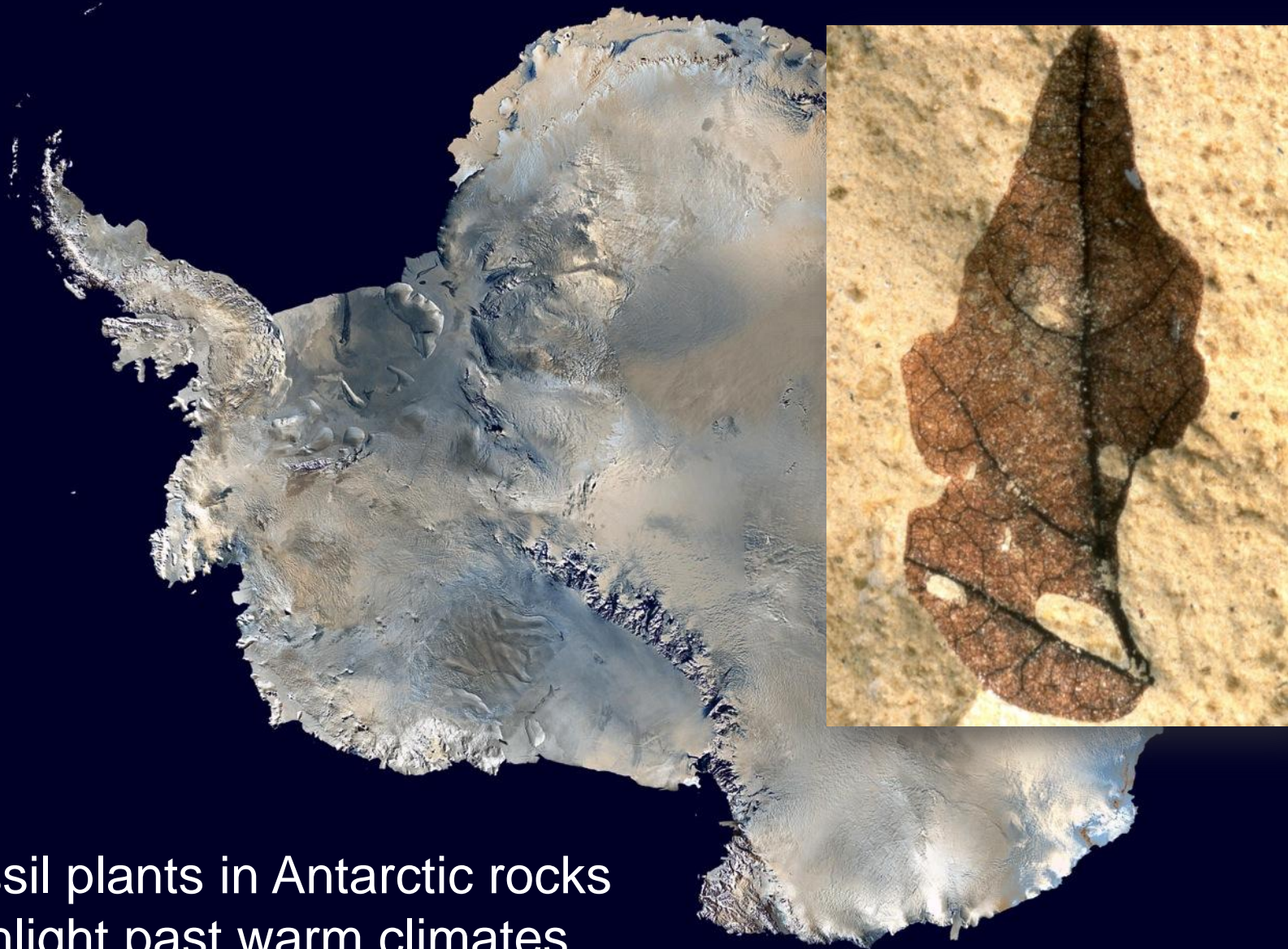


# Pliocene environments on Antarctica from the fossil record



Jane Francis  
British Antarctic Survey





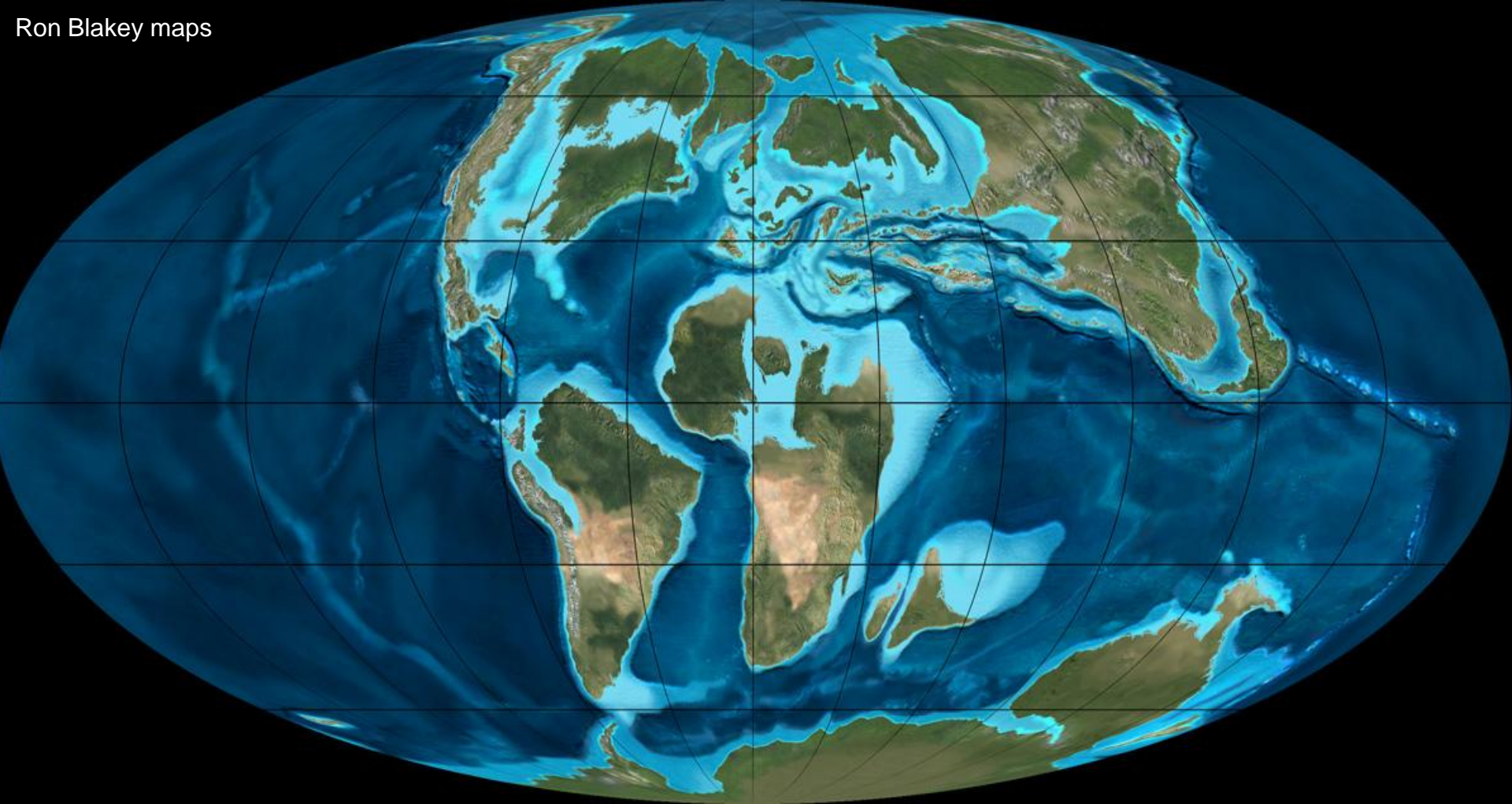
Fossil plants in Antarctic rocks  
highlight past warm climates

<1% rock but with fossils



# Seymour Island, Antarctica





From 100 million years ago (Cretaceous) the  
Antarctic continent was over the South Pole.....  
but Antarctica was warm and green



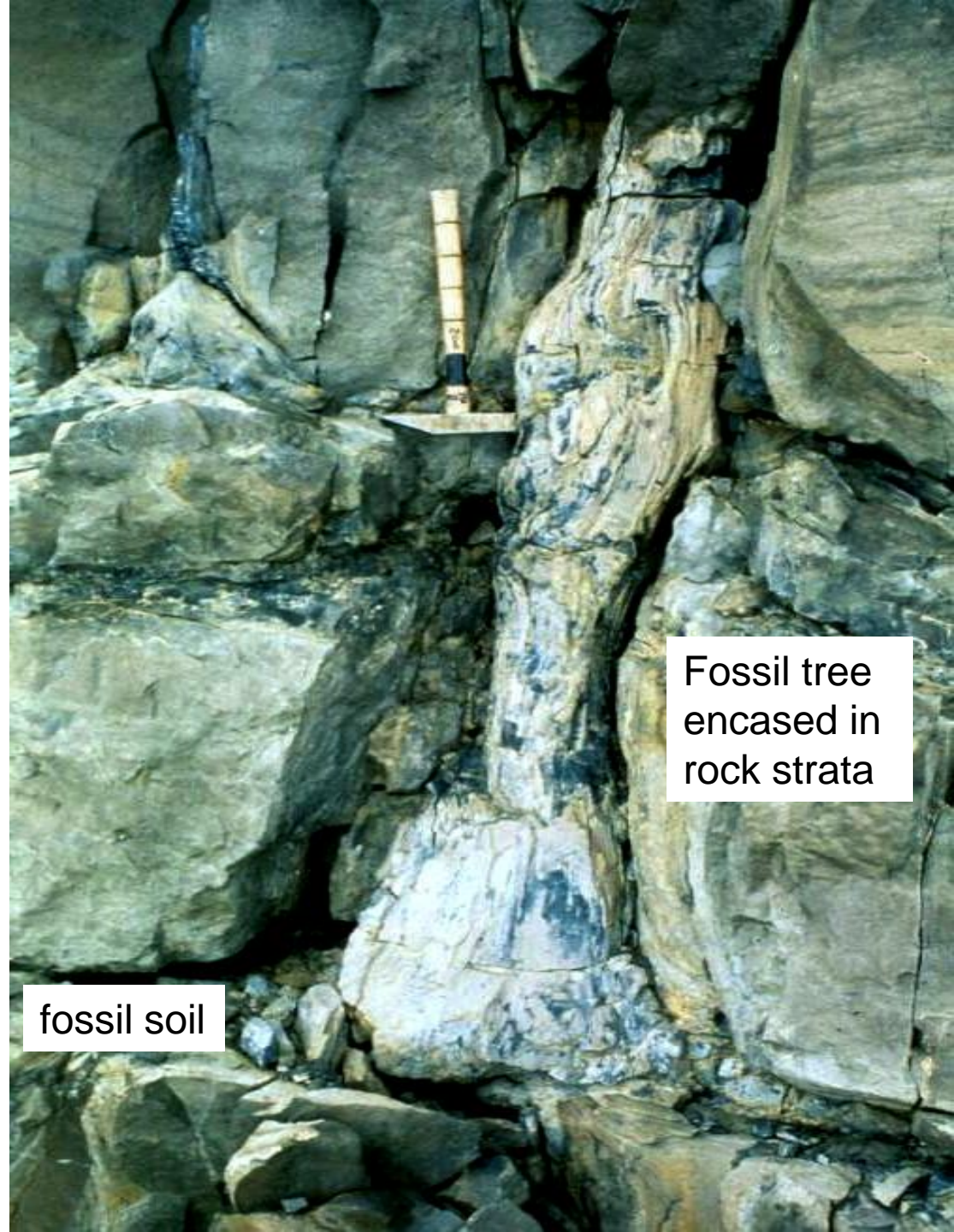
# Cretaceous petrified tree stumps in their original growth position

Alexander Island, Antarctica

petrified tree trunk



Jodie Howe

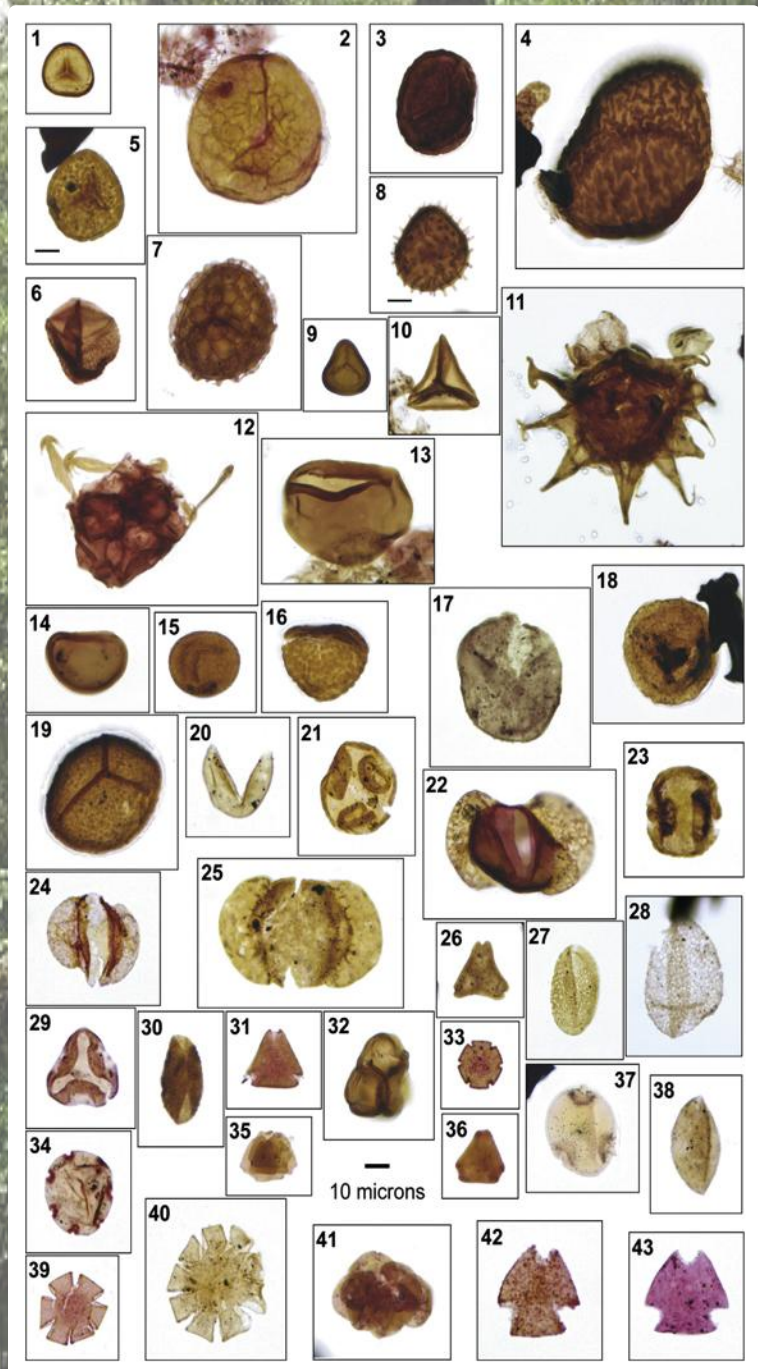


Fossil tree  
encased in  
rock strata

fossil soil



# Fossil pollen, fossil leaves and fossil wood





# Ferns



Fossil *Cladophlebis*

*Dicksonia antarctica*



# Monkey Puzzle trees grew in Antarctica



J.Francis

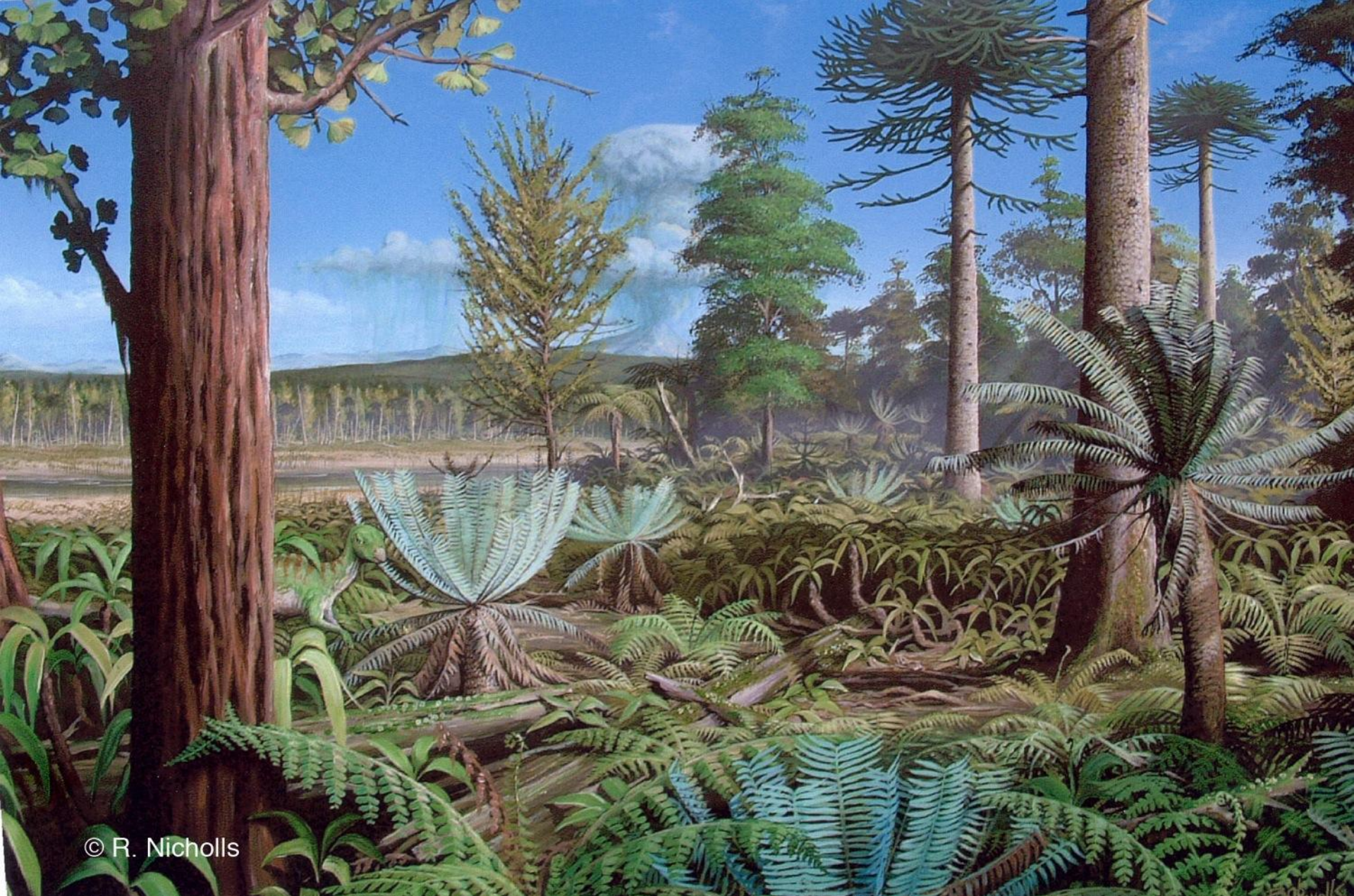


*Araucaria  
araucana*



*Araucaria araucana*, Monkey Puzzle,  
growing today in the Chilean Andes





© R. Nicholls

## 100 million year old forests, Alexander Island

Based on PhD work of Jodie Howe & Jane Francis, University of Leeds and BAS geologists. Painted by Rob Nicholls. Housed at BAS



Many Antarctic fossil plants are related to plants that live today in South America, Australia and New Zealand - ancient ancestors of Southern Hemisphere vegetation under warm climates



*Nothofagus*  
Cool temp



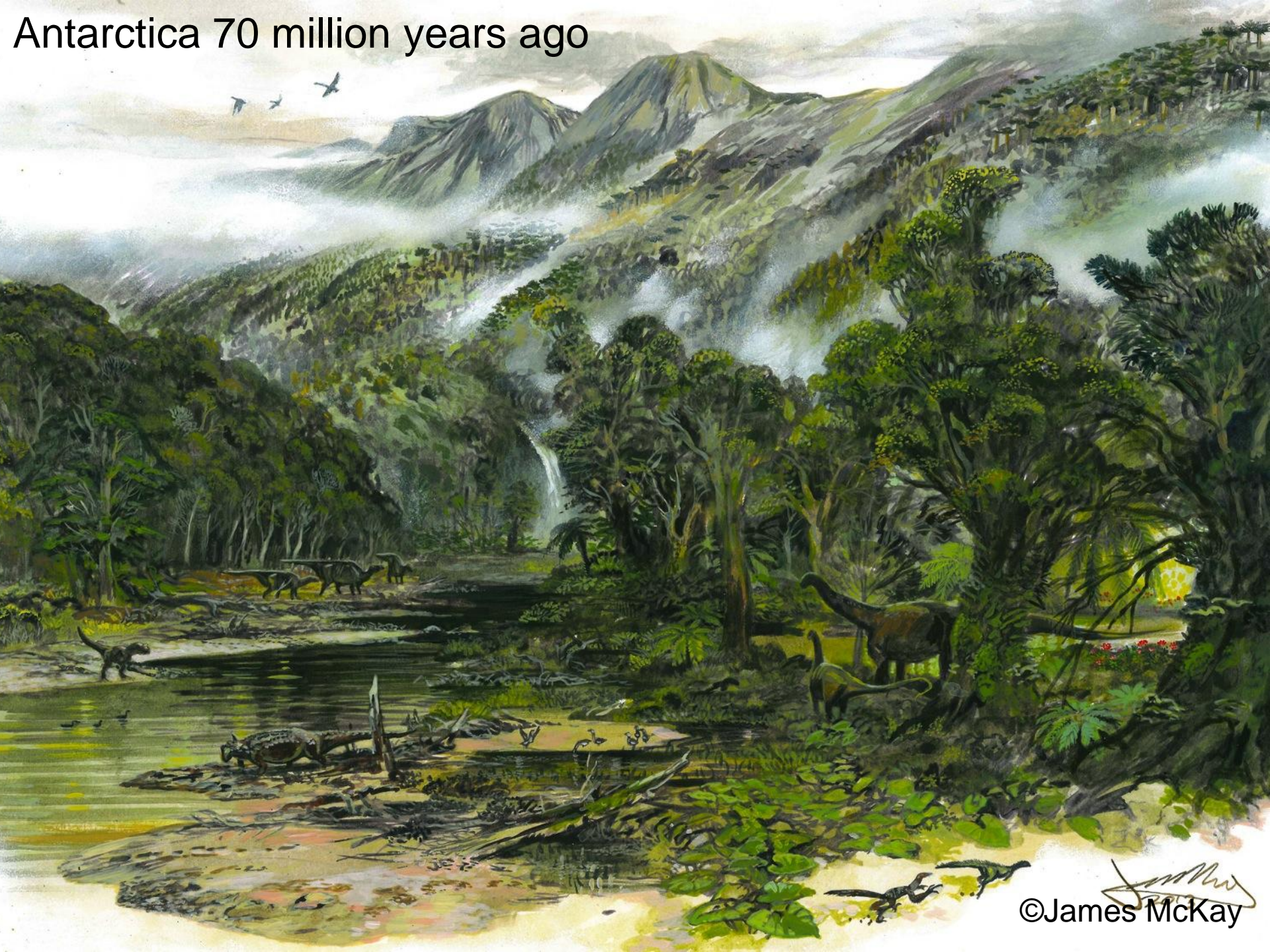
*Embothrium*  
Warm temp



*Brachychiton*  
Sub-tropical



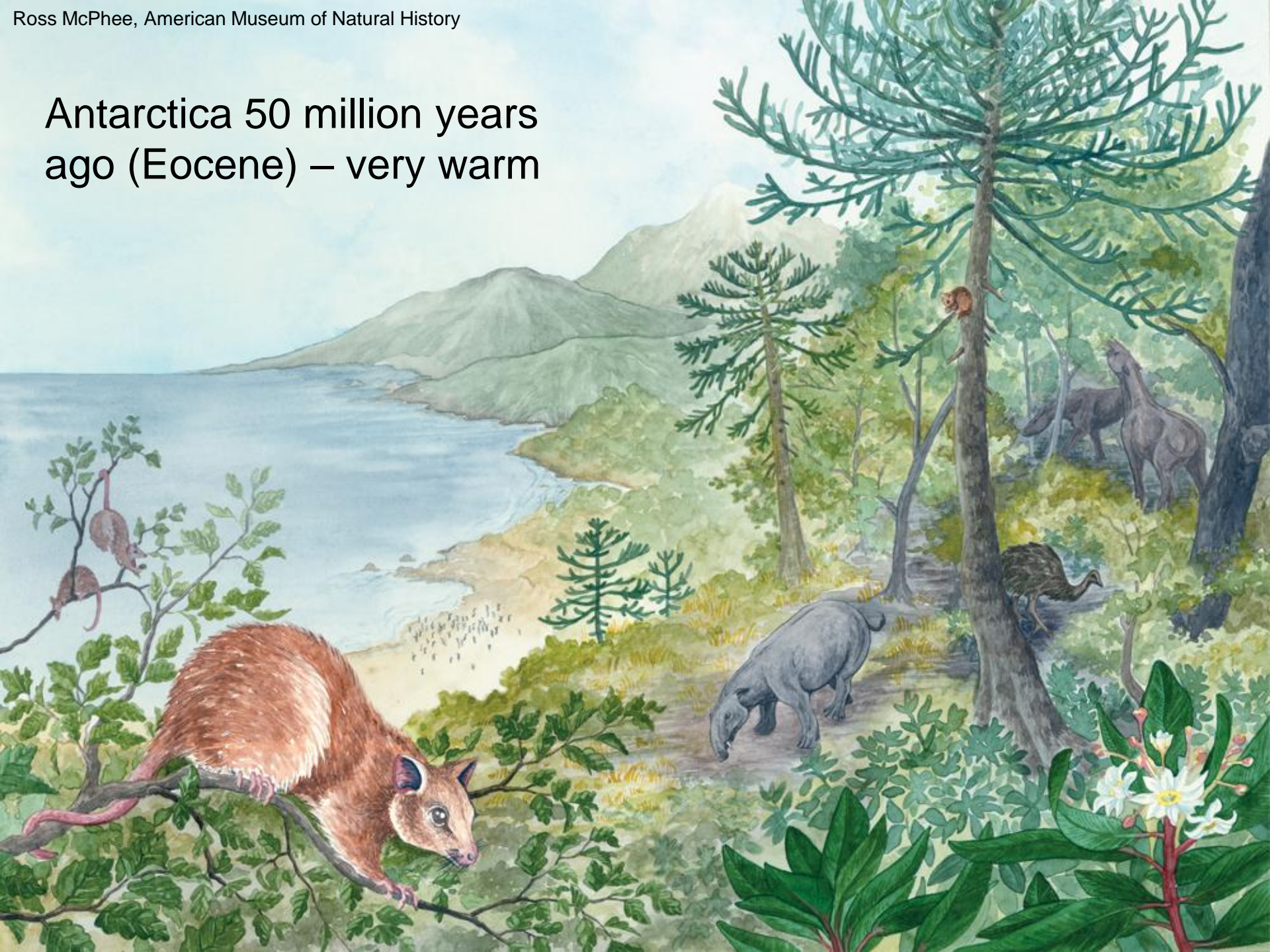
# Antarctica 70 million years ago



©James McKay



# Antarctica 50 million years ago (Eocene) – very warm





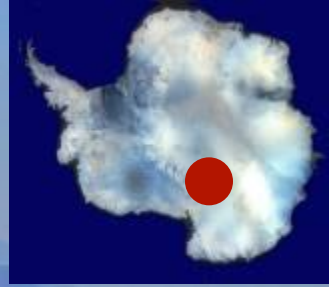
Cooler climates allowed ice sheets to form  
and glaciers reached the coast by 40  
million years ago



Reconstruction of Miocene ice sheet, Antarctica. 14-23 my

Gasson et al. 2016 PNAS v113. [www.umass.edu](http://www.umass.edu)





Beardmore glacier

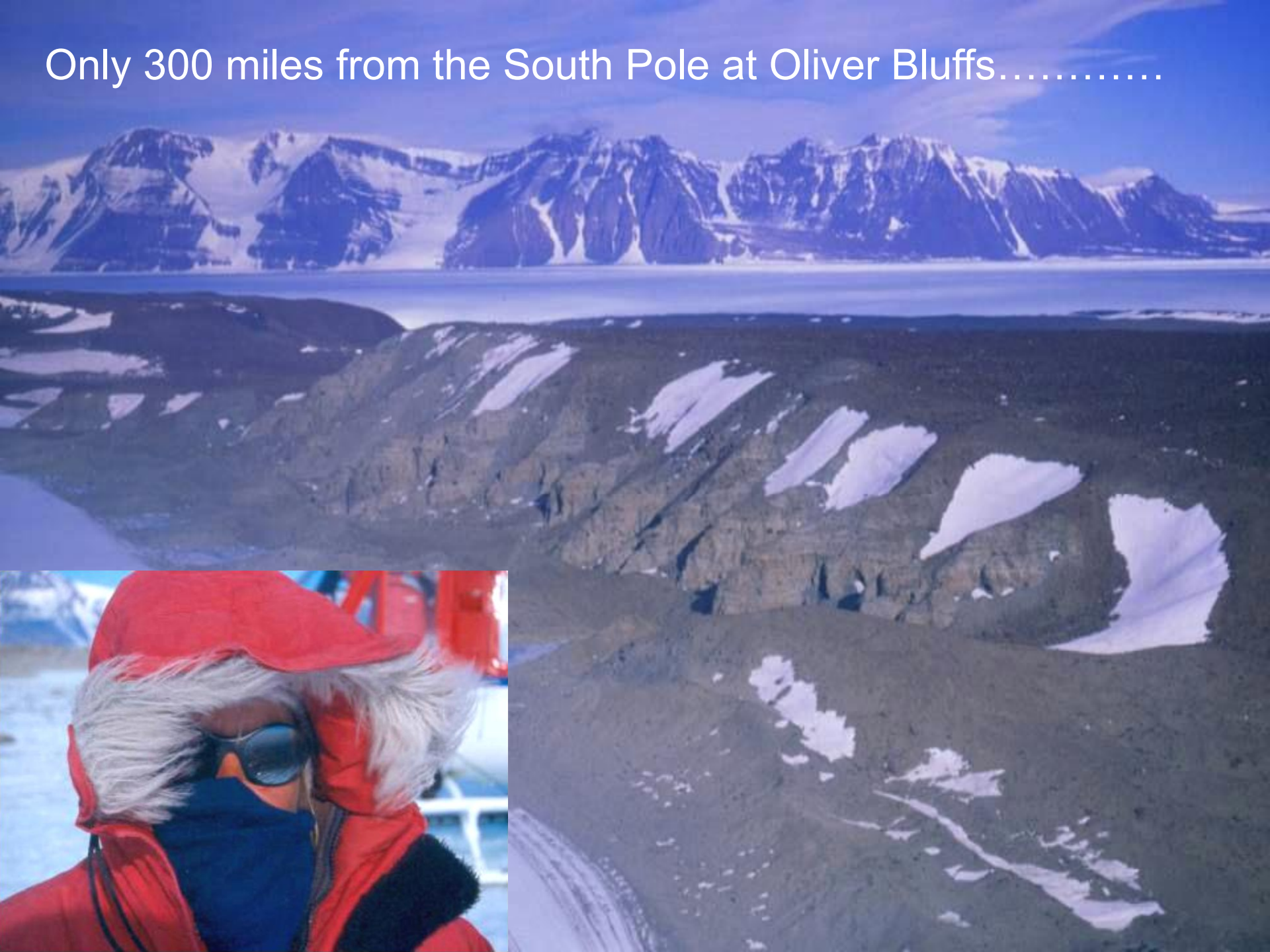
40km wide

40 million years ago the  
climate changed and  
glaciers covered Antarctica  
– but the forests survived,  
even in the cold climate





Only 300 miles from the South Pole at Oliver Bluffs.....

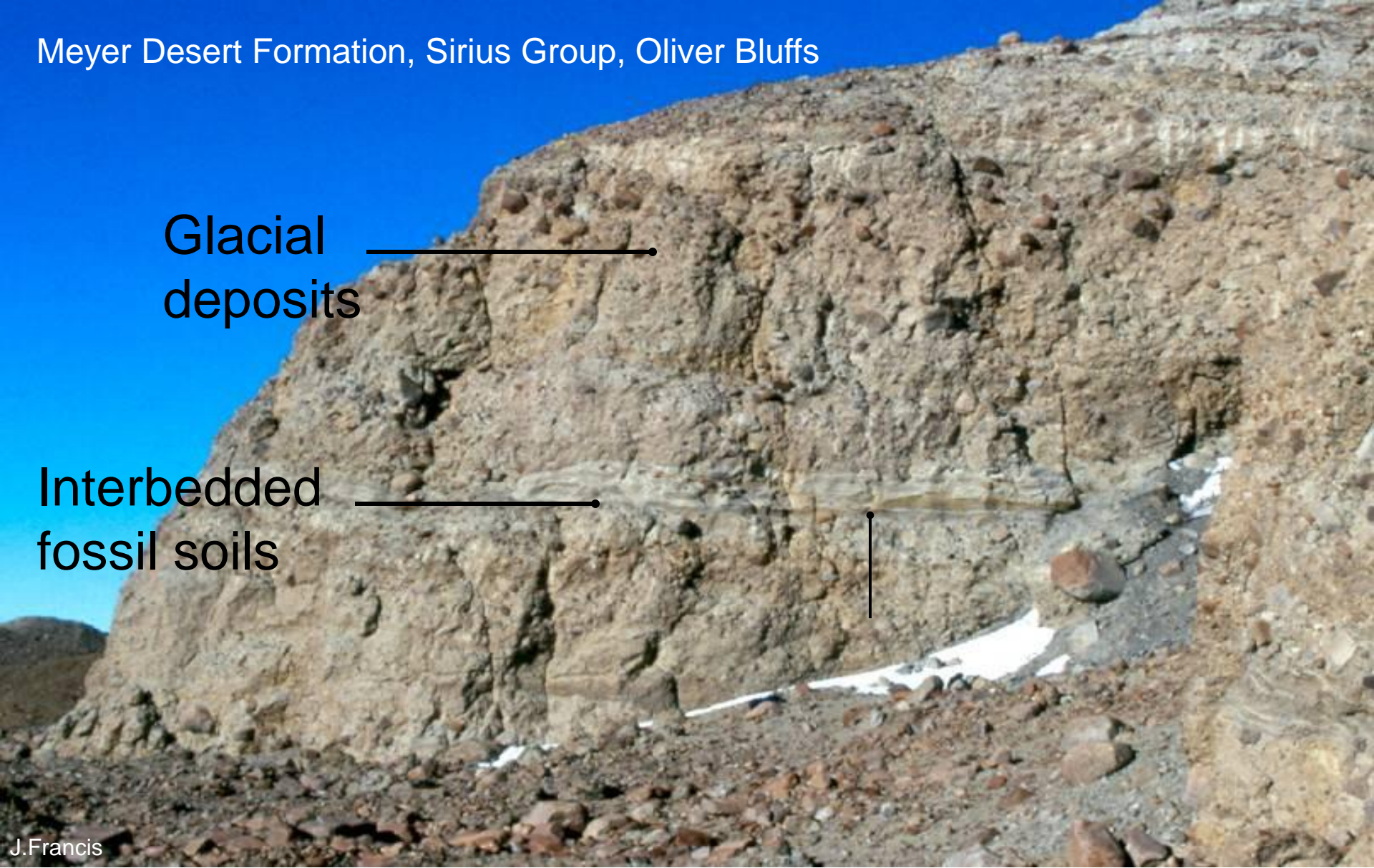




# Meyer Desert Formation, Sirius Group, Oliver Bluffs

Glacial deposits

Interbedded fossil soils



J.Francis

The last place you would ever look for fossil plants – in a glacial tillite!





Tiny mummified twigs



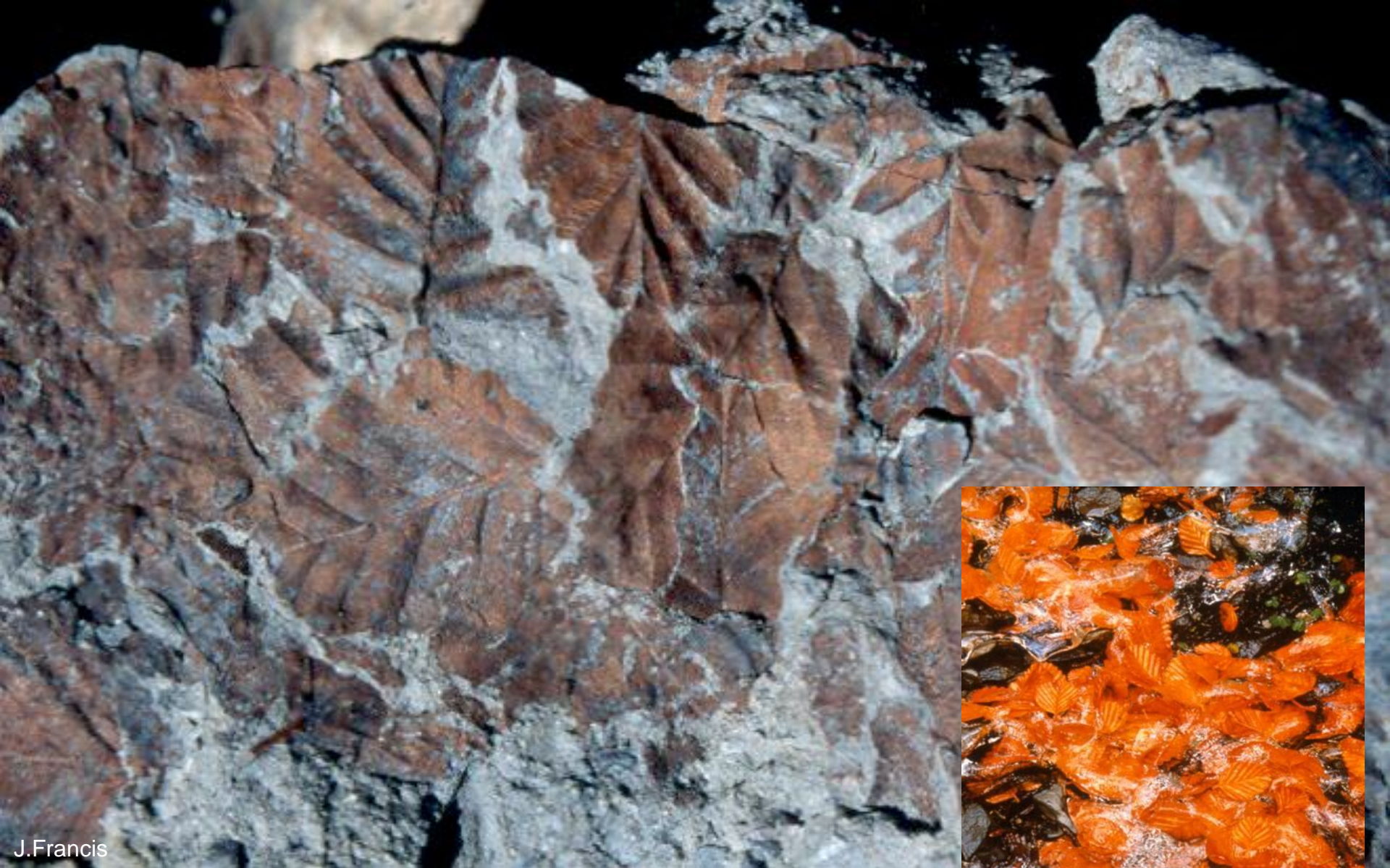


Living Arctic  
dwarf tree

Small woody shrubs rooted in immature  
soils, with branches hugging the ground  
surface and twisting around boulders







J.Francis

Leaf mat of 12 million year old fossil leaves  
*Nothofagus beardmorensis* (southern beech)







Modern analogue for Sirius  
environments in Antarctica - Axel  
Heiberg, Canadian High Arctic

Mean annual temperature  $-12^{\circ}\text{C}$







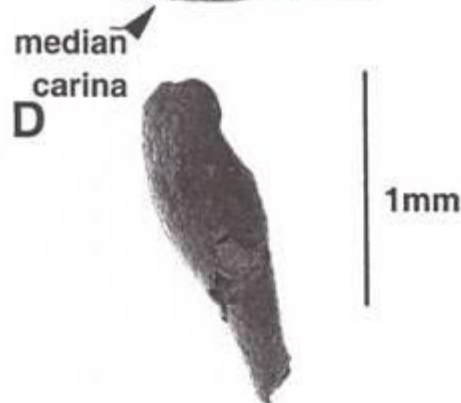
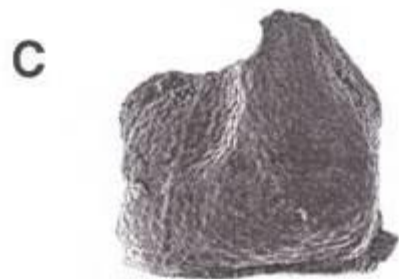
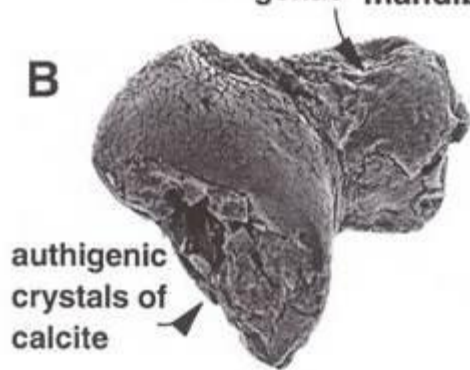
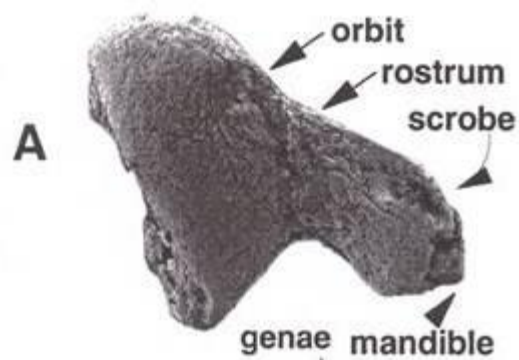
Ashworth & Cantrill 2004



Antarctic fossil cushion plant

Mountain tundra  
landscape, Tasmania



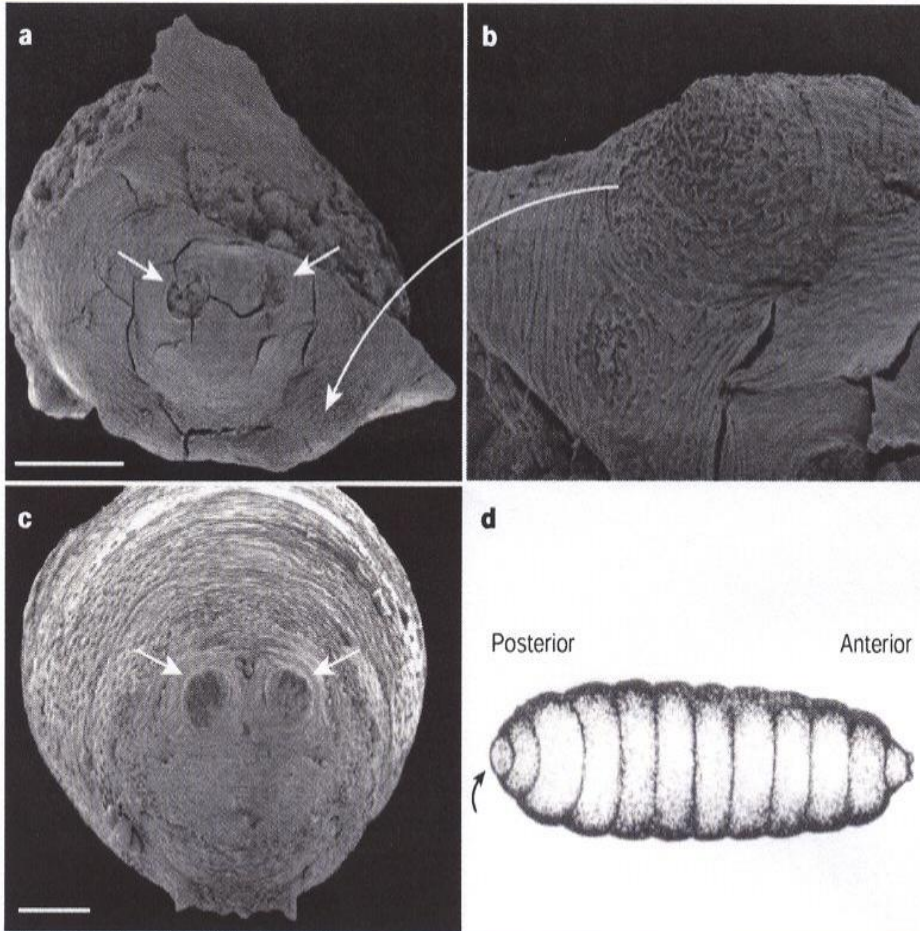


Allan Ashworth

Amazing finds of  
fossil weevils



## Fossil fly puparium (maggot case)







- Fossil biomarkers (e.g. alkenones, lipids) from the fossil plants indicate the presence of angiosperms (flowering trees), mosses, sedges, bryophytes, algae
- Mosaic of bogs, herbs, shrubs and tundra plants
- Terpine palaeothermometers suggest summer temperatures of 3 – 5°C



A photograph of a dense, lush forest. In the foreground, there are large, moss-covered tree trunks and branches. A large, vibrant green fern frond is prominent in the center-left. The background shows a valley filled with dense green vegetation, leading up to steep, forested mountains under a bright sky with some clouds. The text "Antarctica future?" is overlaid in the upper center.

Antarctica  
future?