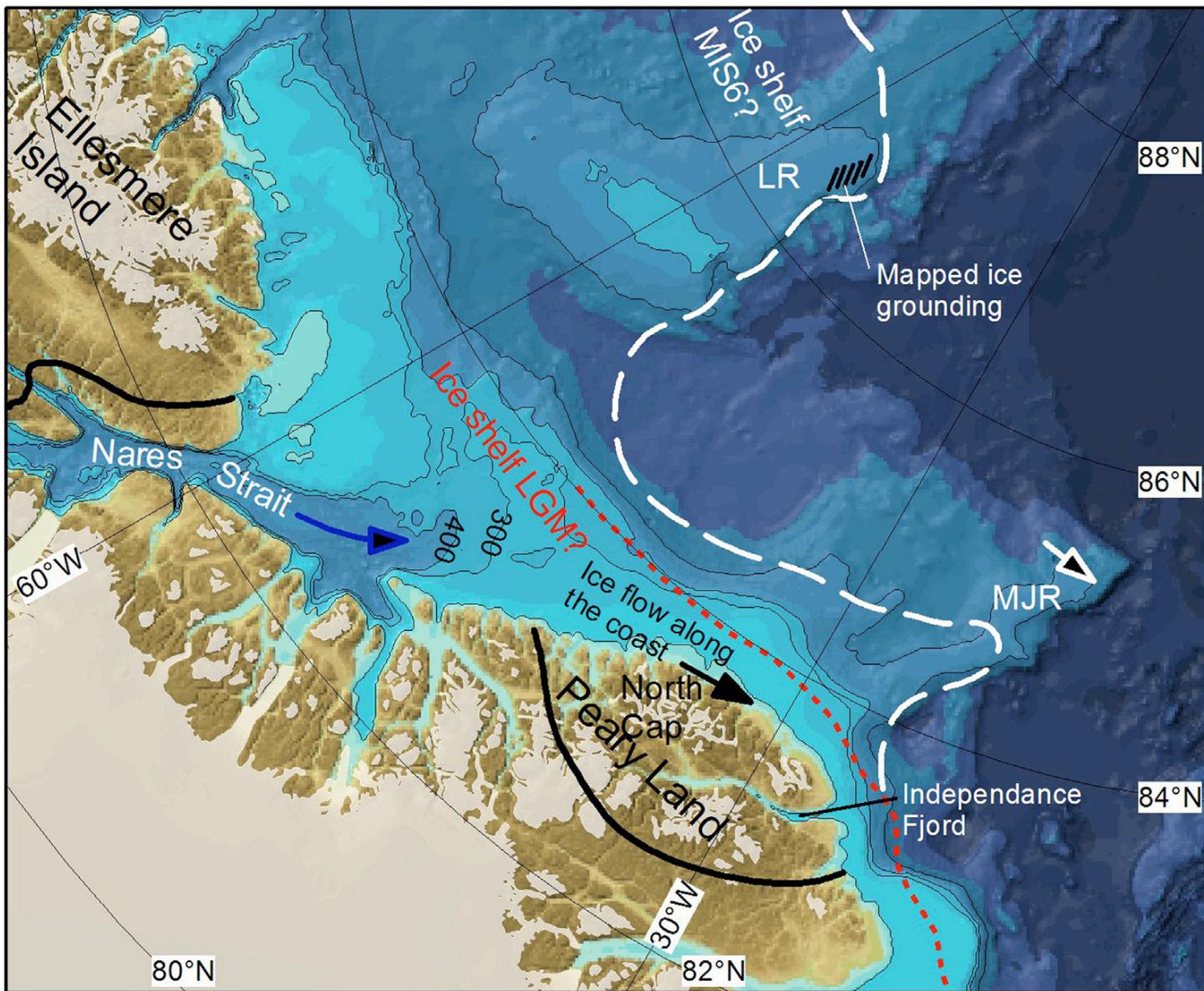
Ice Streams
During
Last Glacial Maximum

=

Present Day
Trough/Canyon
Systems

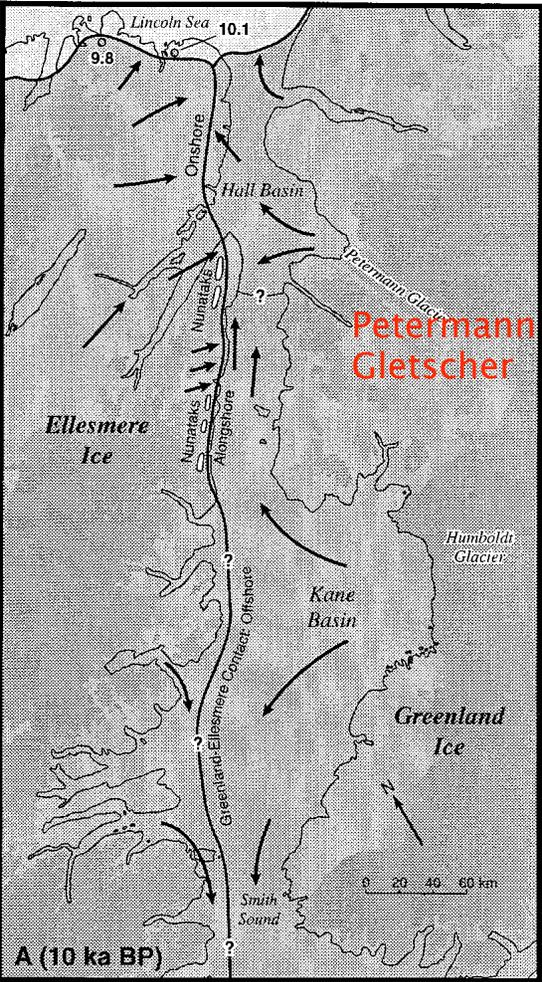




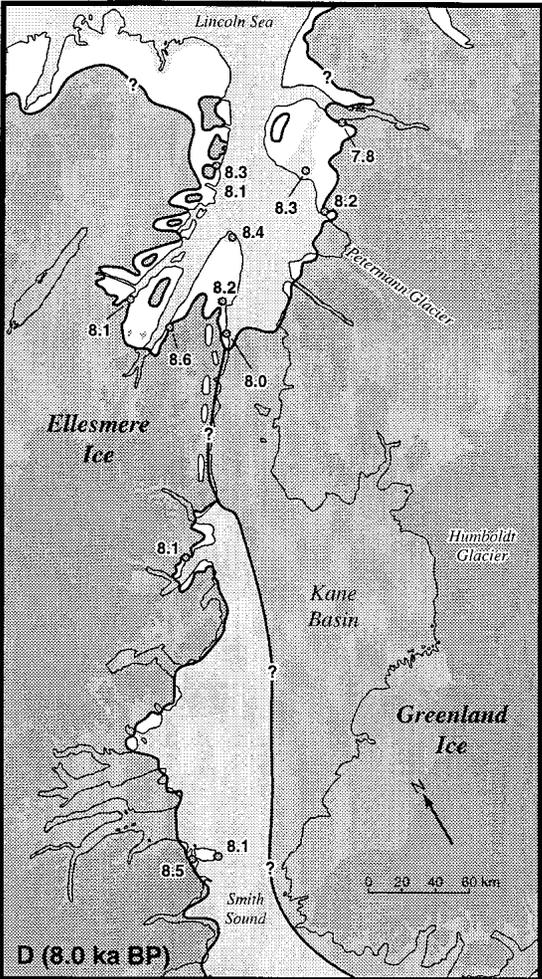


Opening of Nares Strait:

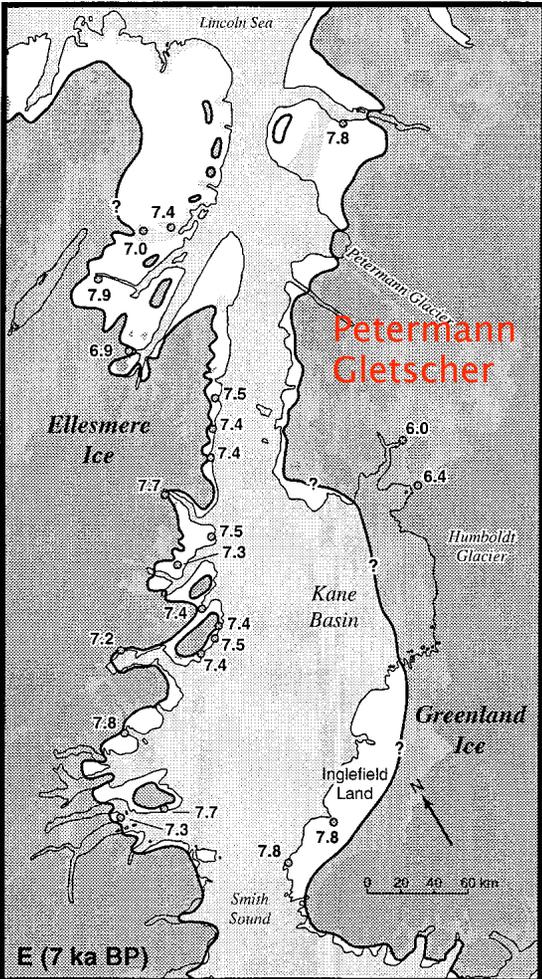
10,000 years

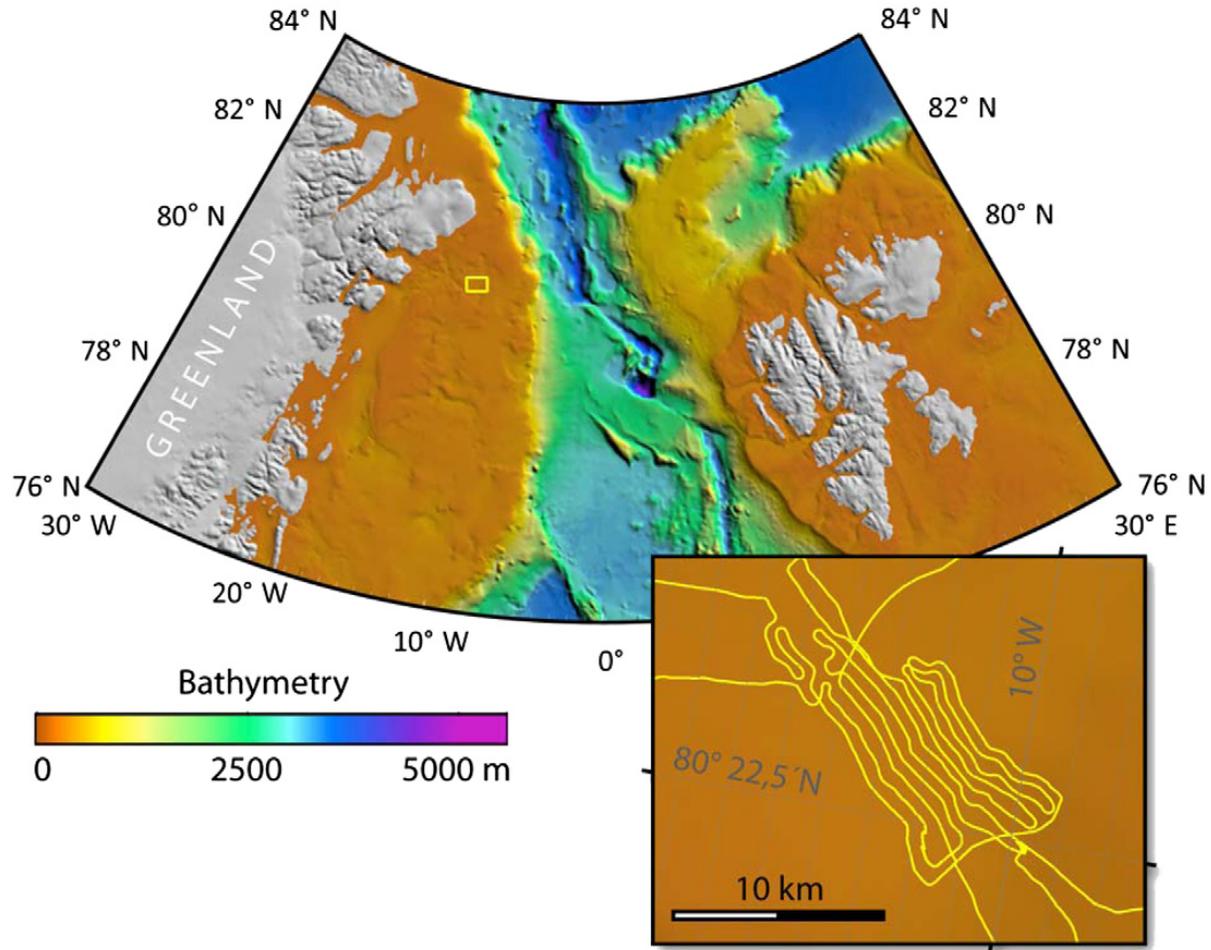


8,000 years



7,000 years





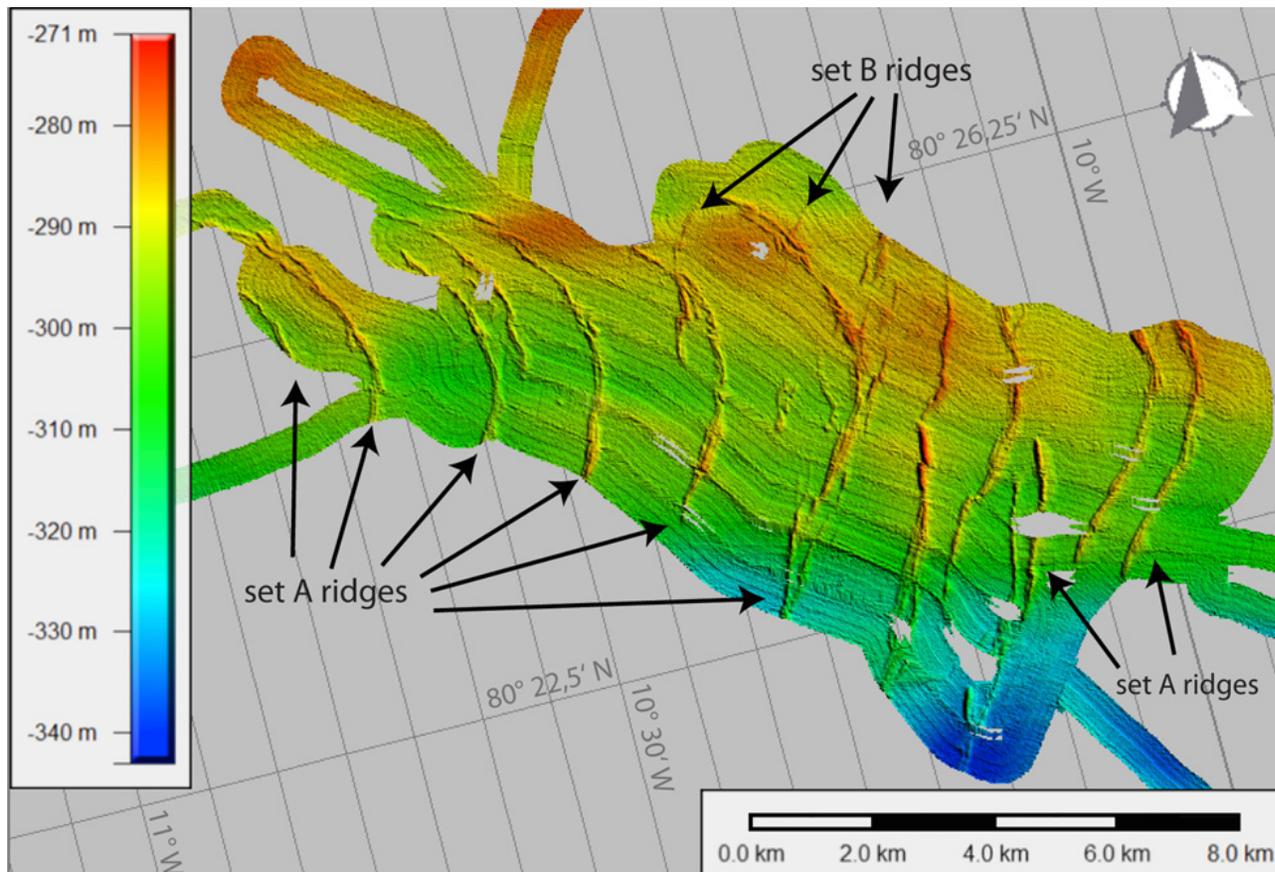


Fig. 2. High-resolution bathymetry map with shaded relief depicting two sets (A and B) of submarine ridges on the shelf.

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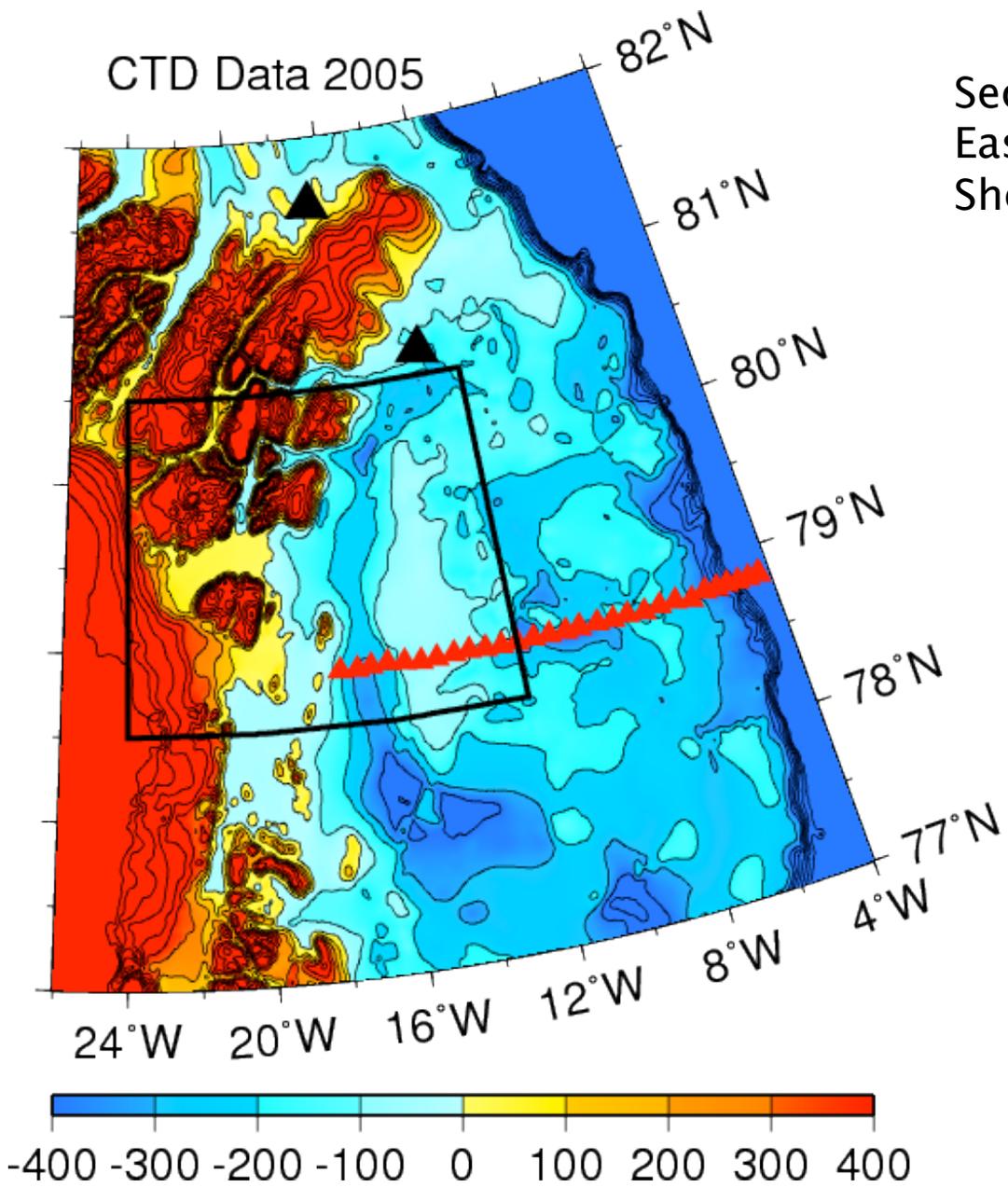
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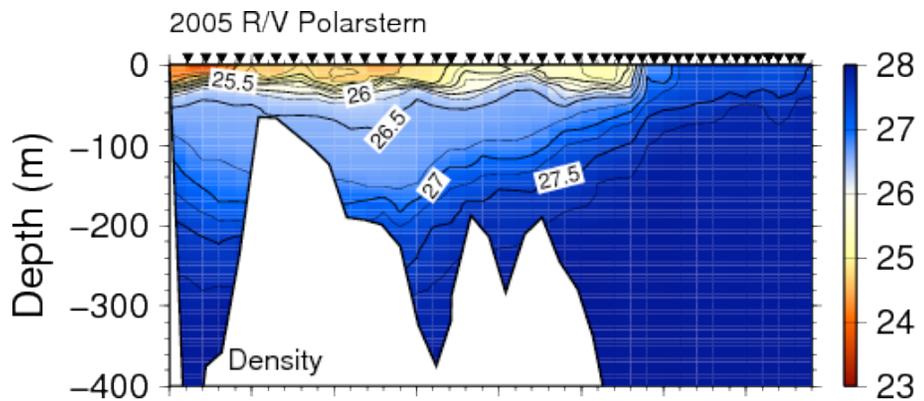
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Bathymetry and Oceanography: Example(s)

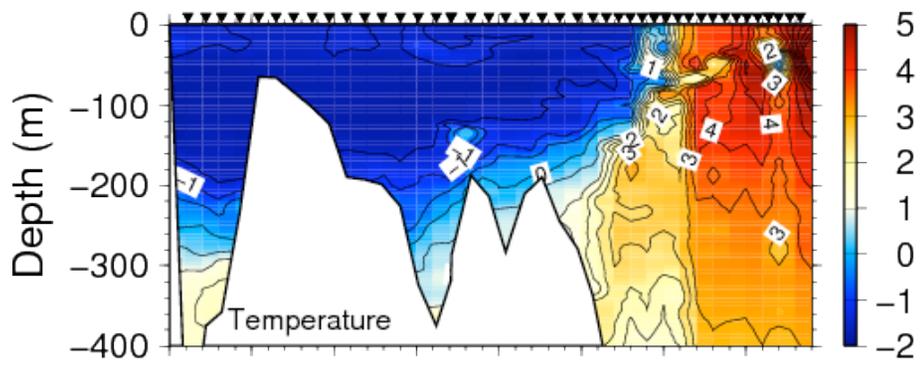
CTD Data 2005

Section across
East-Greenland
Shelf, Trough, and Slope

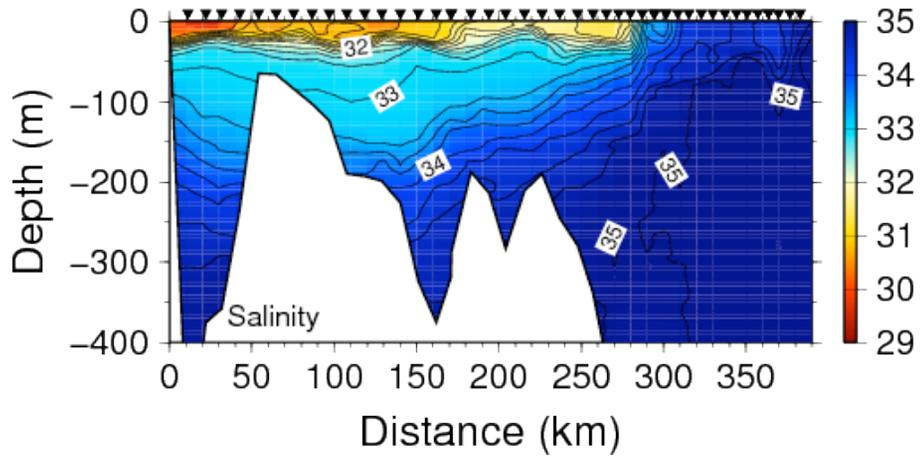




Section across
East-Greenland
Shelf, Trough, and Slope

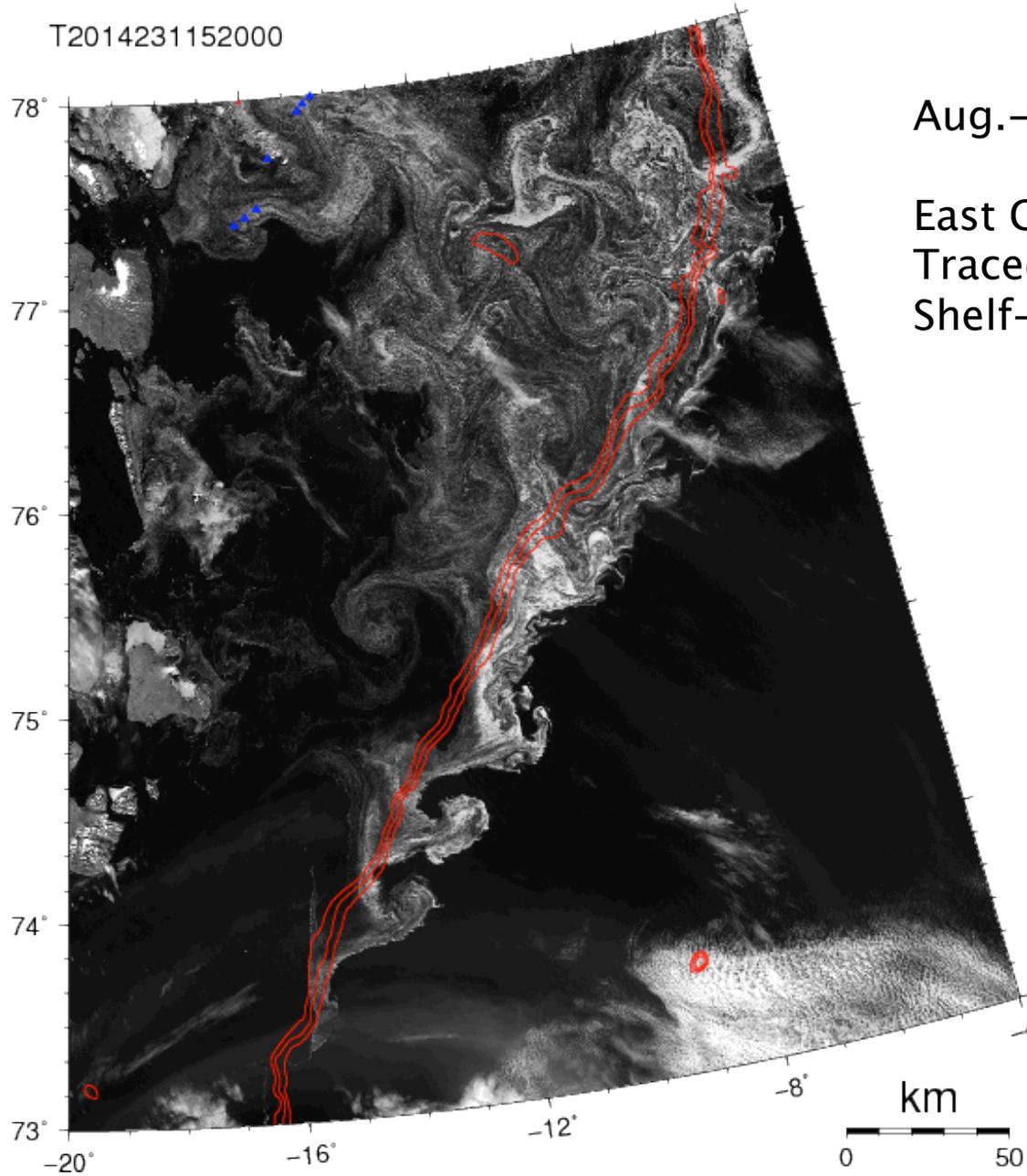


Temperature ($^{\circ}\text{C}$)



Salinity (psu)

T2014231152000



Aug.-19, 2014:

East Greenland Current
Traced by ice along the
Shelf-Break