

7. Ice & Water

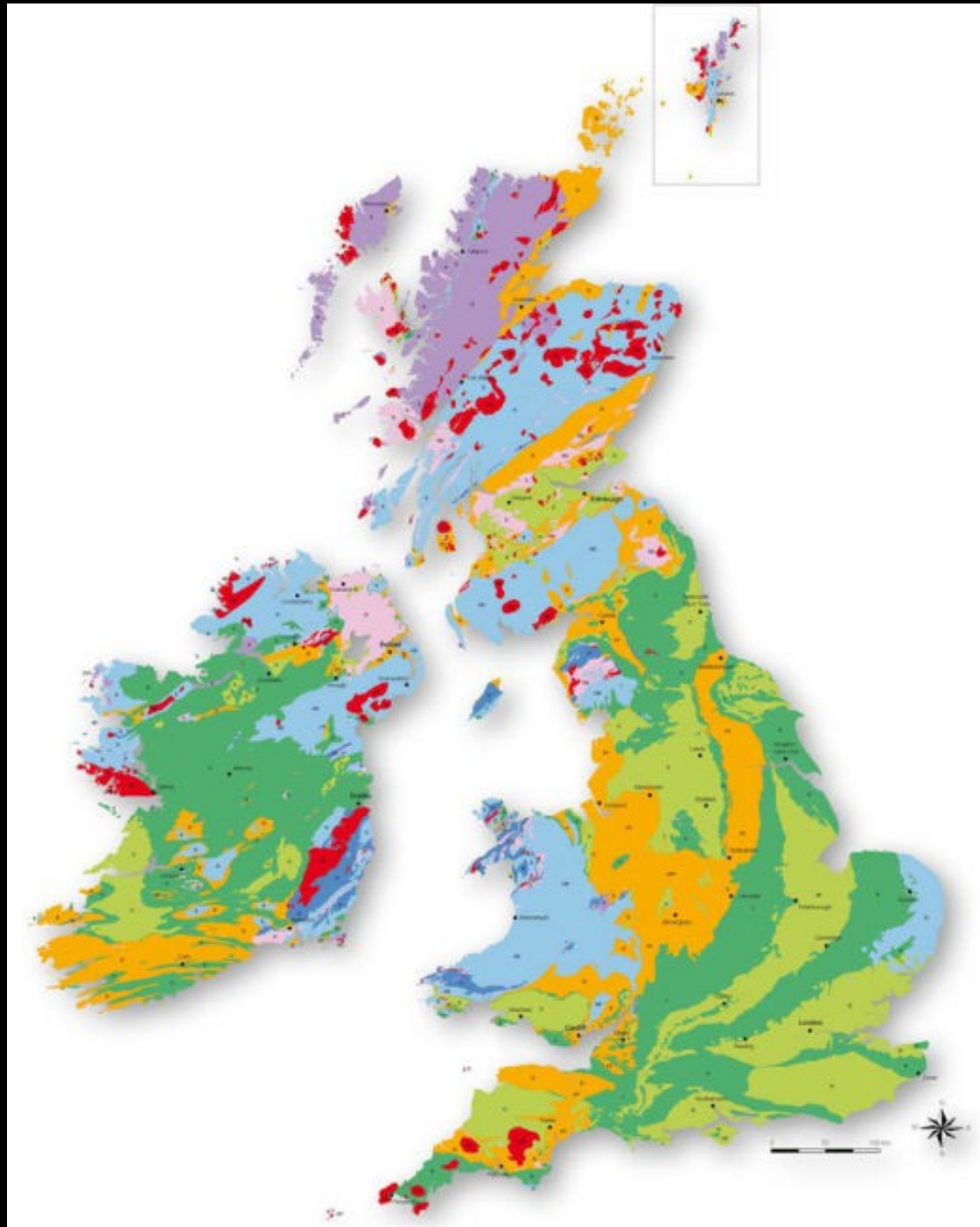


How climate shapes the landscape

Climate through time

The present is the
key to the past

But how do we
assess ancient
climates?



Data Sources

Ice Bay - Obliquity Cycles

Changes in Earth's obliquity (axial tilt)
 Zone of the Kimmeridge Clay,
 peatting at 38 thousand years,
 by Ian West and Tonya West (c) 2003.



Fossil Evidence

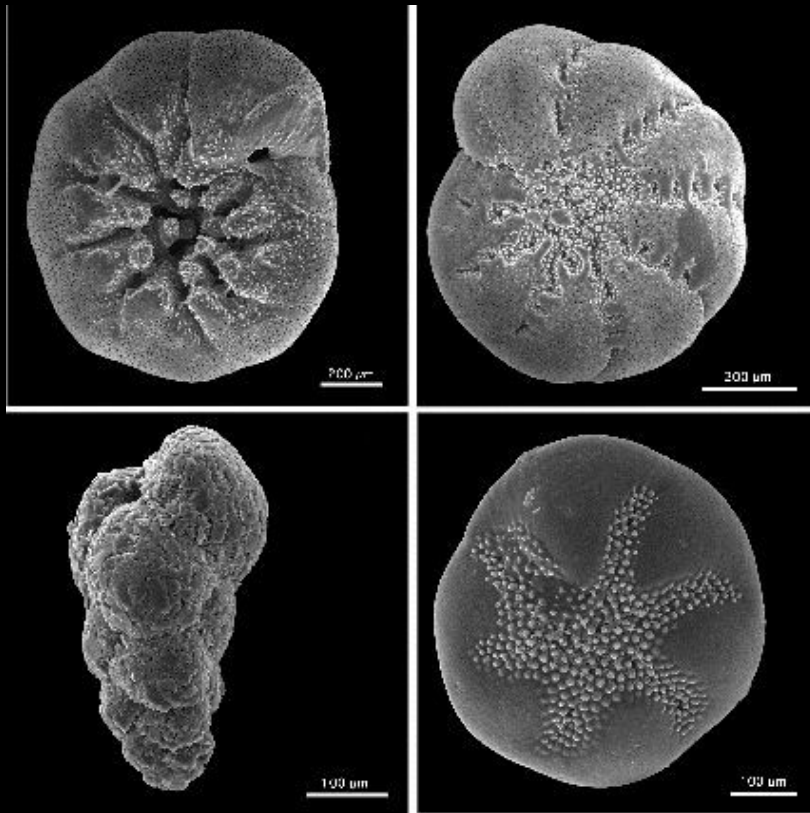
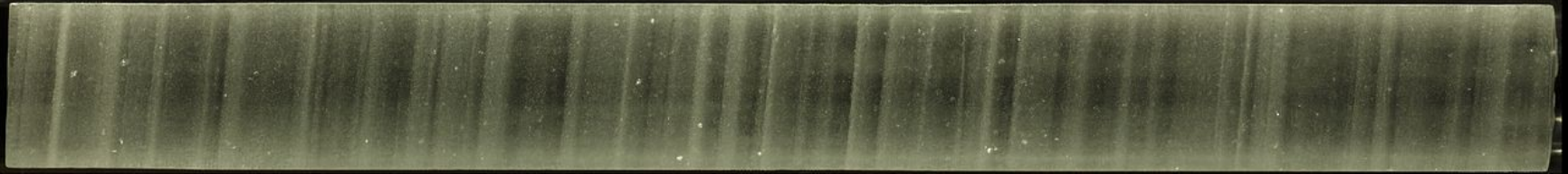
Buckland's bones



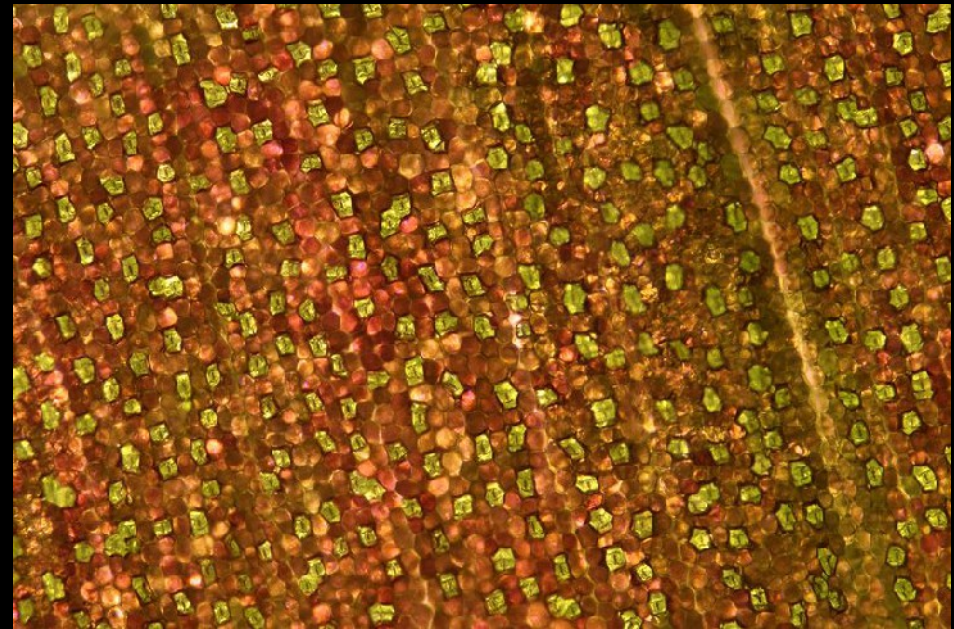
Kirkdale Cave
(c. 125 ka)

Data Analysis

Ice core air bubbles

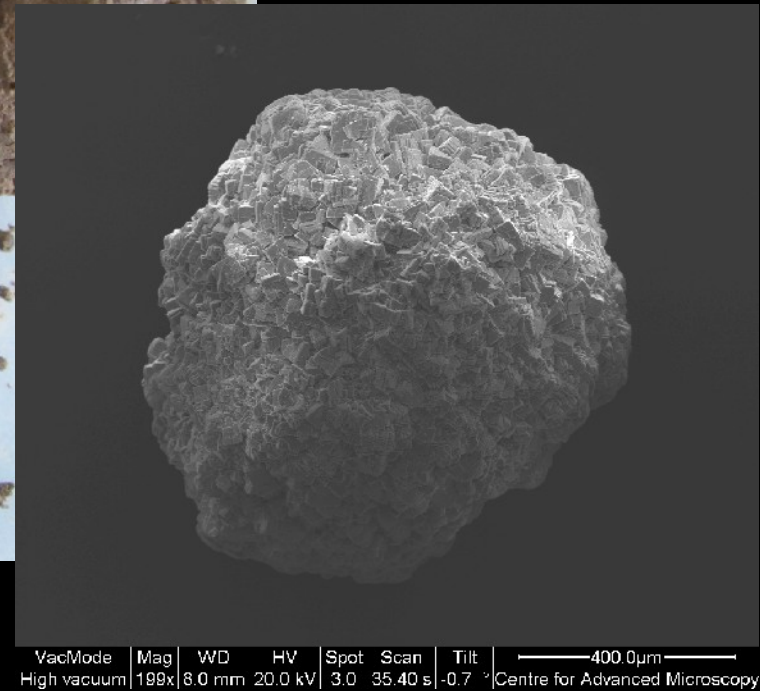


Shell isotopes



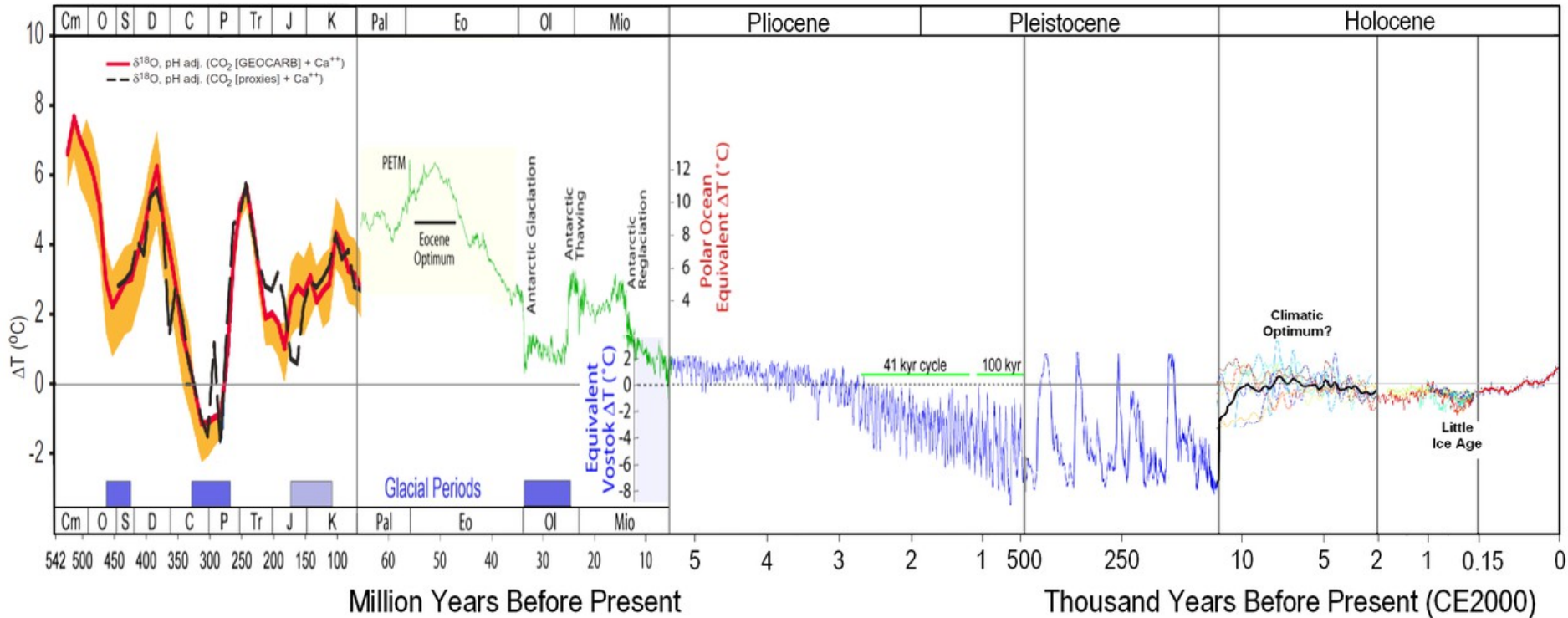
Leaf stomata

Worm poo thermometers!



Climate through time

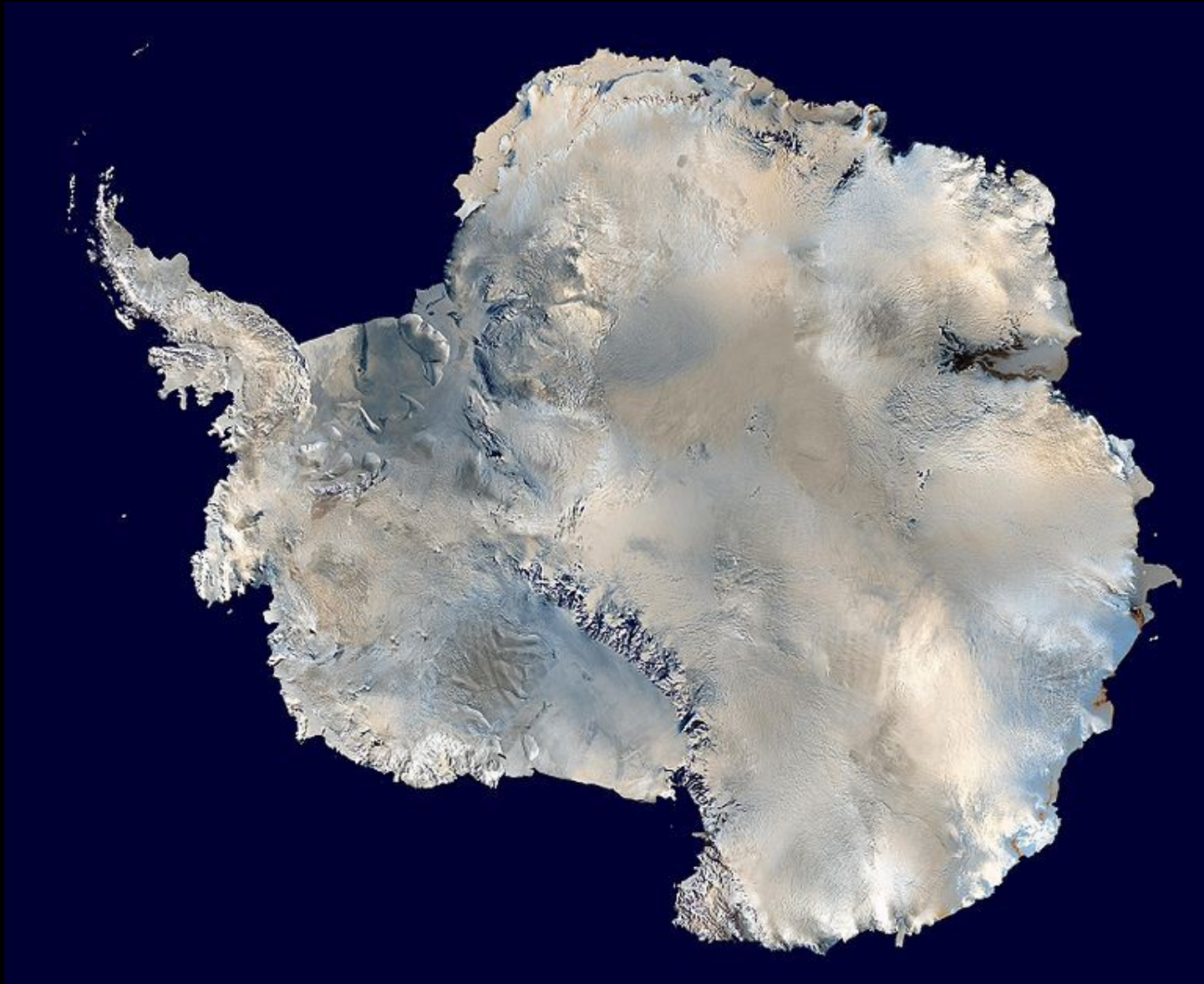
Temperature of Planet Earth



Reconstruction more difficult with greater age

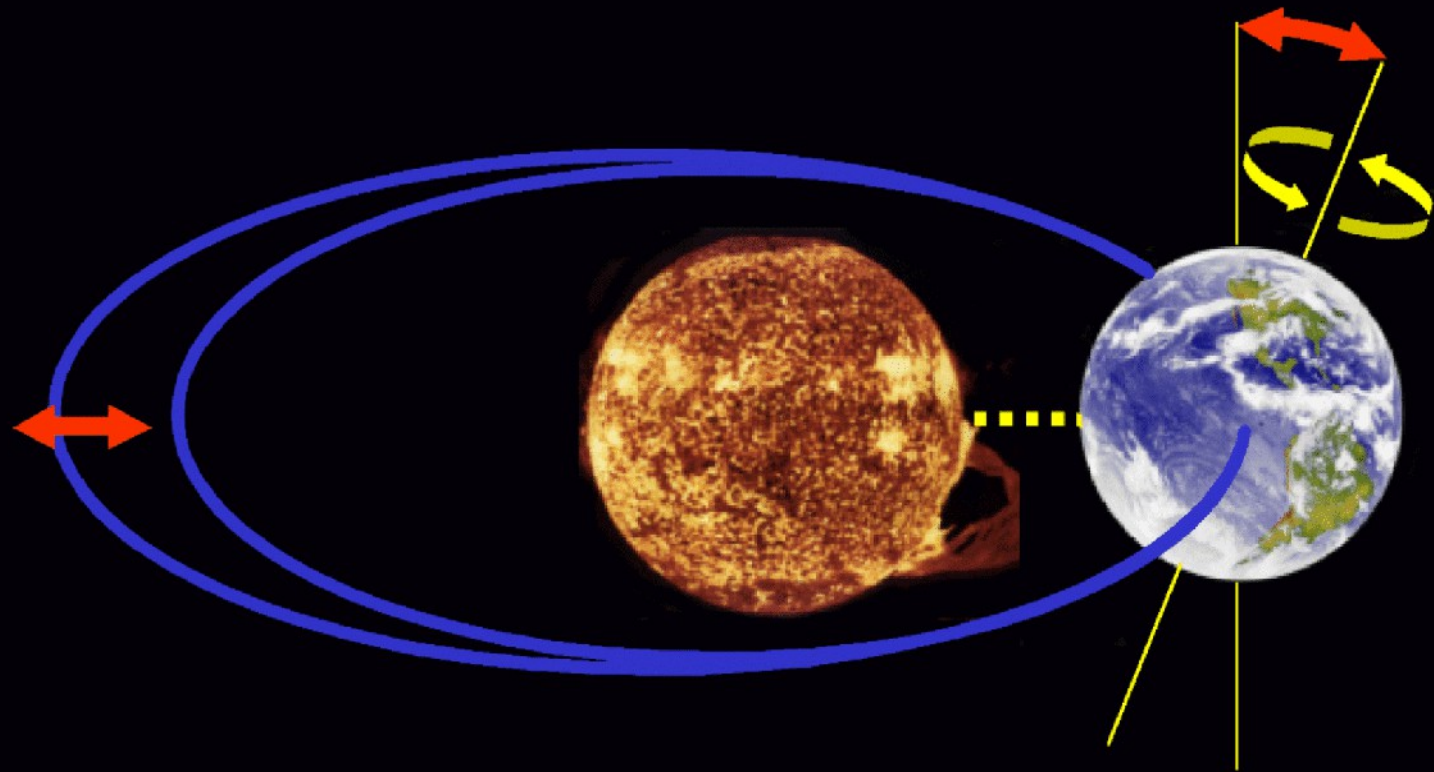
Drivers of climate change

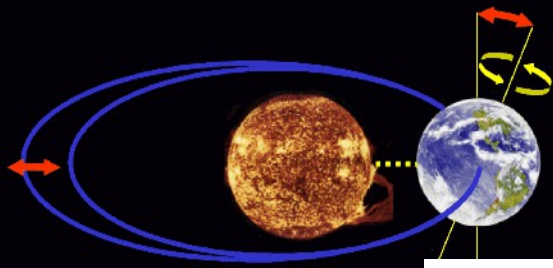
Continental configuration



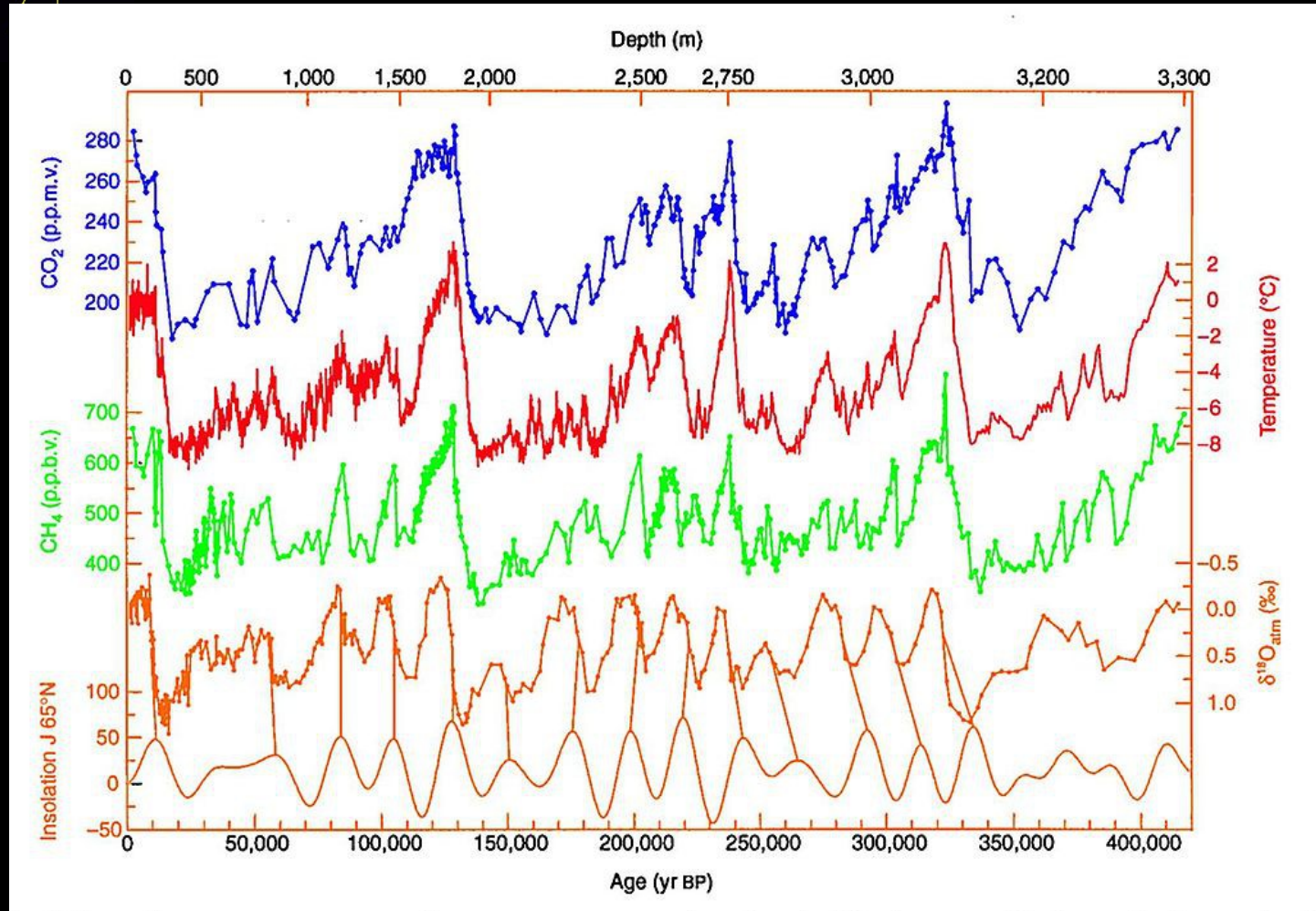
Orbital variations

Croll & Milankovitch





= Climatic cycles

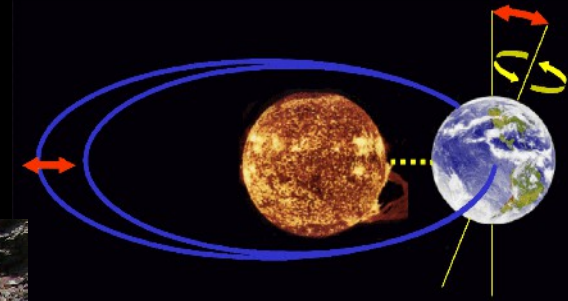


>400,000 years of data, Antarctica

Palaeoclimate cycles

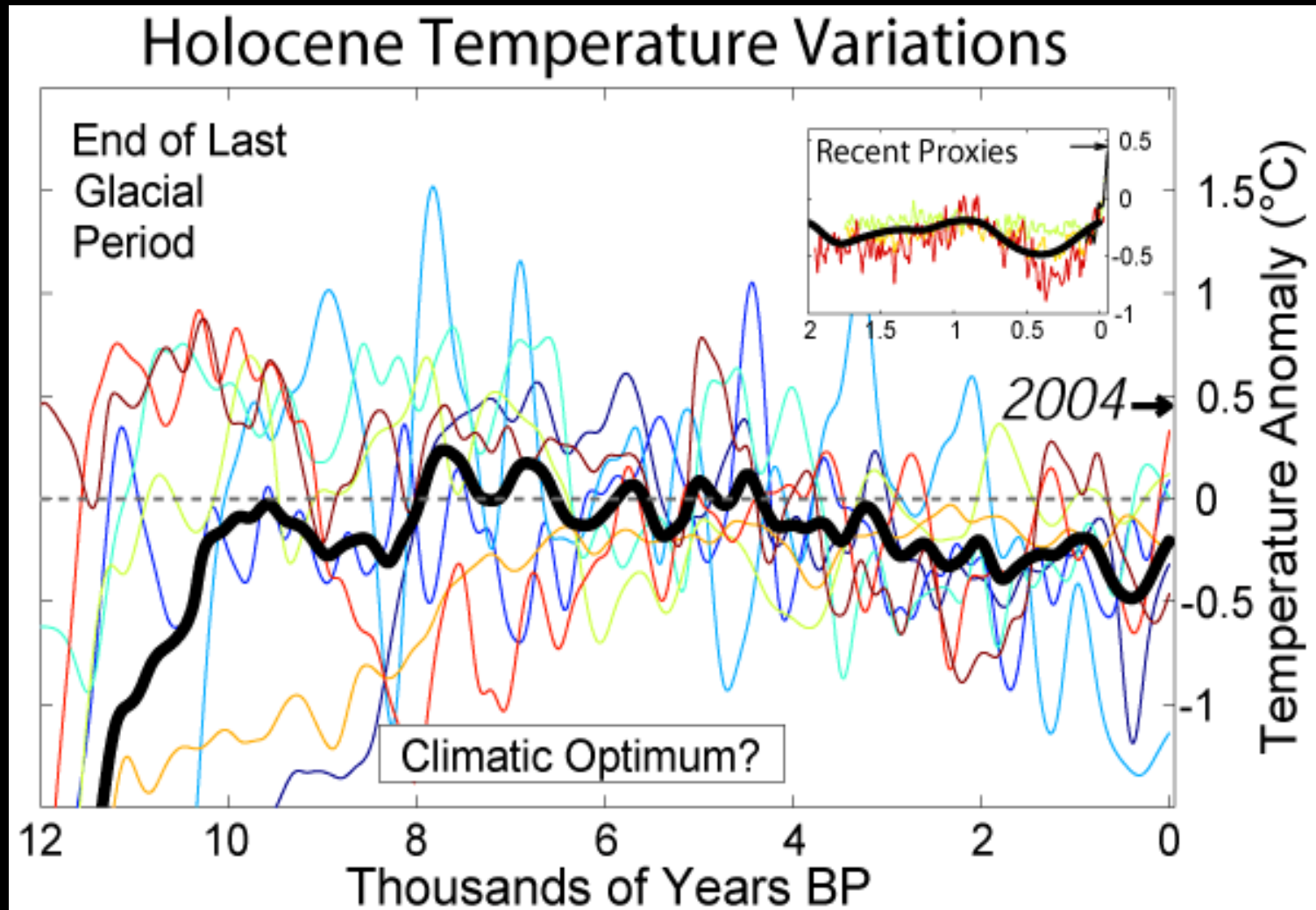
The Jupiter Effect at Kimmeridge Bay - Obliquity Cycles

Effect of gravitational pull of Jupiter etc on Earth's obliquity (axial tilt)
145 million years ago. Antisciodorensis Zone of the Kimmeridge Clay.
Ian West examines bituminous shales repeating at 38 thousand years,
separated by non-bituminous sandstone. Ian West and Tonya West (c) 2005.



Cyclic sedimentation in the Jurassic

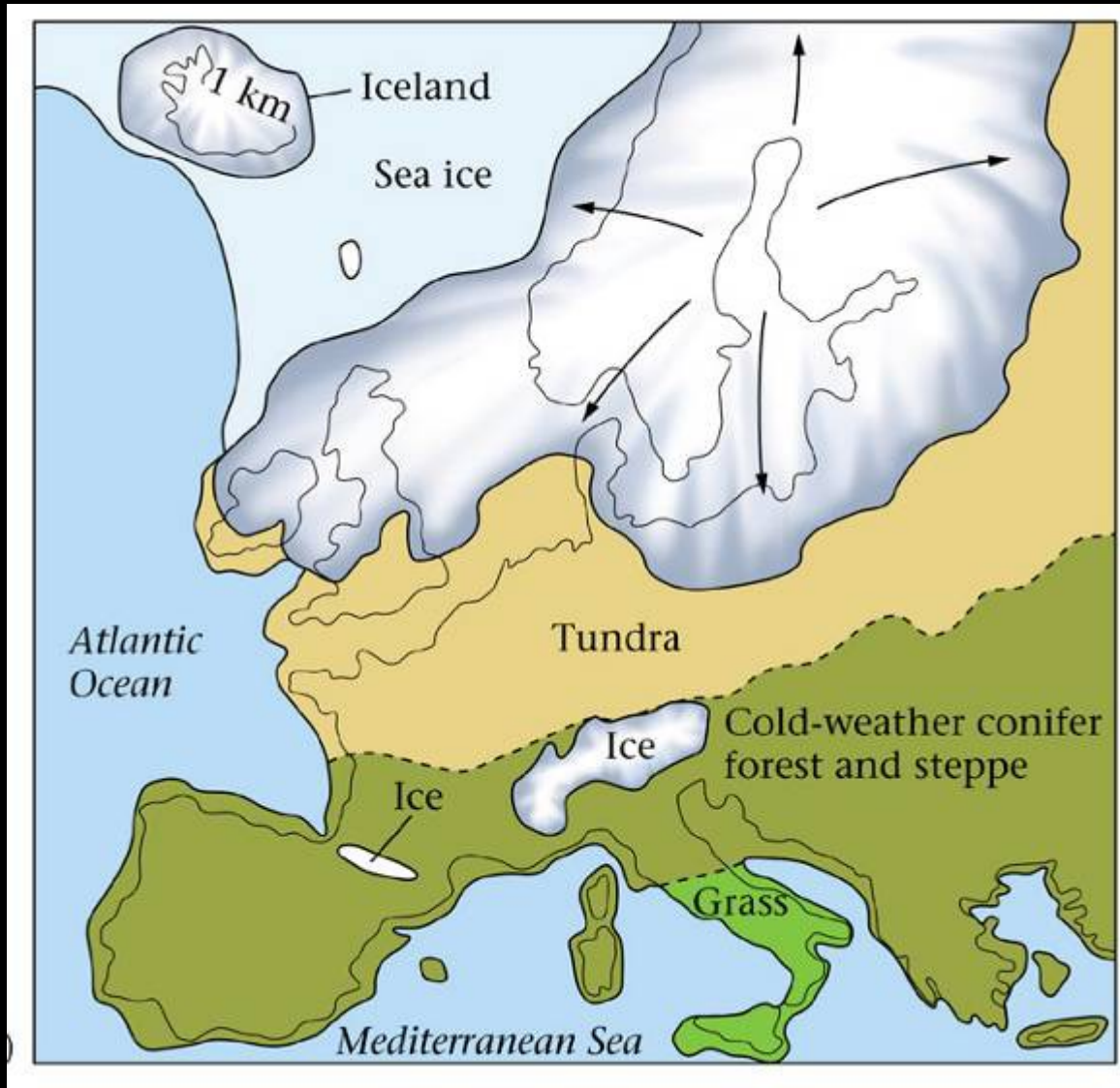
Holocene Britain



~11,500 years of warmth

Ice Age Britain!

c. 18,000
years BP



Glacial processes & products

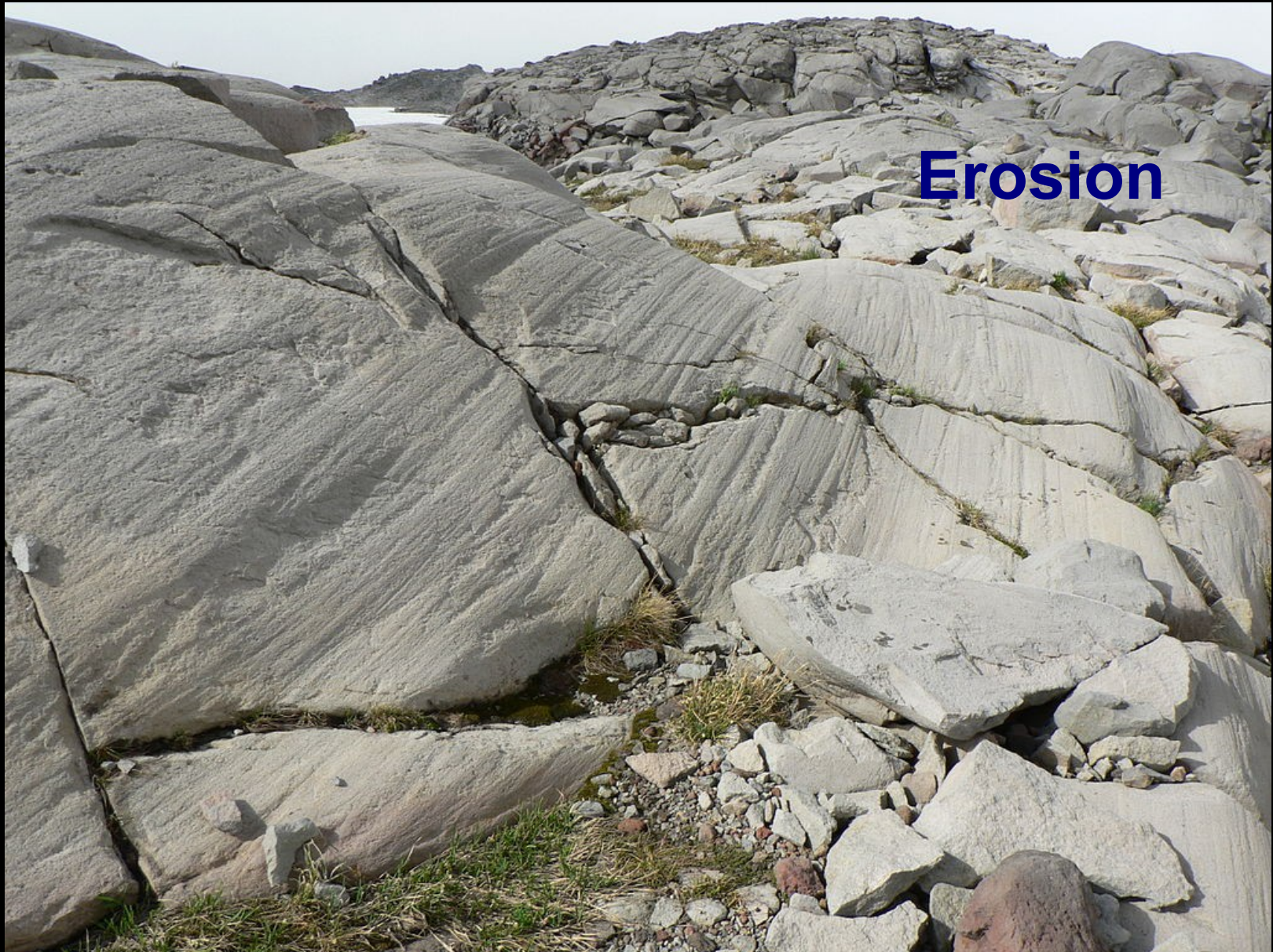


Glacial processes

Sediment transport



Glacial processes



Glacial processes

Sediment Deformation



Glacial products

Tills



Glacial products

Outwash sediments



Glacial products

Erratics



Enable glacial
flow
reconstruction

© Alan Stainforth
coast-alive.eu

Ancient glaciations

Dropstones



Glacial landforms



Moraines (Fr., *morre*, 'snout')

Glacial landforms

Drumlins ('little ridges')



Glacial landforms

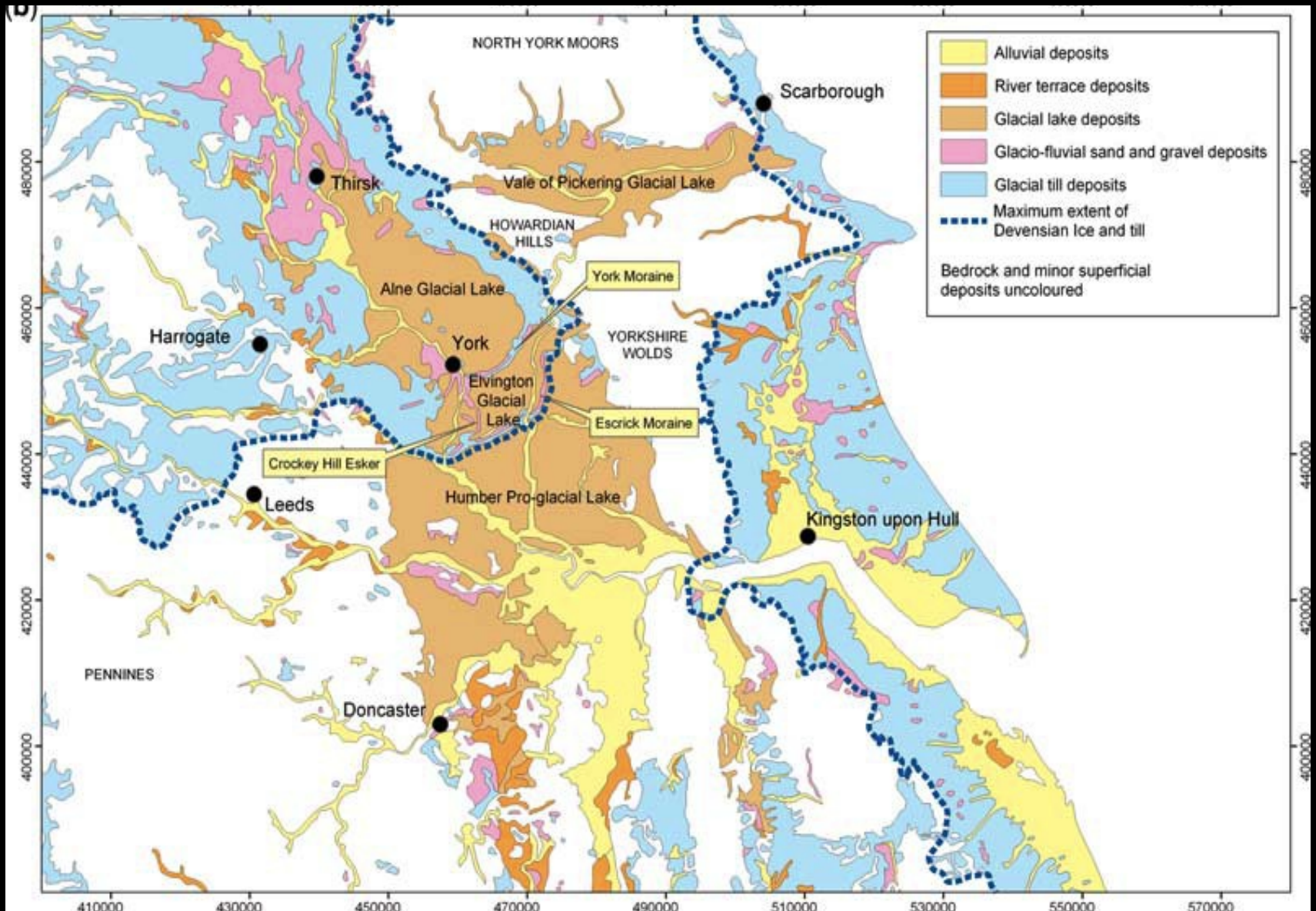


Blakeney Esker, Norfolk (Gaelic, *eiscir*)

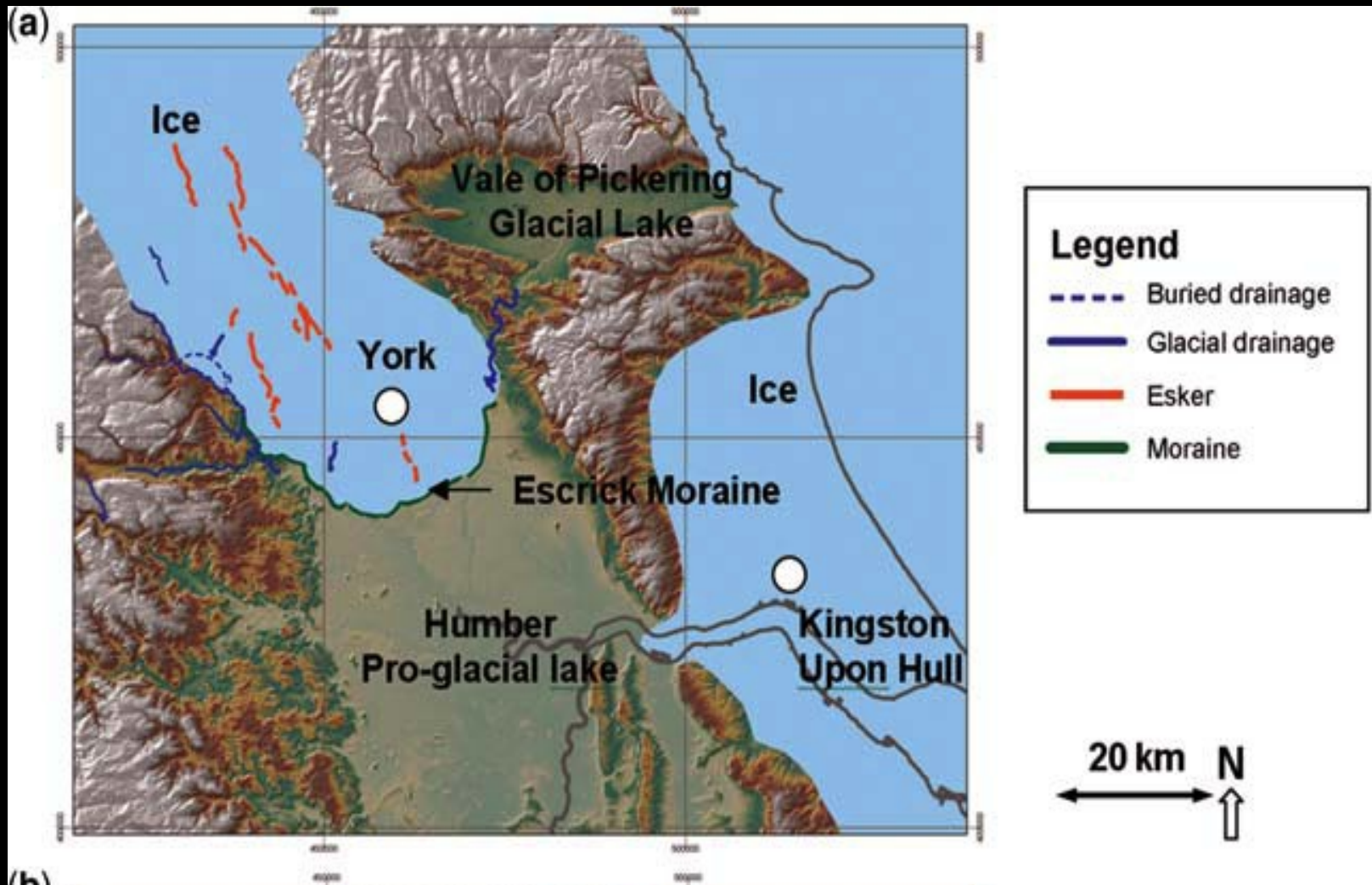
Nunataks!



Ice Age Yorkshire

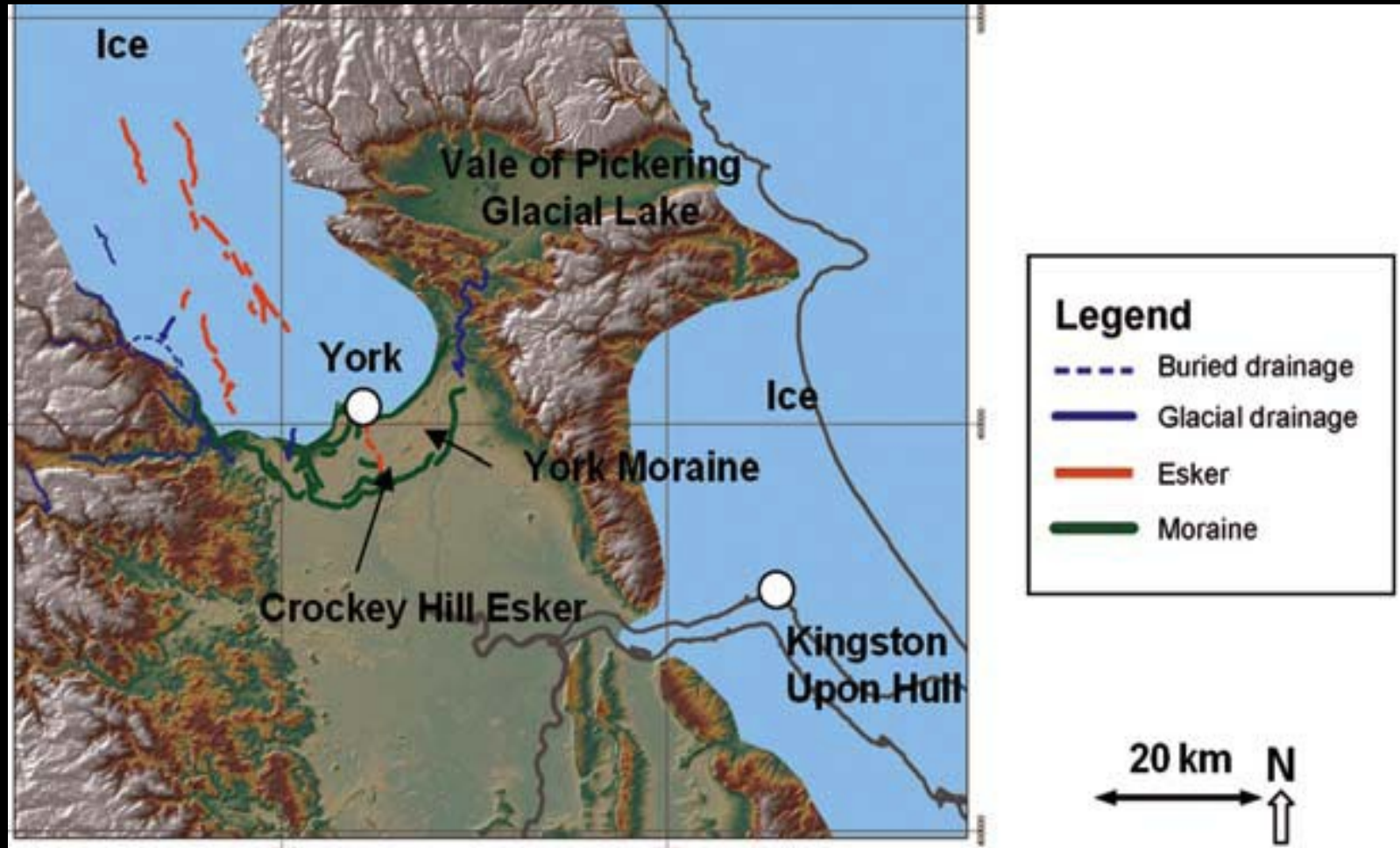


Glaciers in the Vale



Maximum ice extent, c. 18,000 years ago

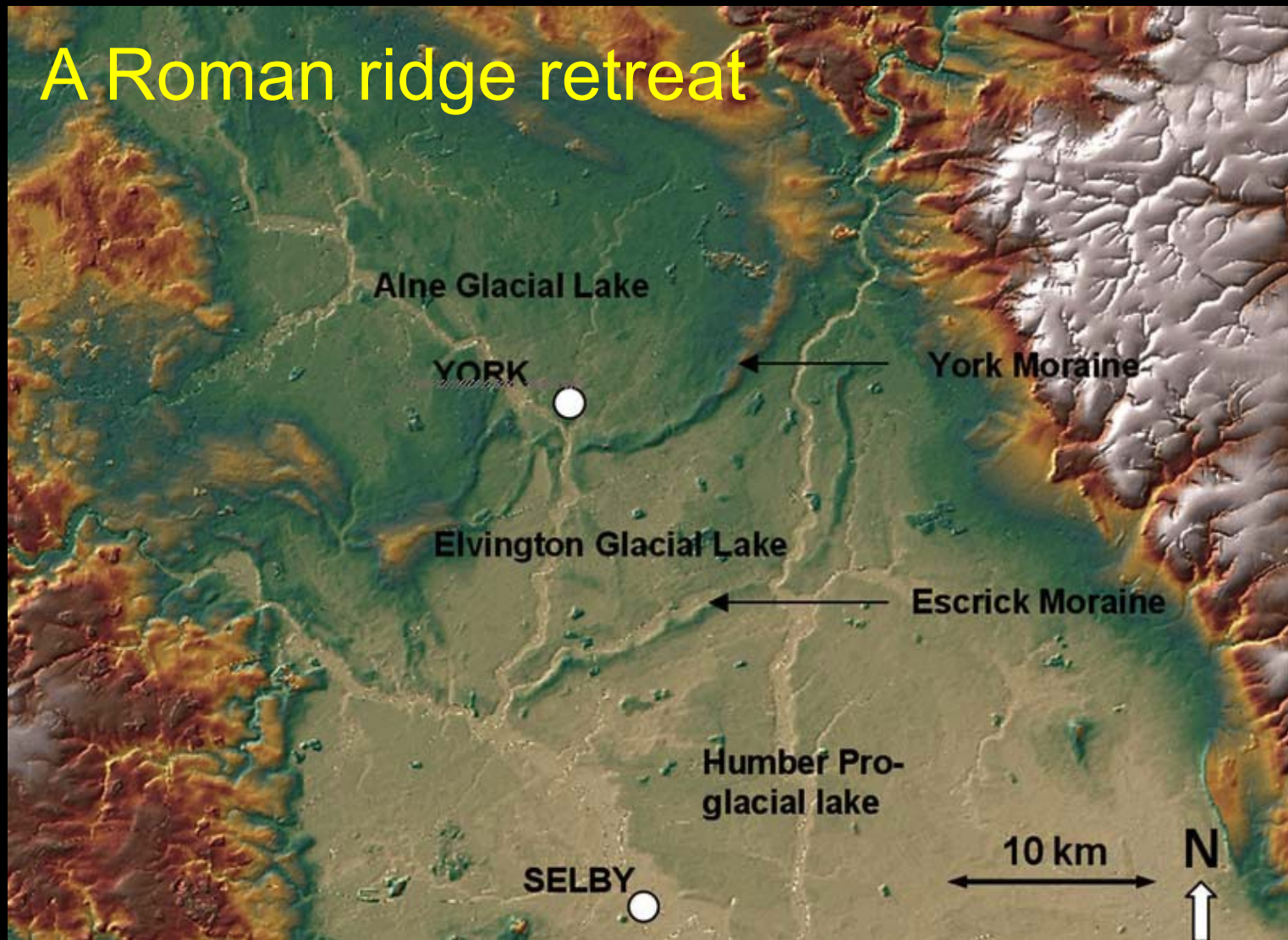
Glaciers in the Vale

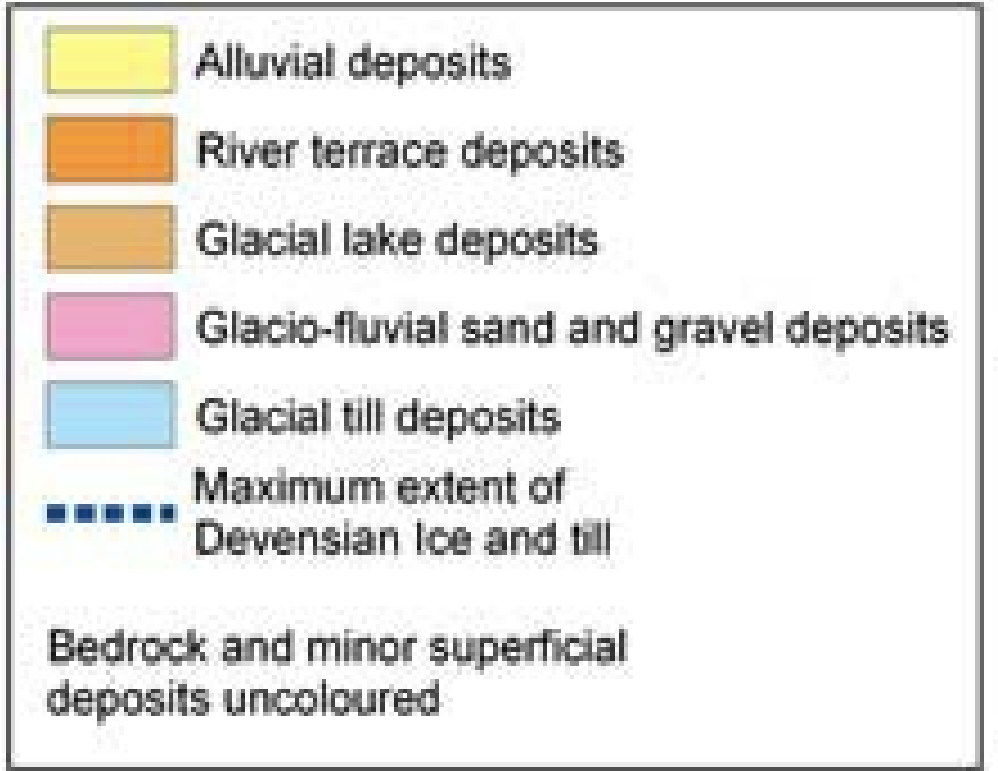
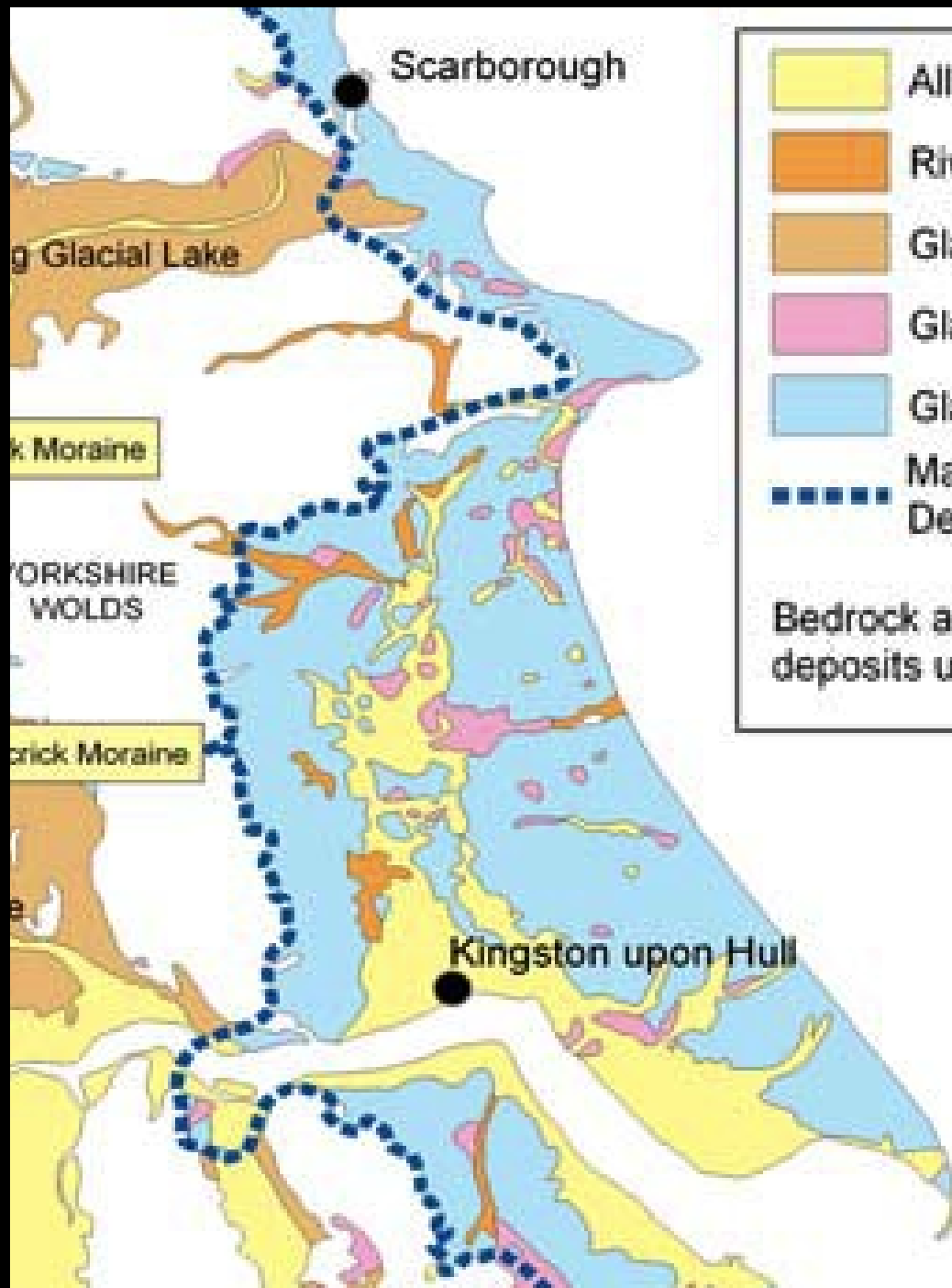


First stage of retreat = York moraine

York moraine

A Roman ridge retreat





Holderness
A glacial blanket

The Melt

Gaping Gill



Gordale Scar,
nr Malham





The Melt

~9,000
years ago

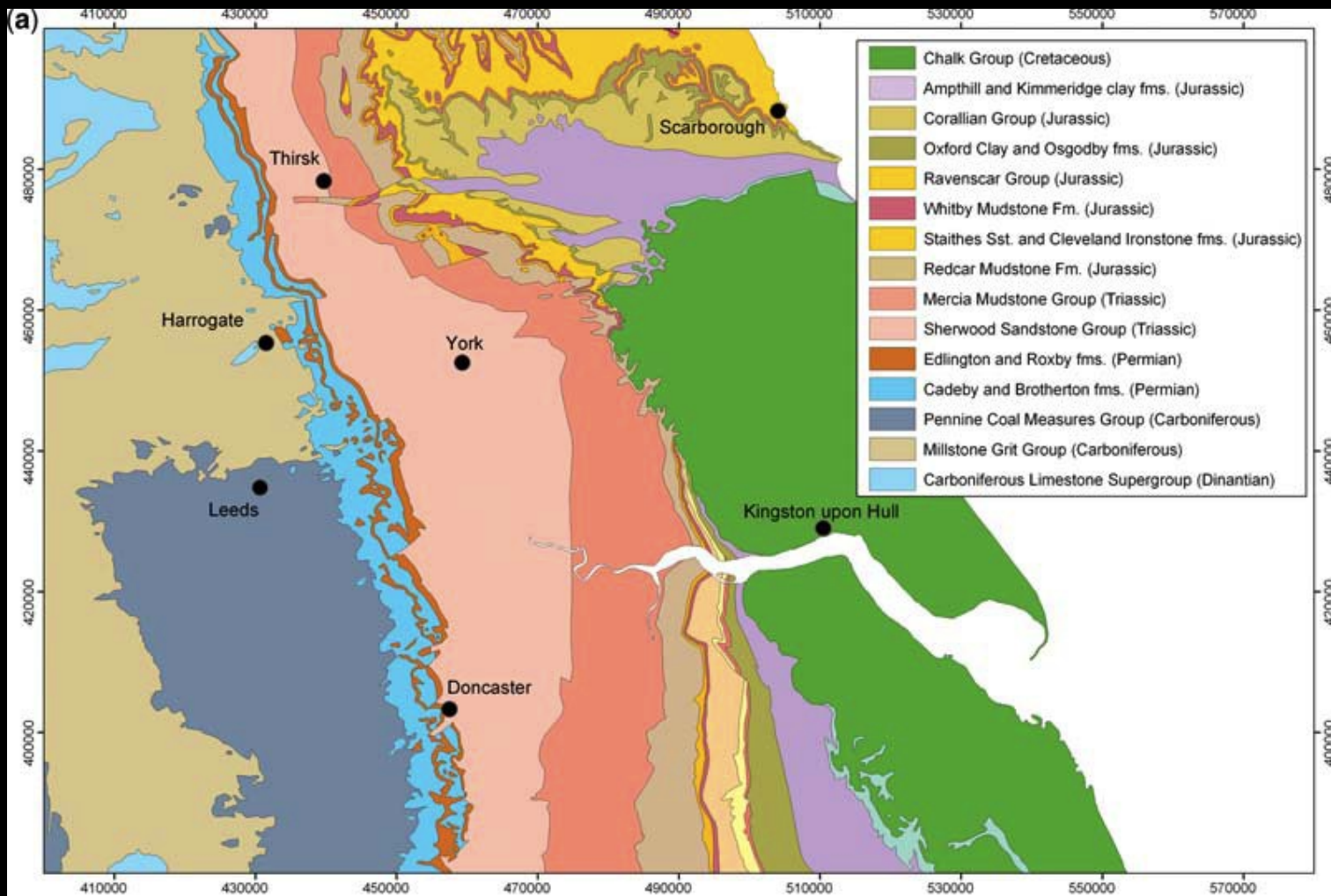
Misfit rivers



Diverted rivers

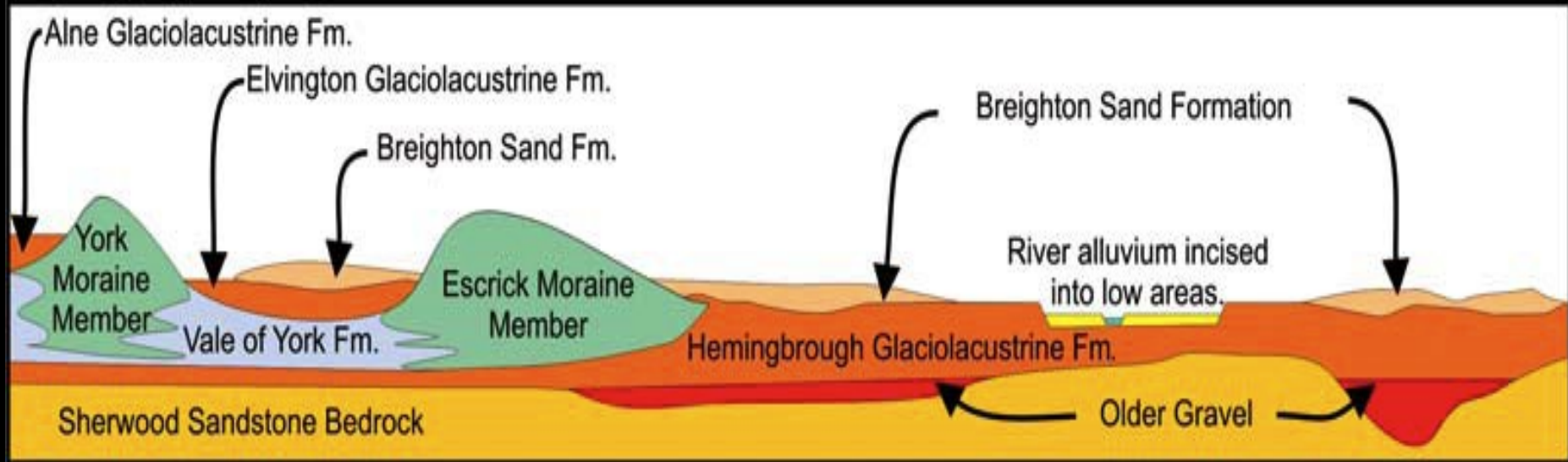


York's aquifer



Sherwood Sandstone Group

York's aquifer



- * Sherwood Sandstone = UK's 2nd biggest
- * Very permeable, but compartmentalized
- * Heavily exploited = contamination risk

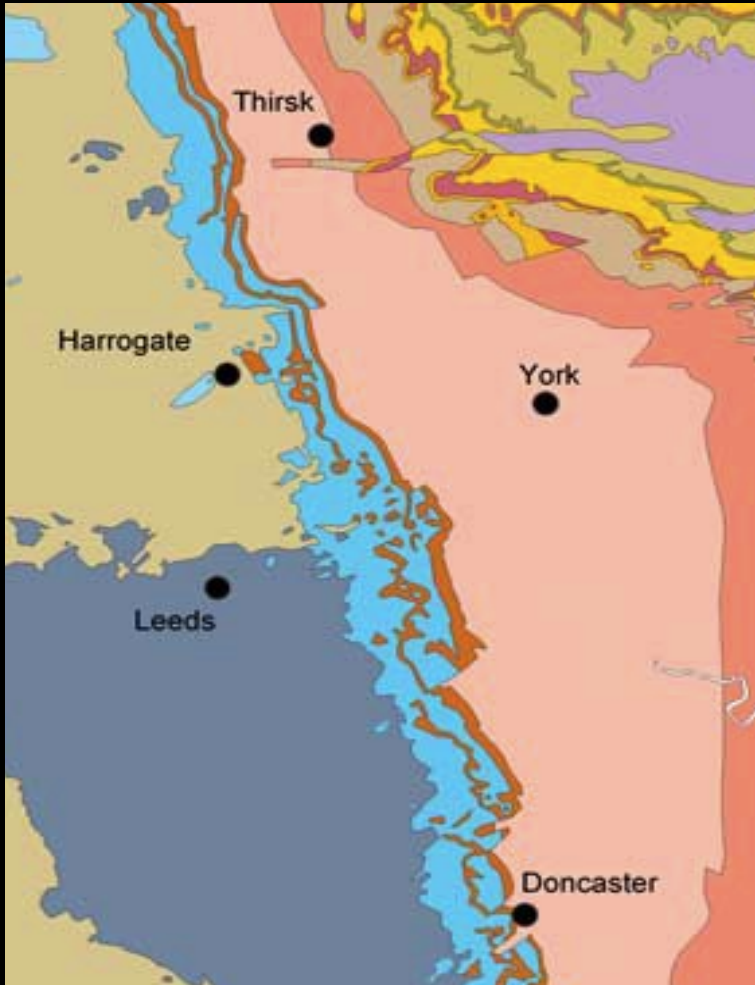
(Magnesian) Water of Life



Spa towns



(Magnesian) Water of Life



Beer!

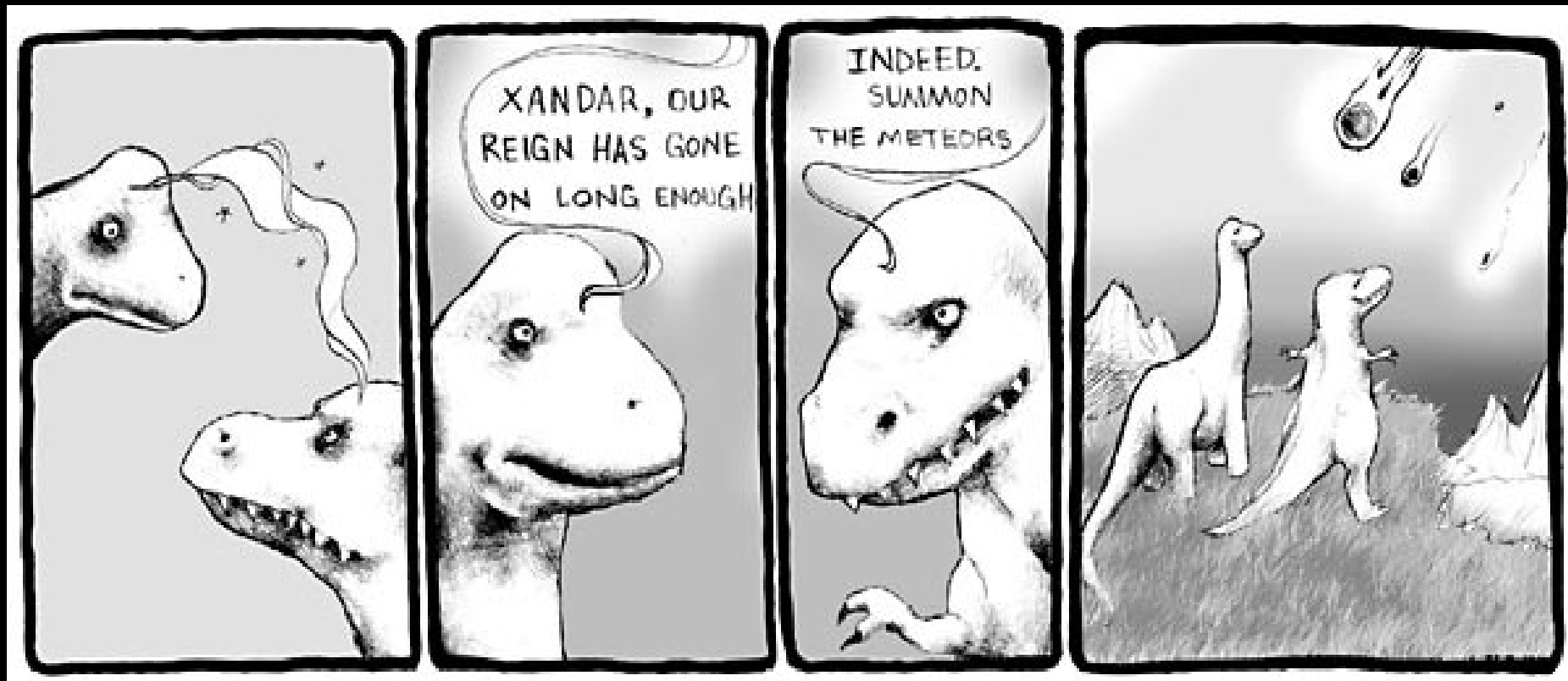
Sea level rise & erosion



Aldbrough,
Holderness
(1-2 m / yr)

Next week

The Fossil Record



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