The Interplay of Tectonics, Climate Change and Sea Level: Florida's Transformation over Geologic Time

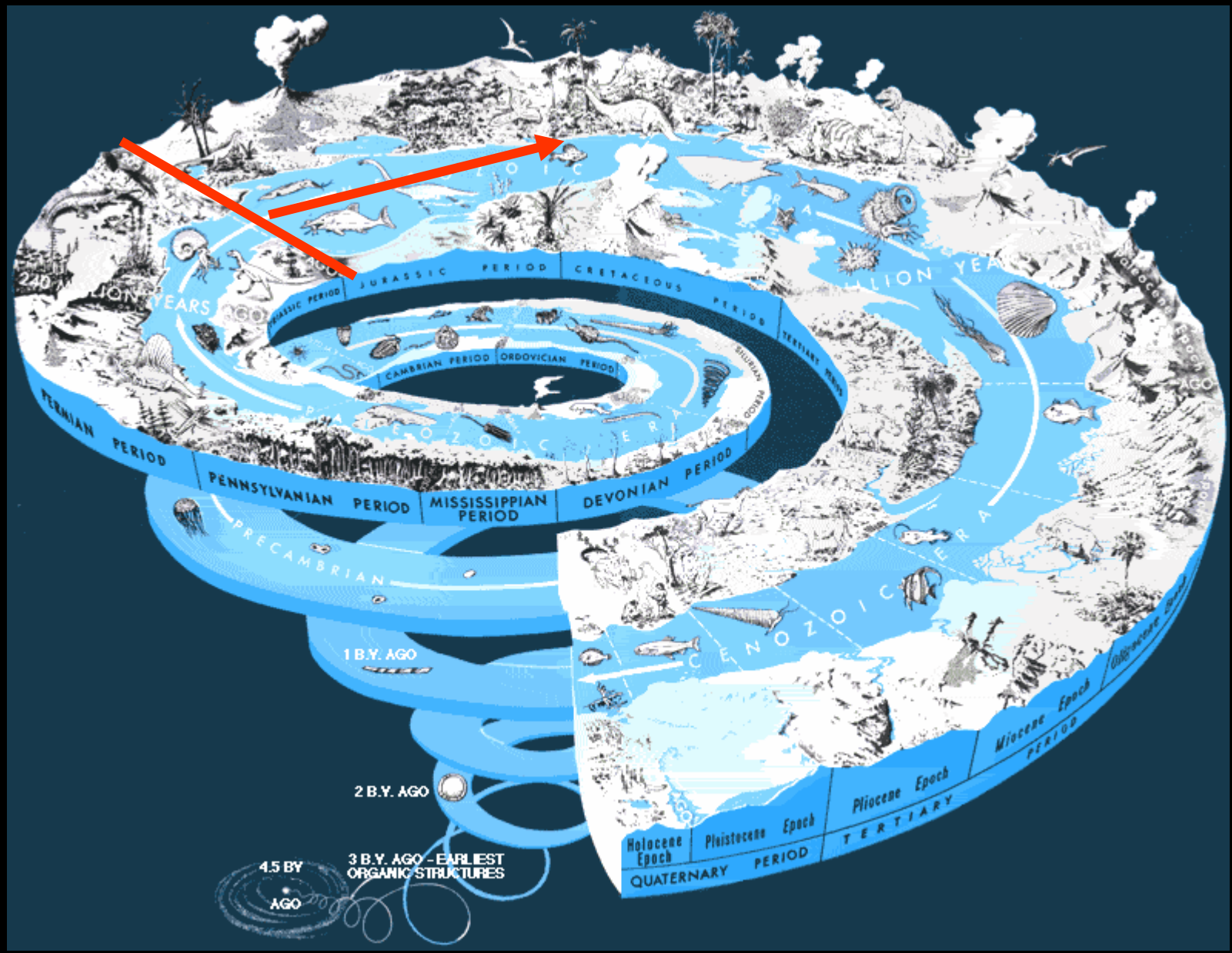
Dr. John Jaeger

Department of Geological Sciences

University of Florida

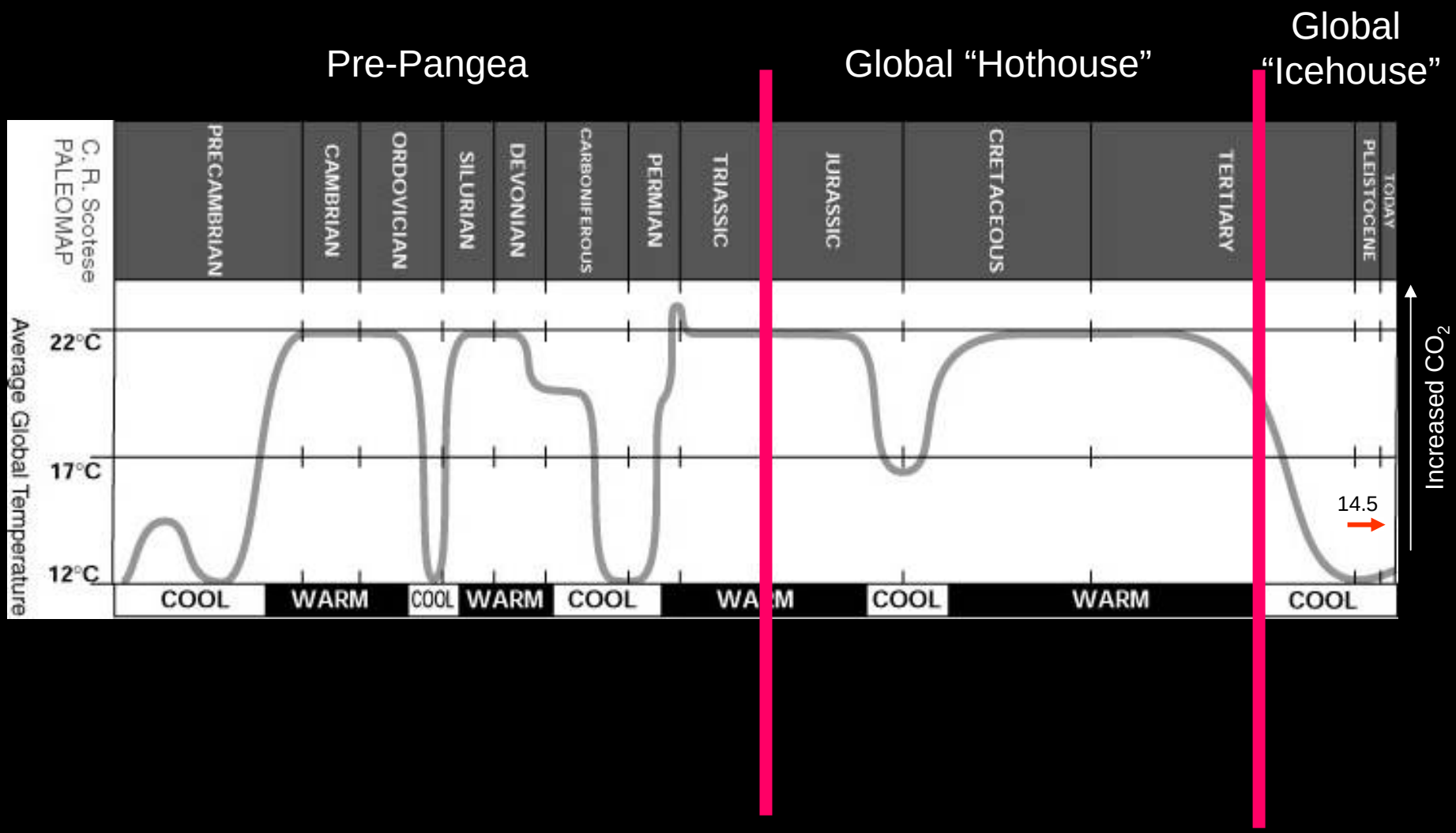
Drs. A Randazzo and G. McClellan

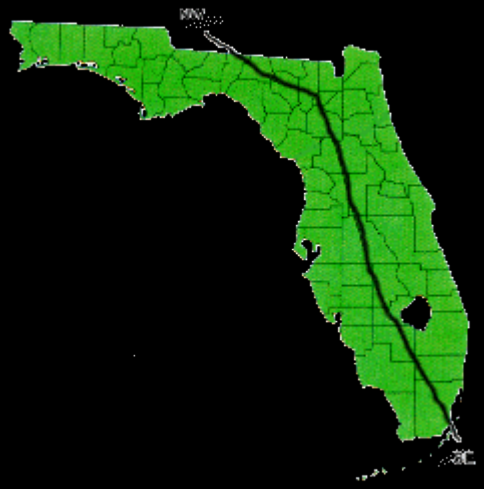
Geologic Time Scale



Global Climate Through Geologic Time

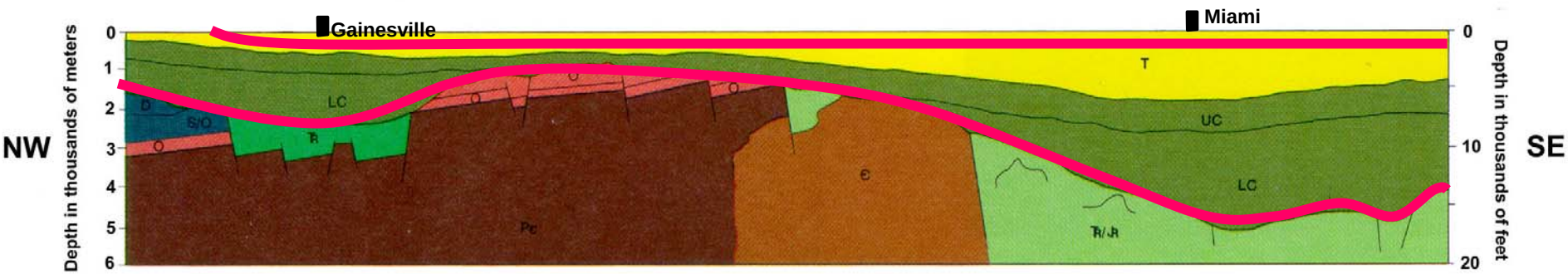
"BLAG" model (Berner, Lasaga, and Garrels) of Climate-Tectonic Interaction:
Variations in seafloor spreading rates lead to variations in volcanic outgassing and, thus, atmospheric CO_2 concentrations. Chemical weathering of rock removes atmospheric CO_2.





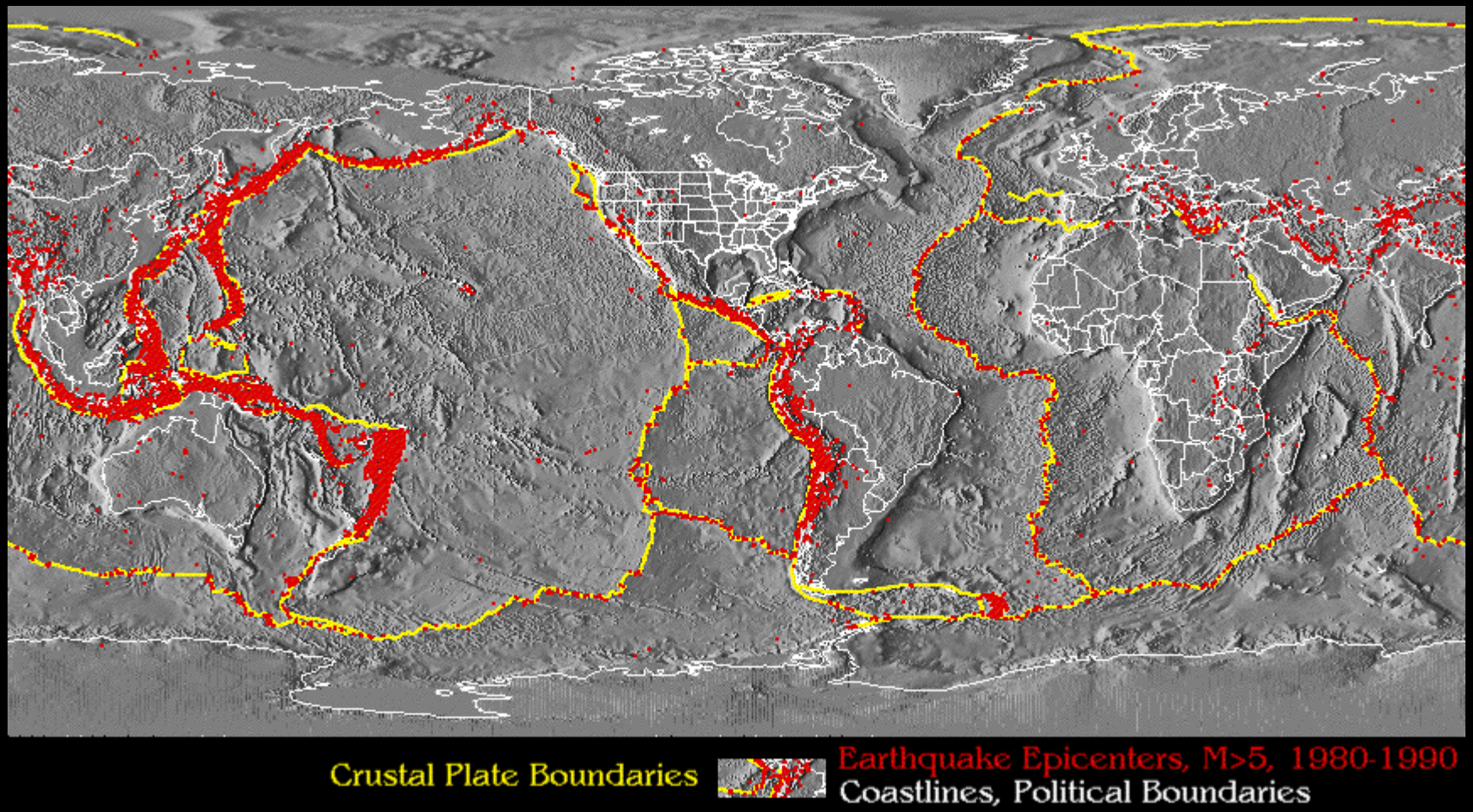
Geologic Cross Section of the Florida Peninsula

Geologic Cross Section Showing Generalized Basement Structure

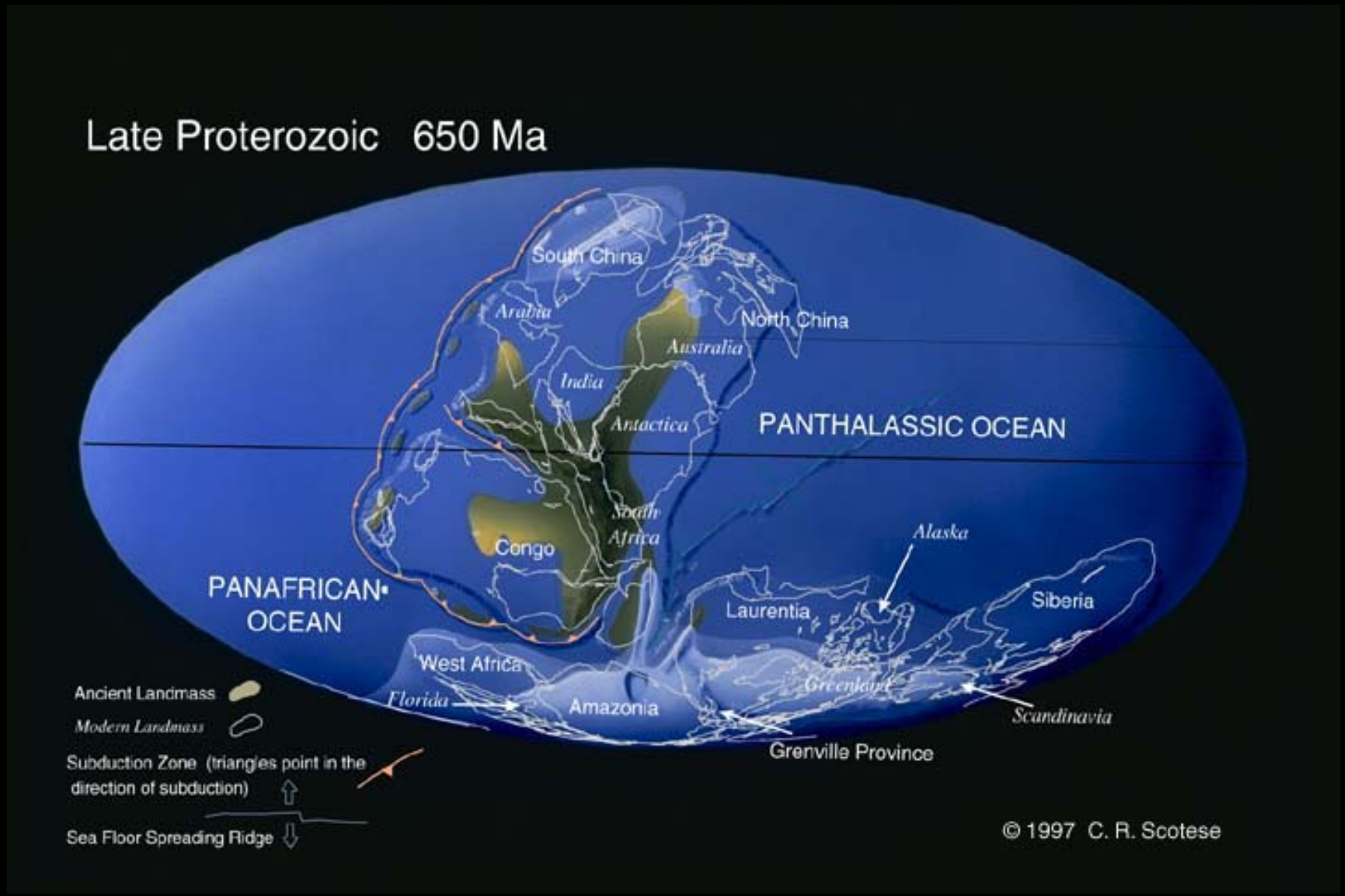


- T — Tertiary sedimentary rocks
- UC/LC — Cretaceous sedimentary rocks
- Tr — Triassic Eagle Mills Formation
- Tr/Jr — Triassic and Jurassic igneous and volcanic complex
- D/S/O — Devonian, Silurian/Ordovician sedimentary rocks
- O — Ordovician sedimentary rocks
- Є — Lower Cambrian granitoid batholith
- Pc — Precambrian metamorphic and volcanic complex

Global Plate Tectonics

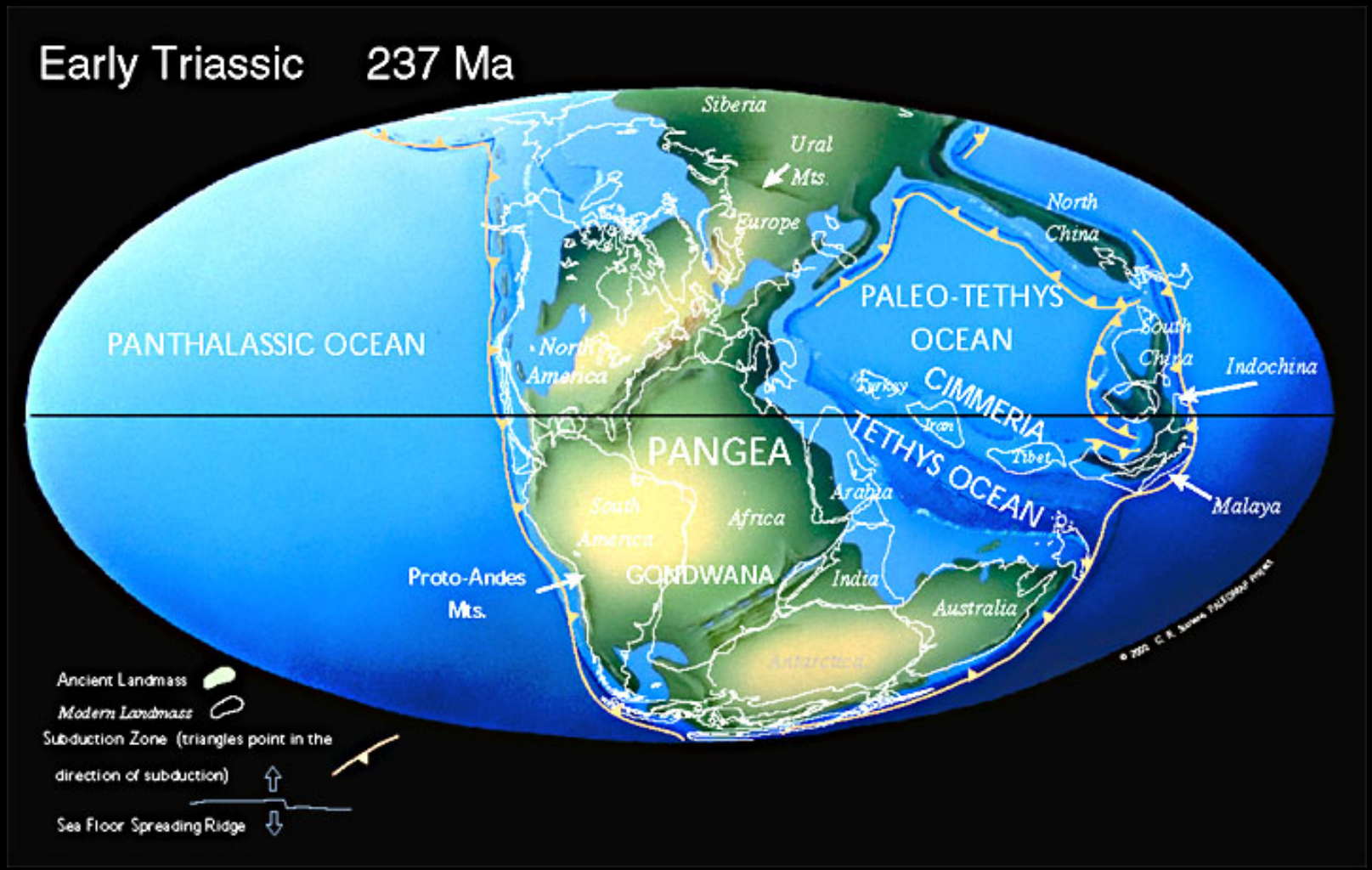


Florida's Geologic Past

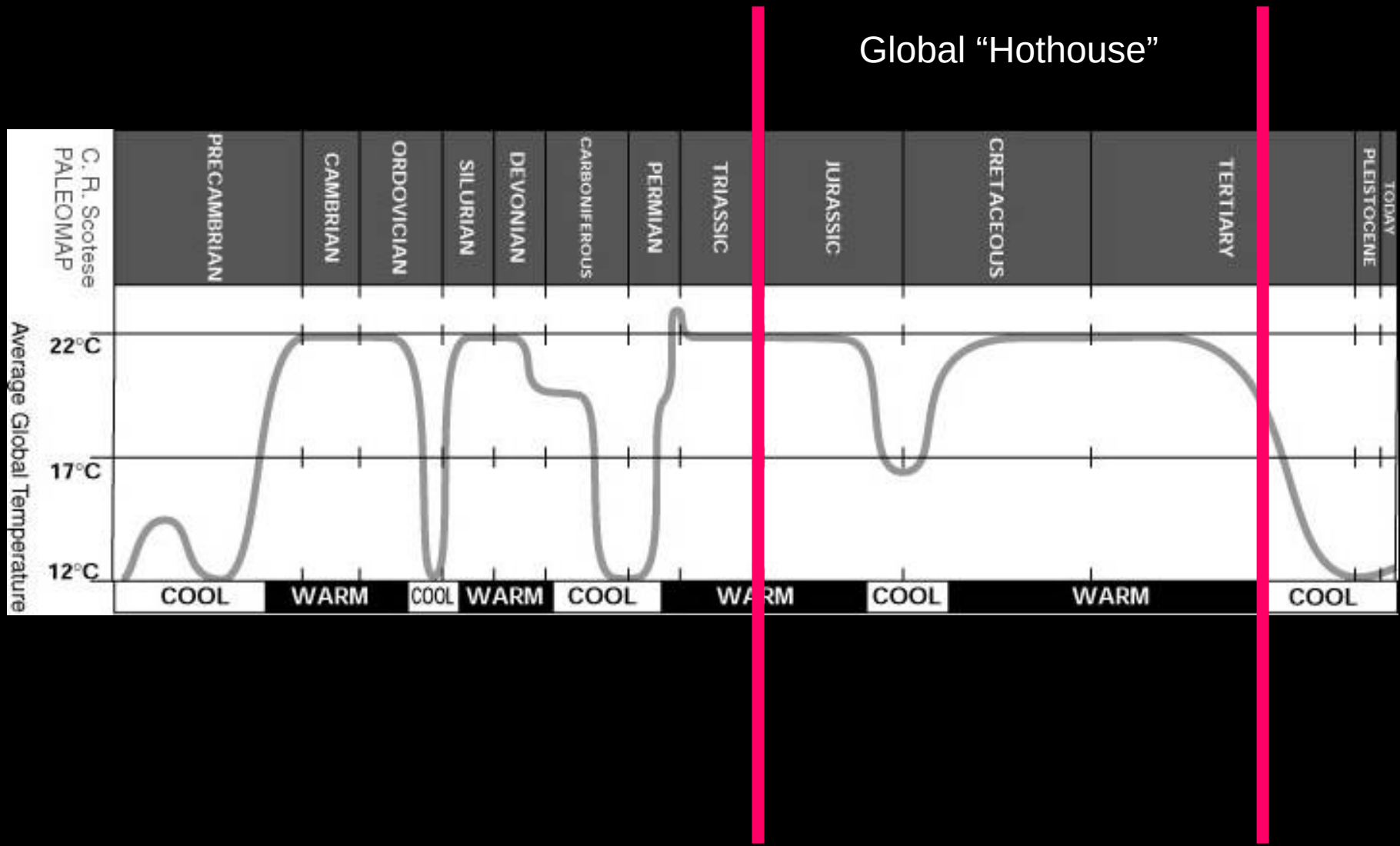


Florida in the Late Proterozoic

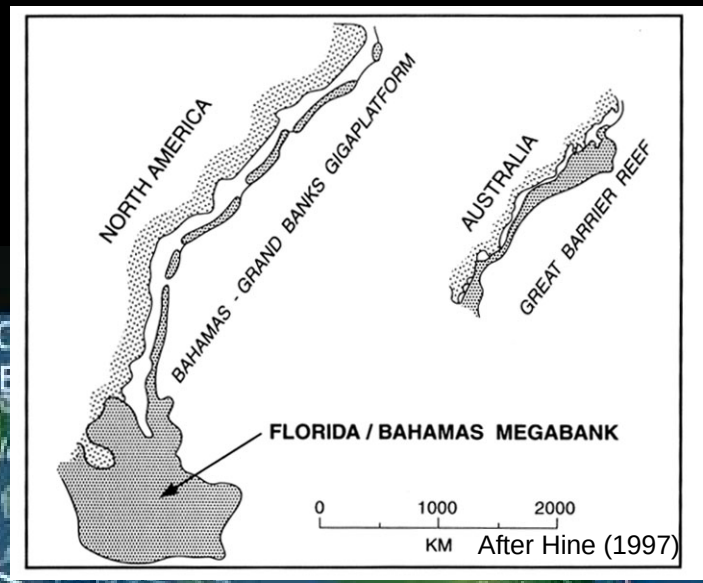
Florida's Geologic Past



Global Climate Through Geologic Time

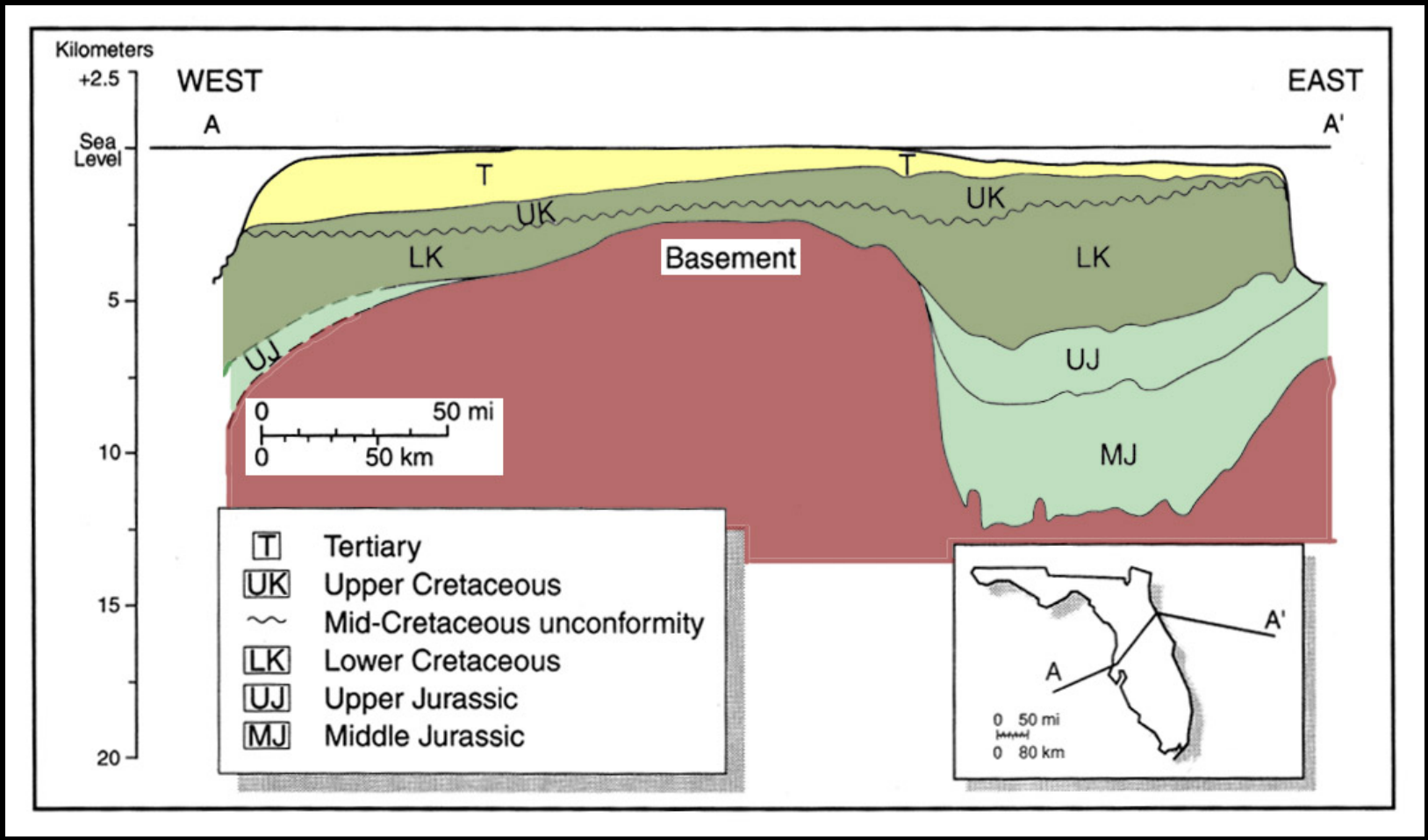


Florida in the Mesozoic



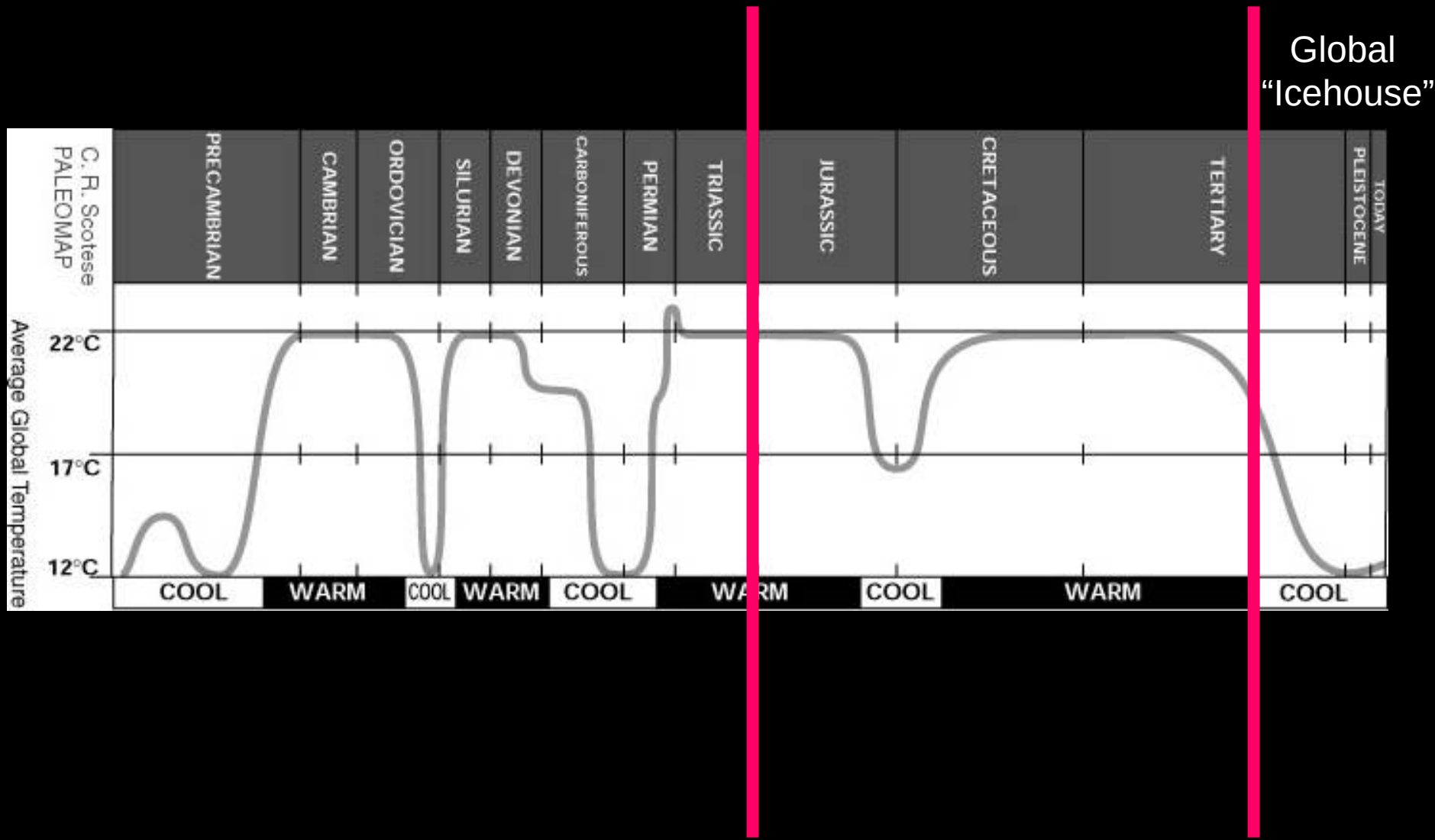
Florida

Florida in the Mesozoic

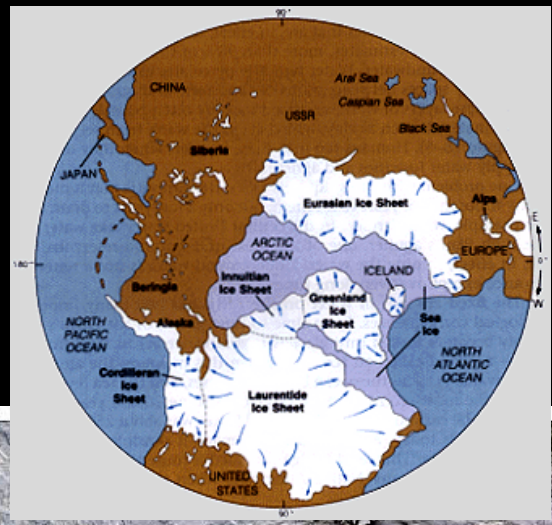


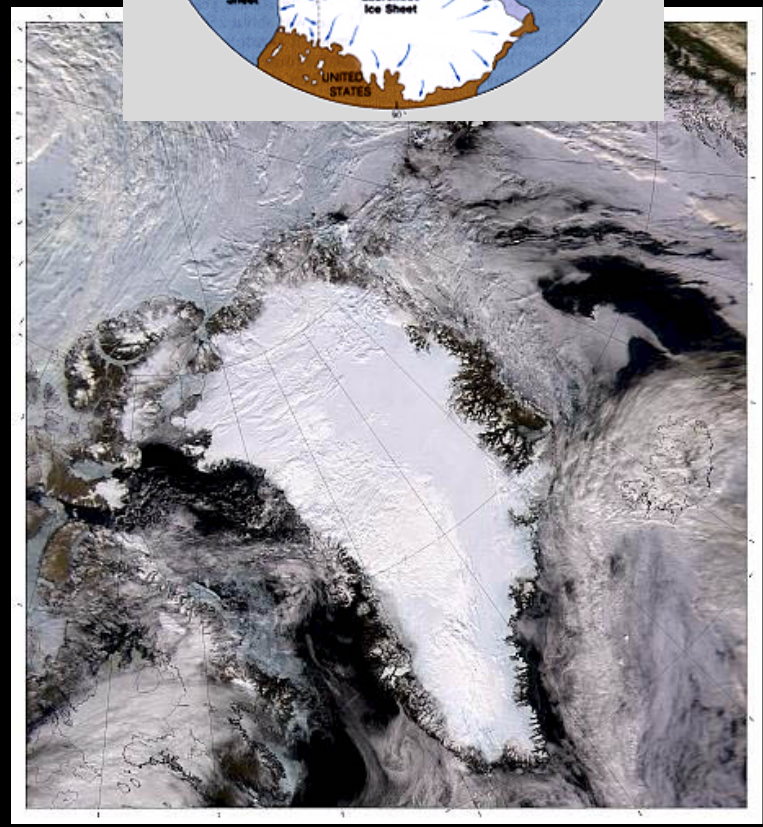
After Randazzo (1997)

Global Climate Through Geologic Time



Global Ice Sheet Formation

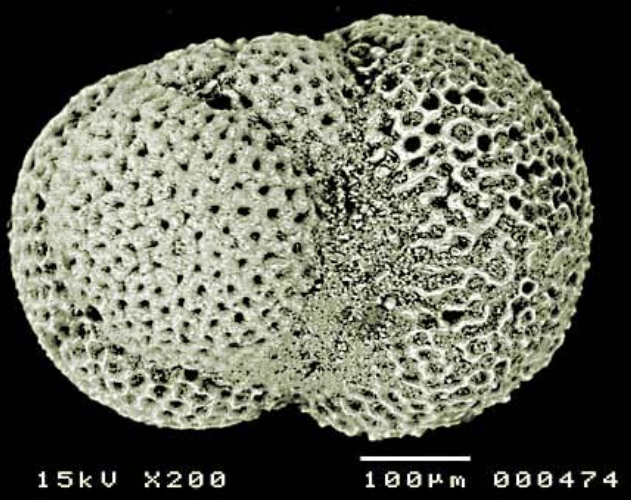




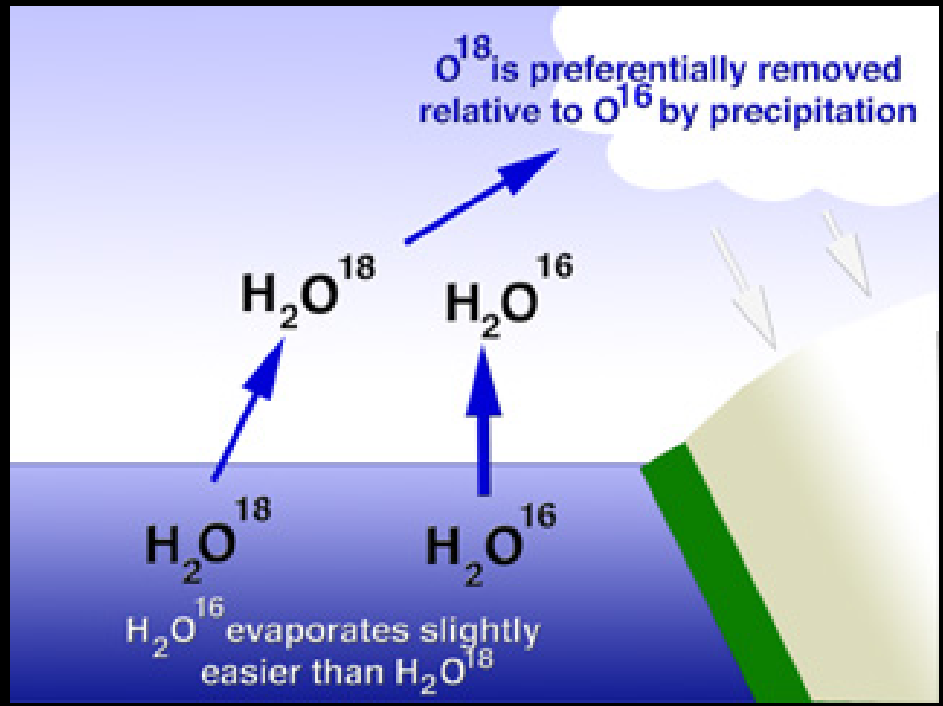
Pictures courtesy NASA/Goddard Space Flight Center Scientific Visualization Studio

Marine Isotopic Record of Cenozoic Sea Level Fluctuations

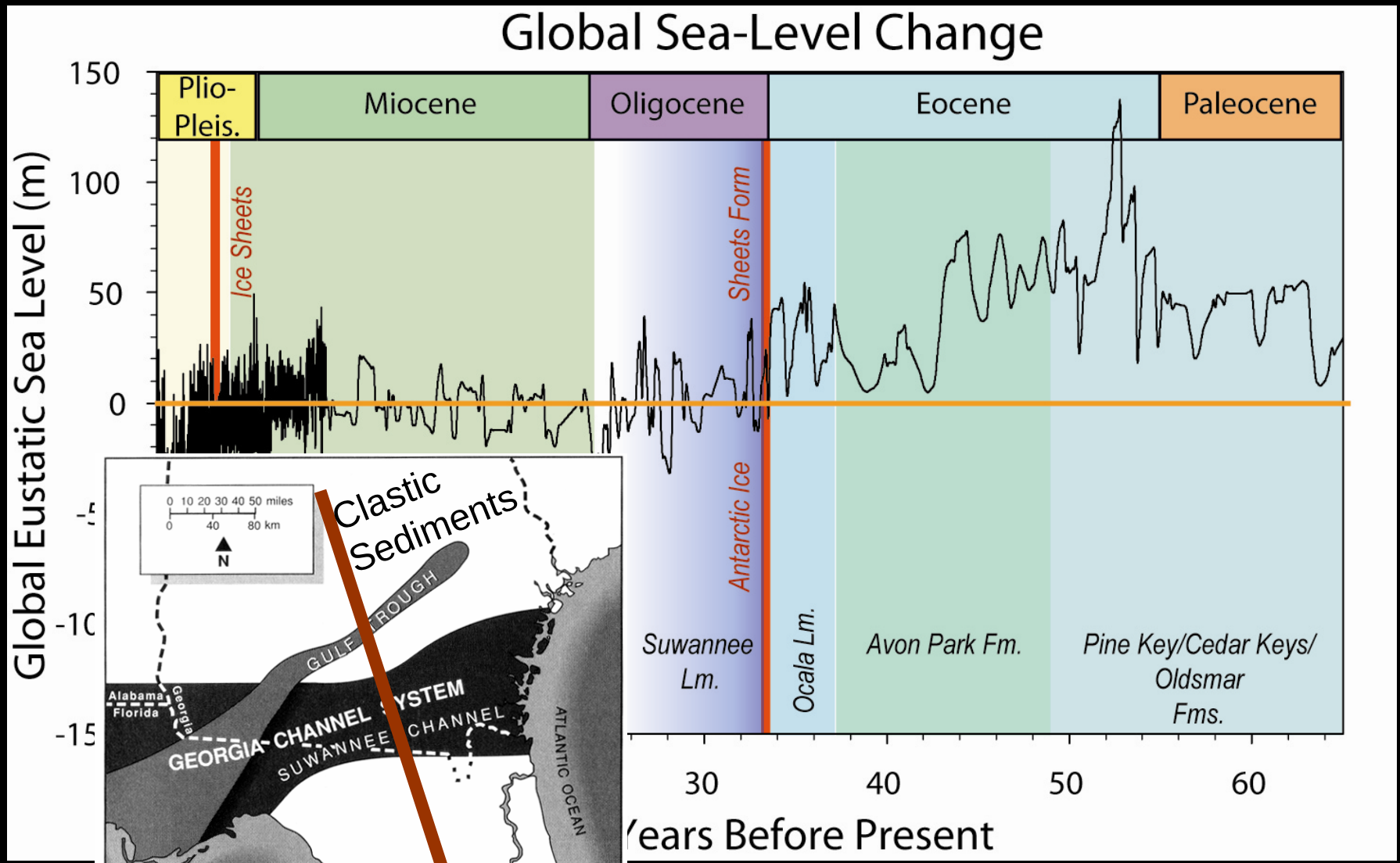
Light oxygen in water ($H_2{}^{16}O$) evaporates more readily that water with heavy oxygen ($H_2{}^{18}O$). Hence oceans will be relatively rich in ^{18}O when glaciers grow and hold the precipitated ^{16}O



Carbonate Microfossils ($CaCO_3$)



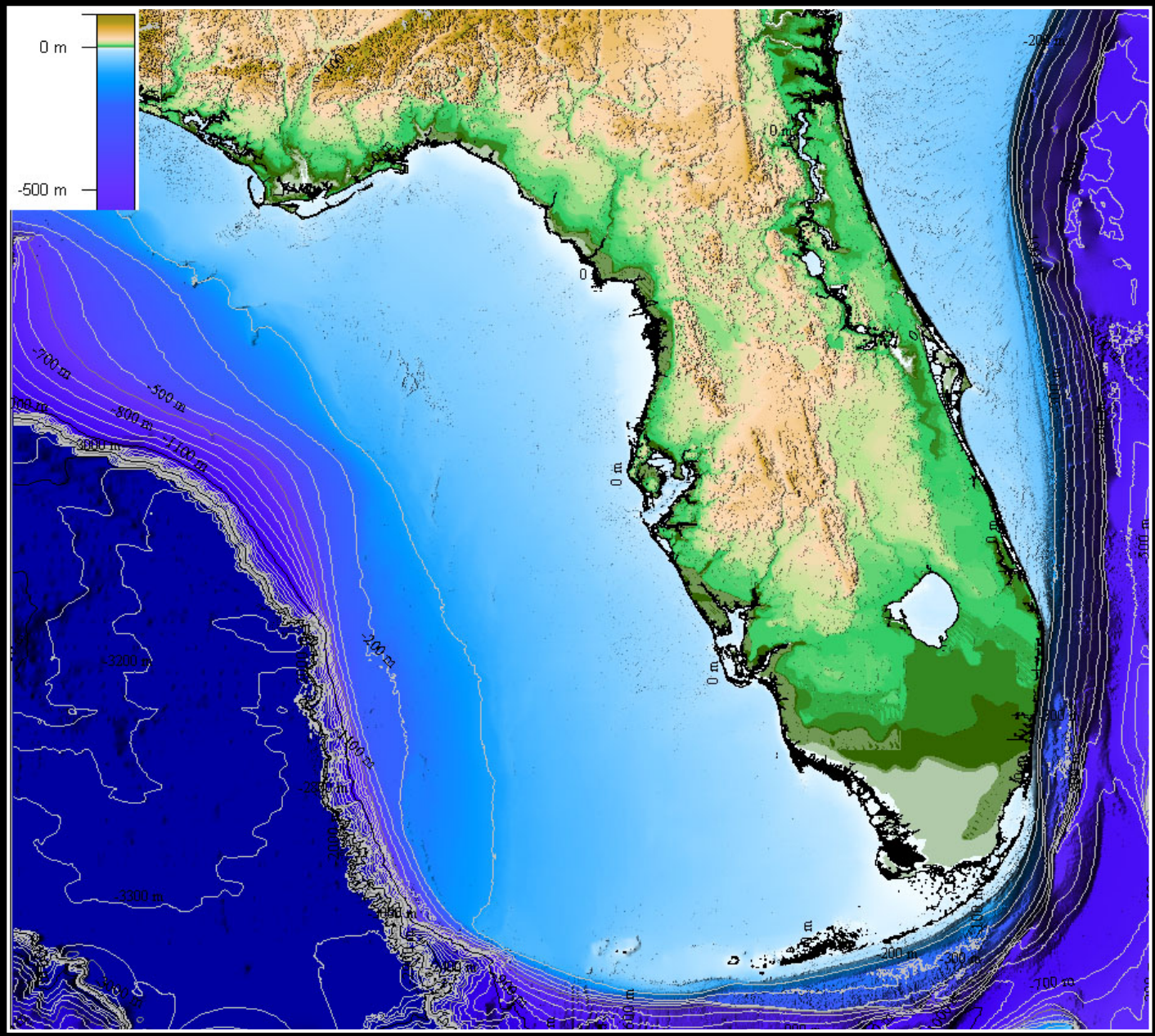
Cenozoic Sea Level Fluctuations



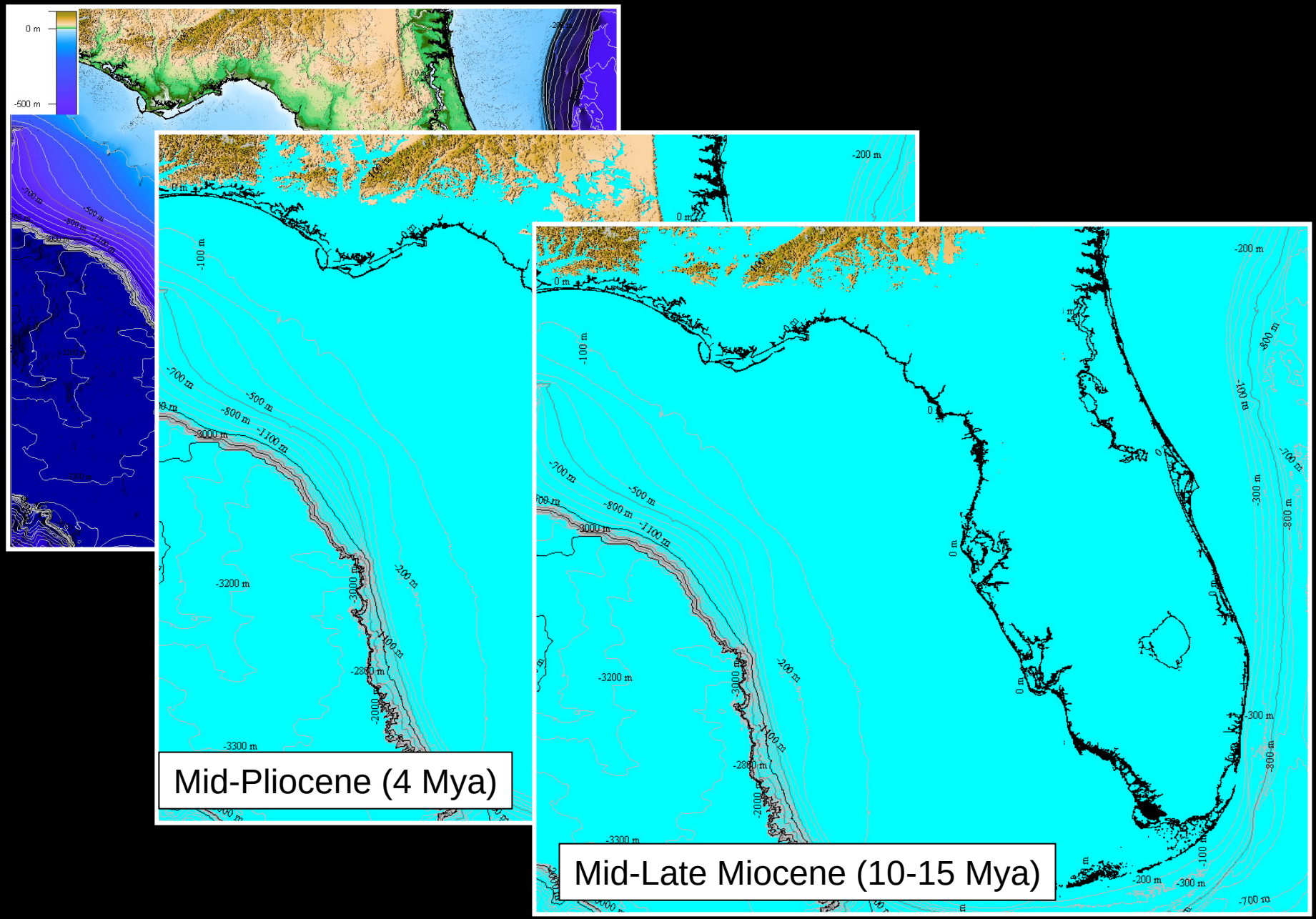
After Randazzo, 1997; Huddlestun, 1993

After Miller et al. (2005), *Science* v. 310, p.1293

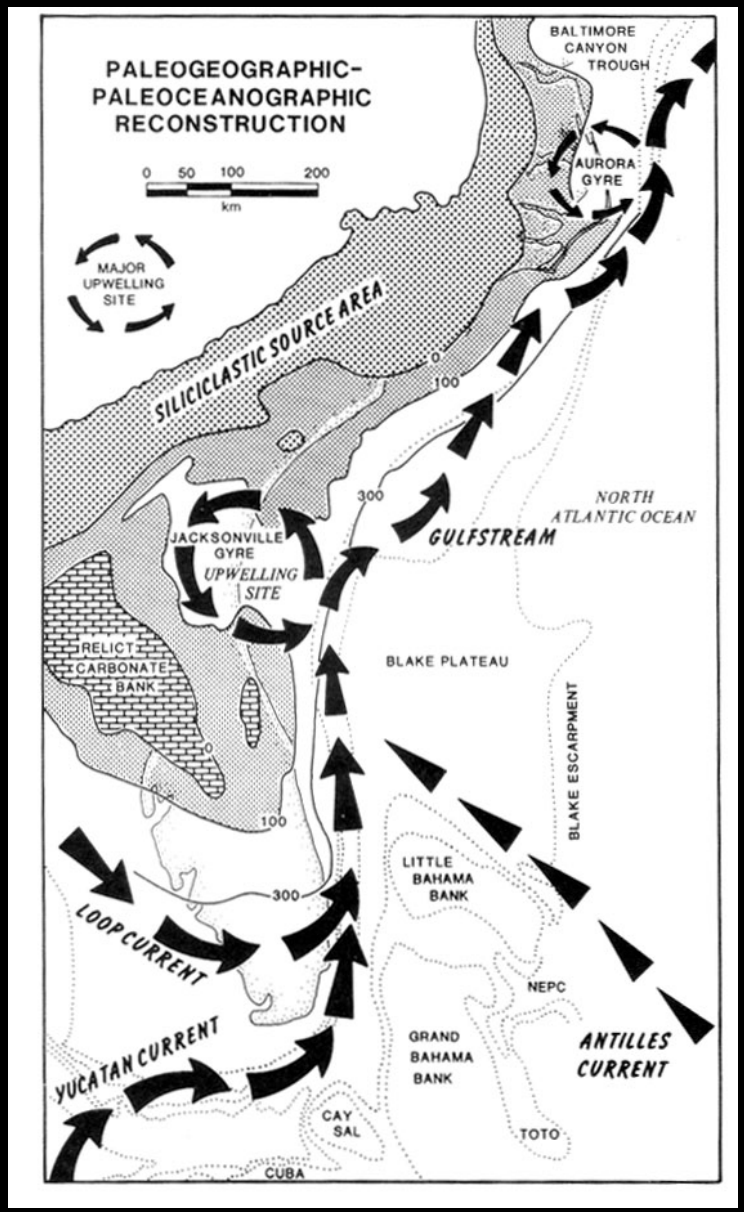
Recent Sea Level Fluctuations

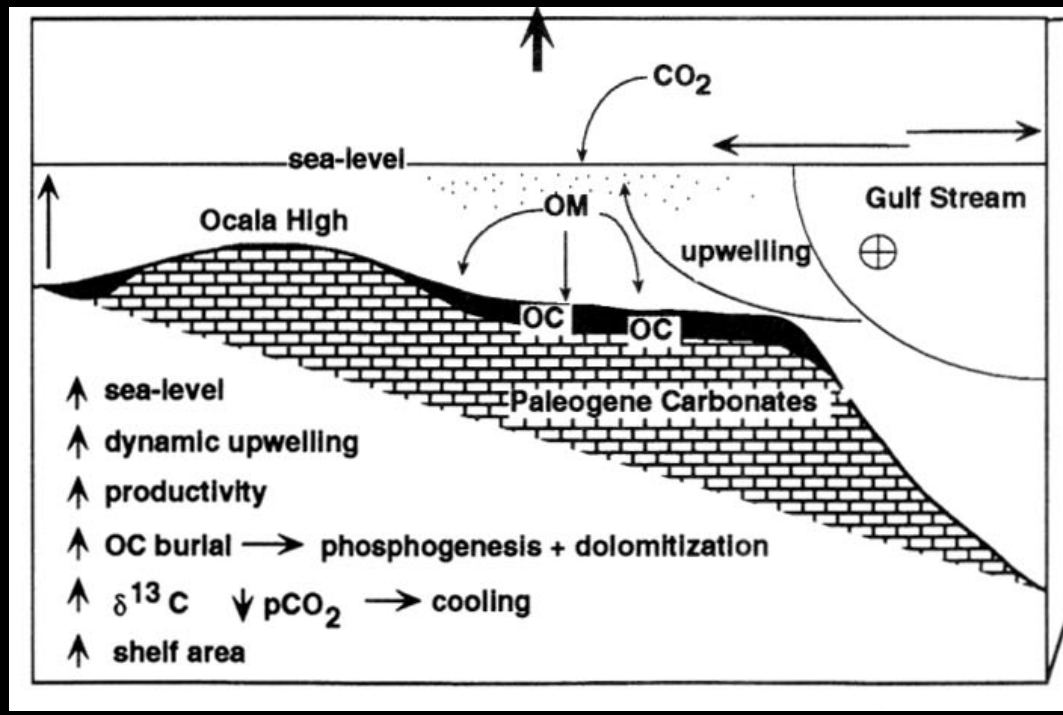


“Icehouse” Sea Level Fluctuations



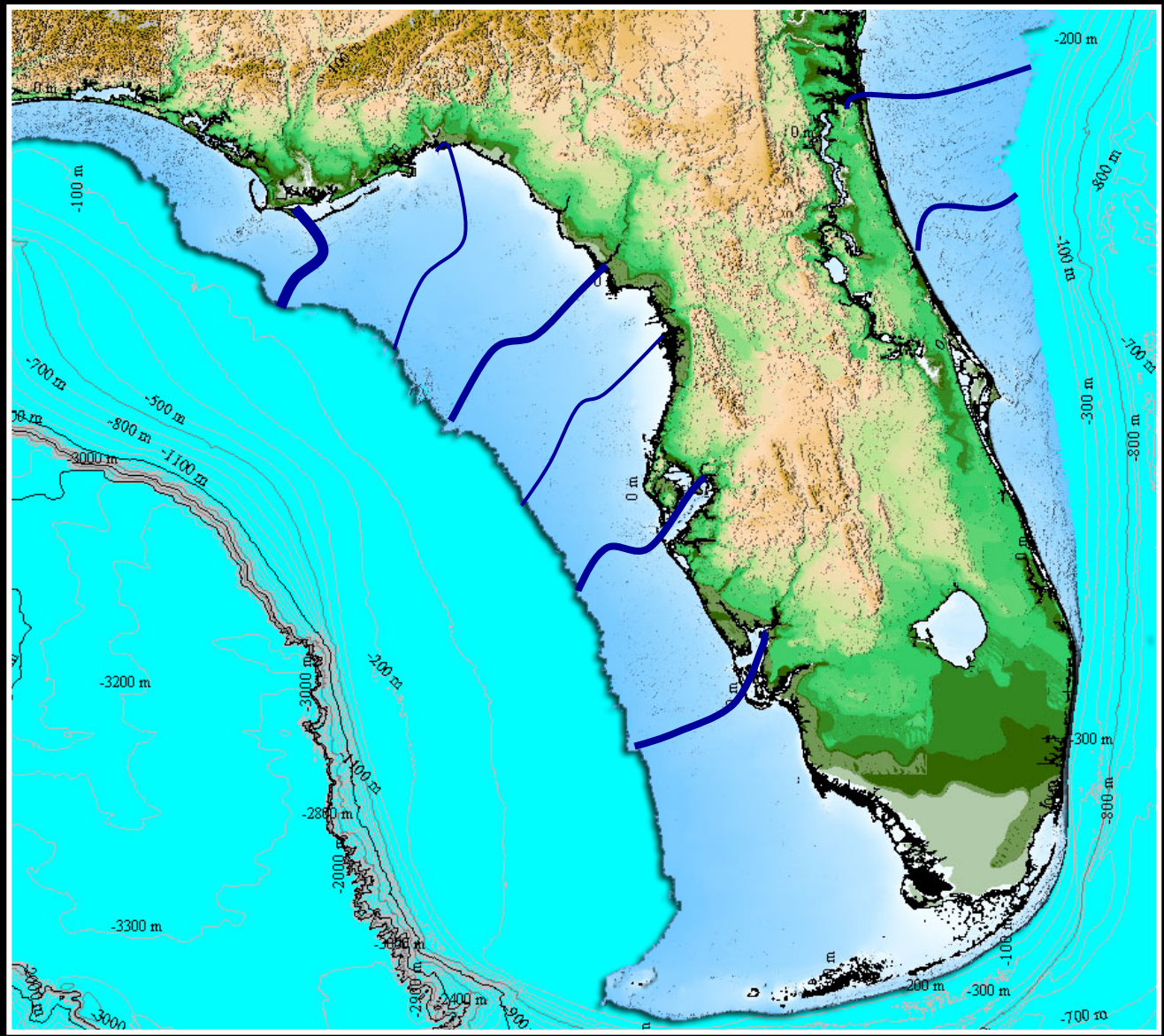
Miocene Paleoceanography and Phosphates



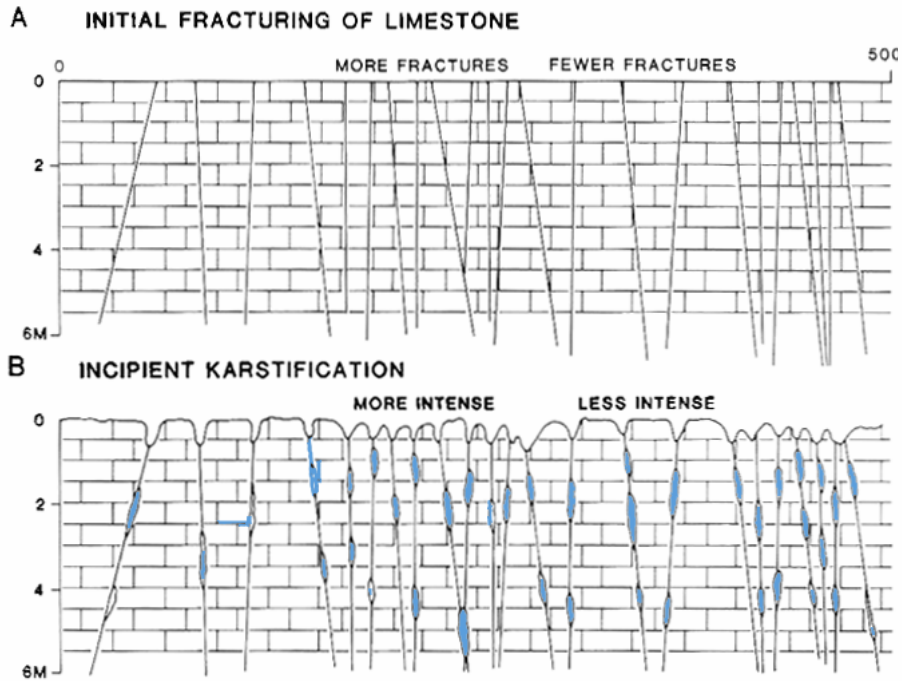


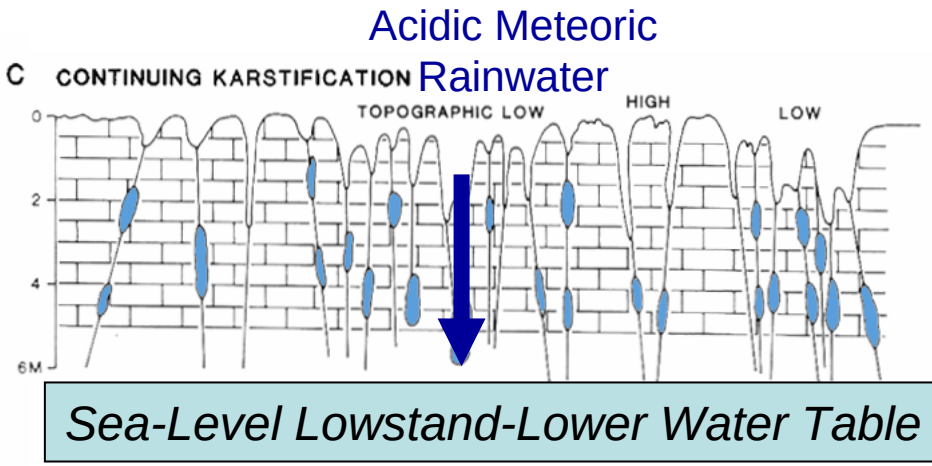
After Compton (1997)

Miocene-Pliocene Sea-Level Low stands



Sea-Level Lowstands and Karstification

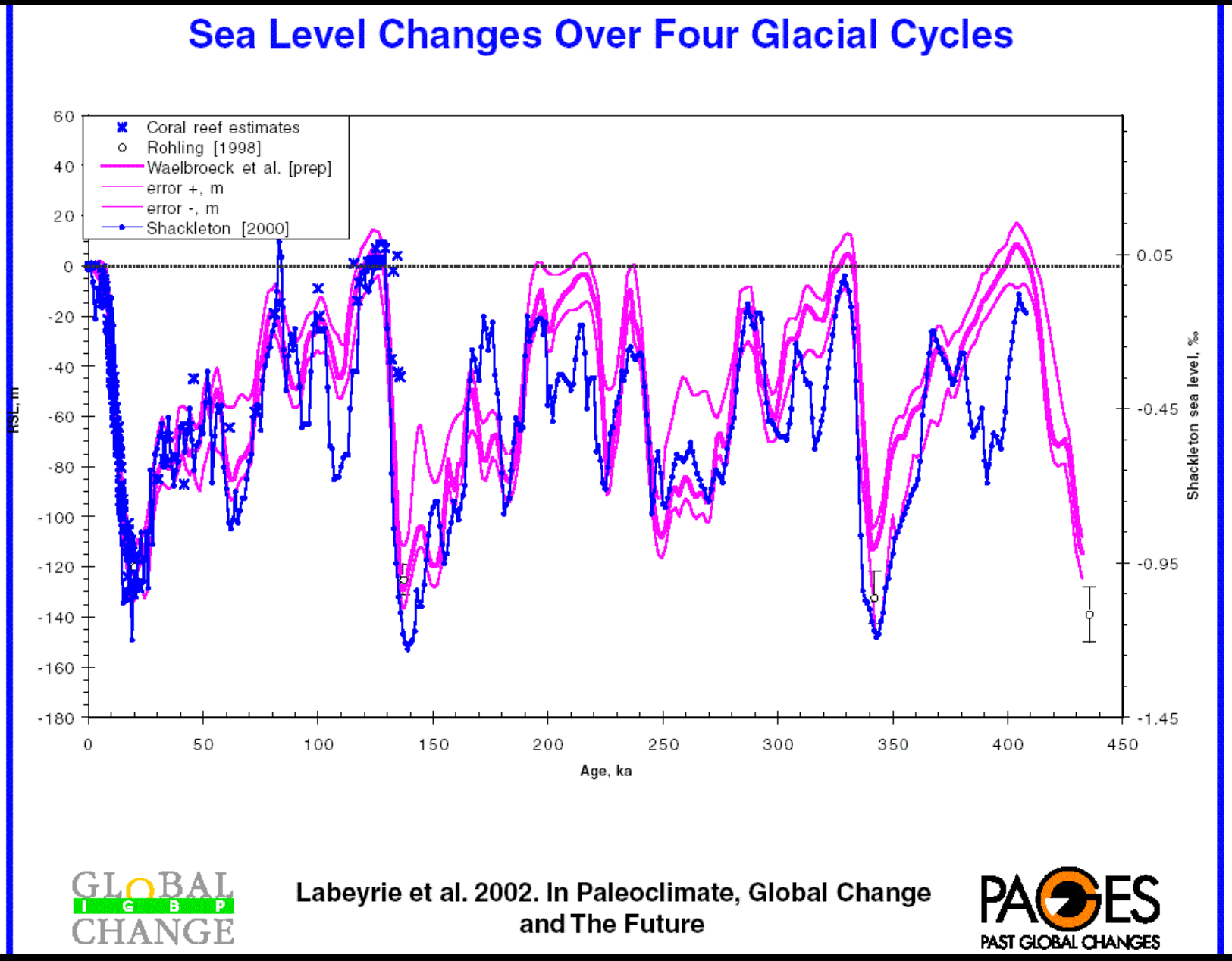




Sea-Level Lowstand-Lower Water Table

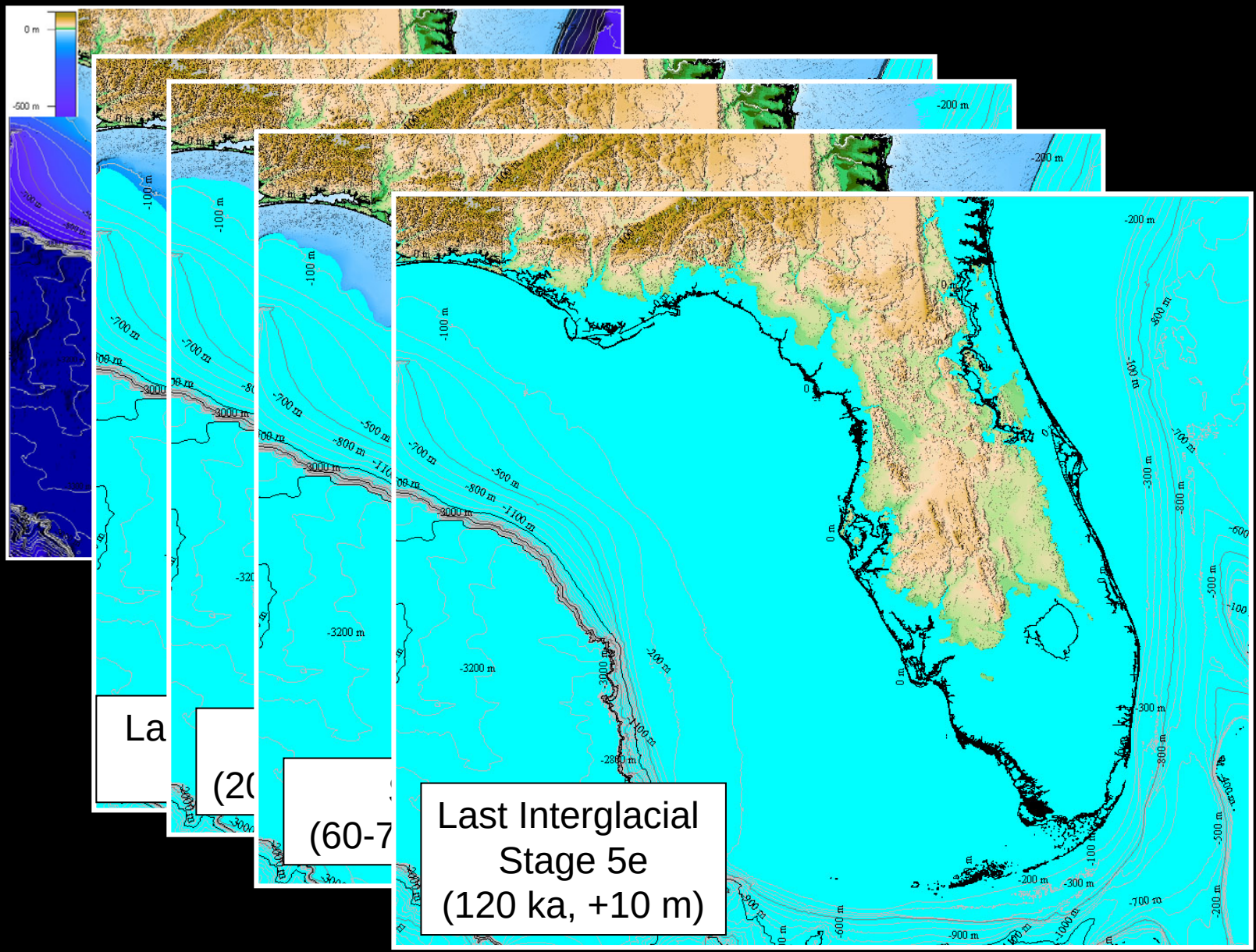
After Hine (1997)

Recent Sea Level Fluctuations

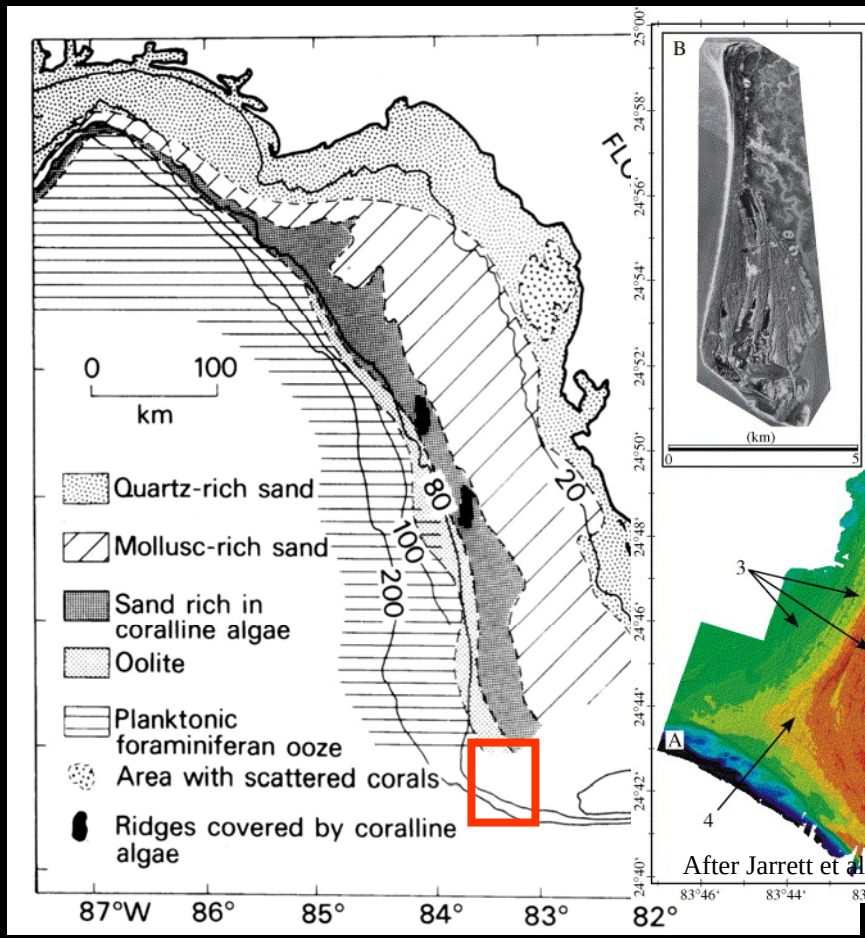


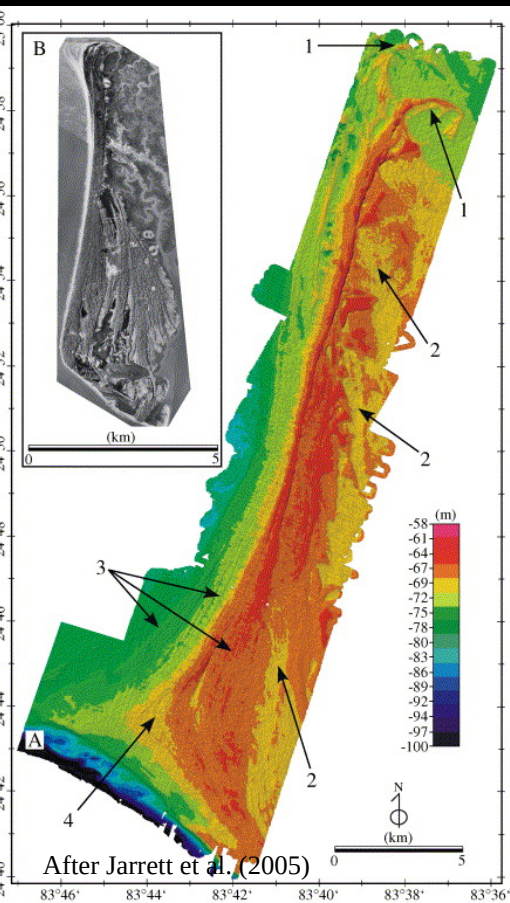
Labeyrie et al. 2002. In Paleoclimate, Global Change and The Future

Late Pleistocene Sea Level Fluctuations

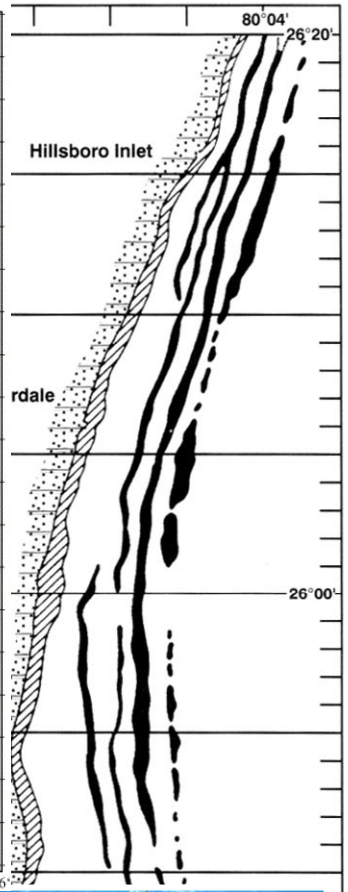


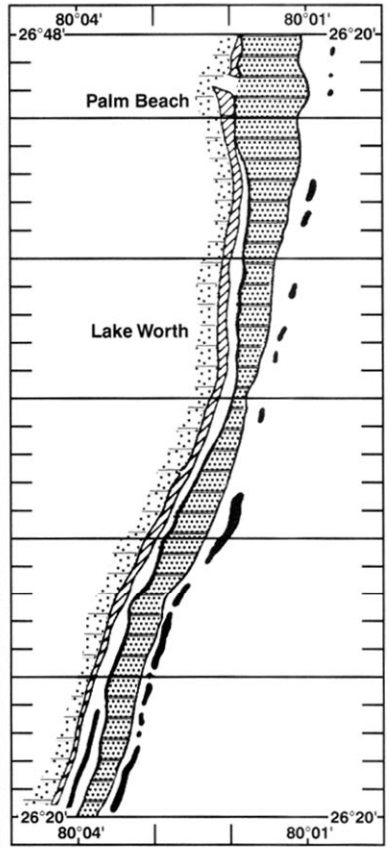
Evidence for Recent Sea Level Low Stands

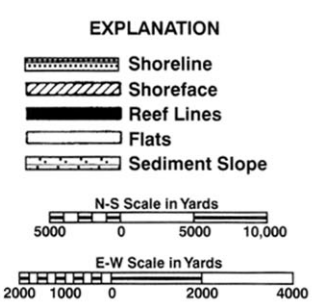




After Jarrett et al. (2005)

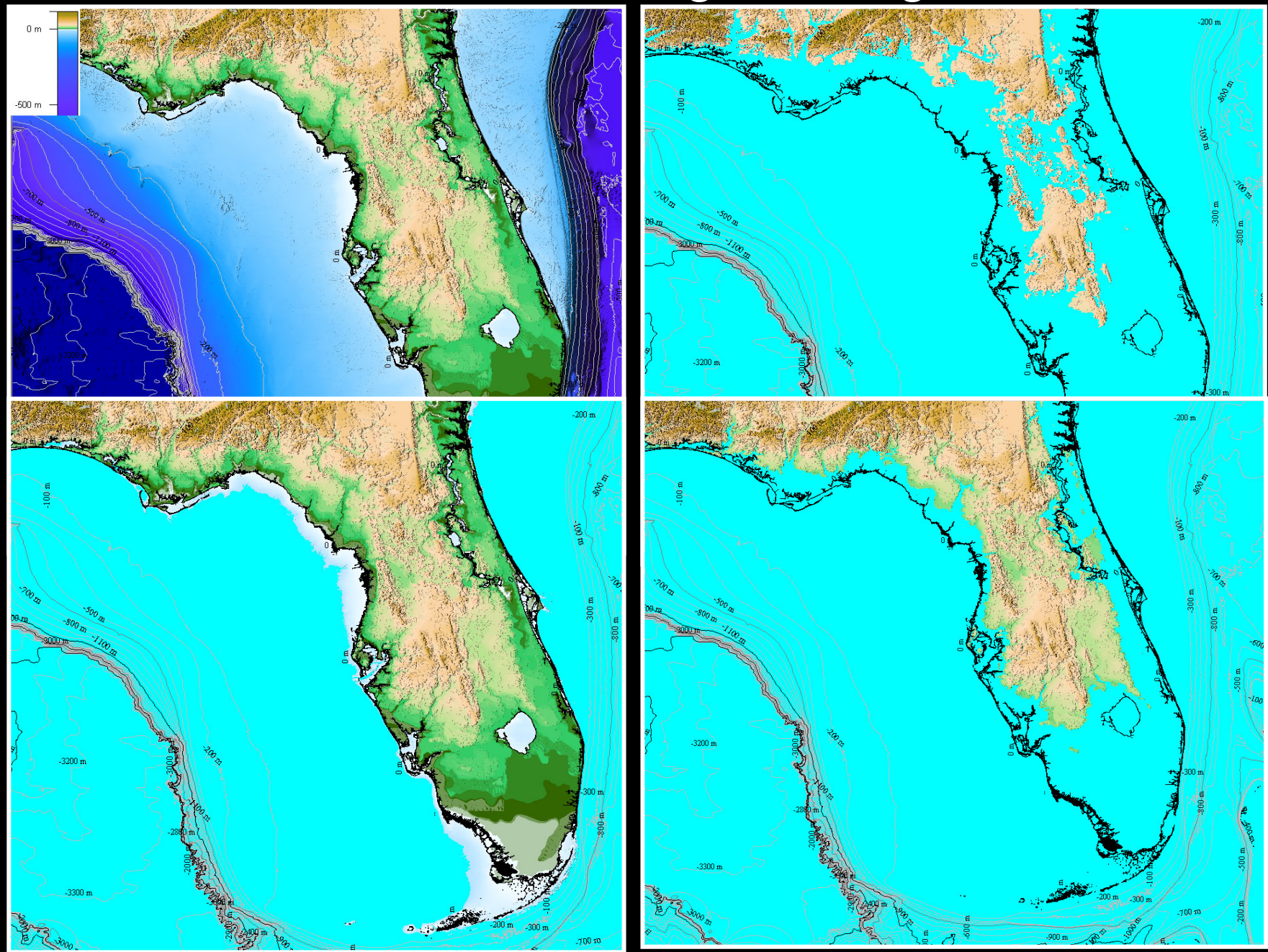




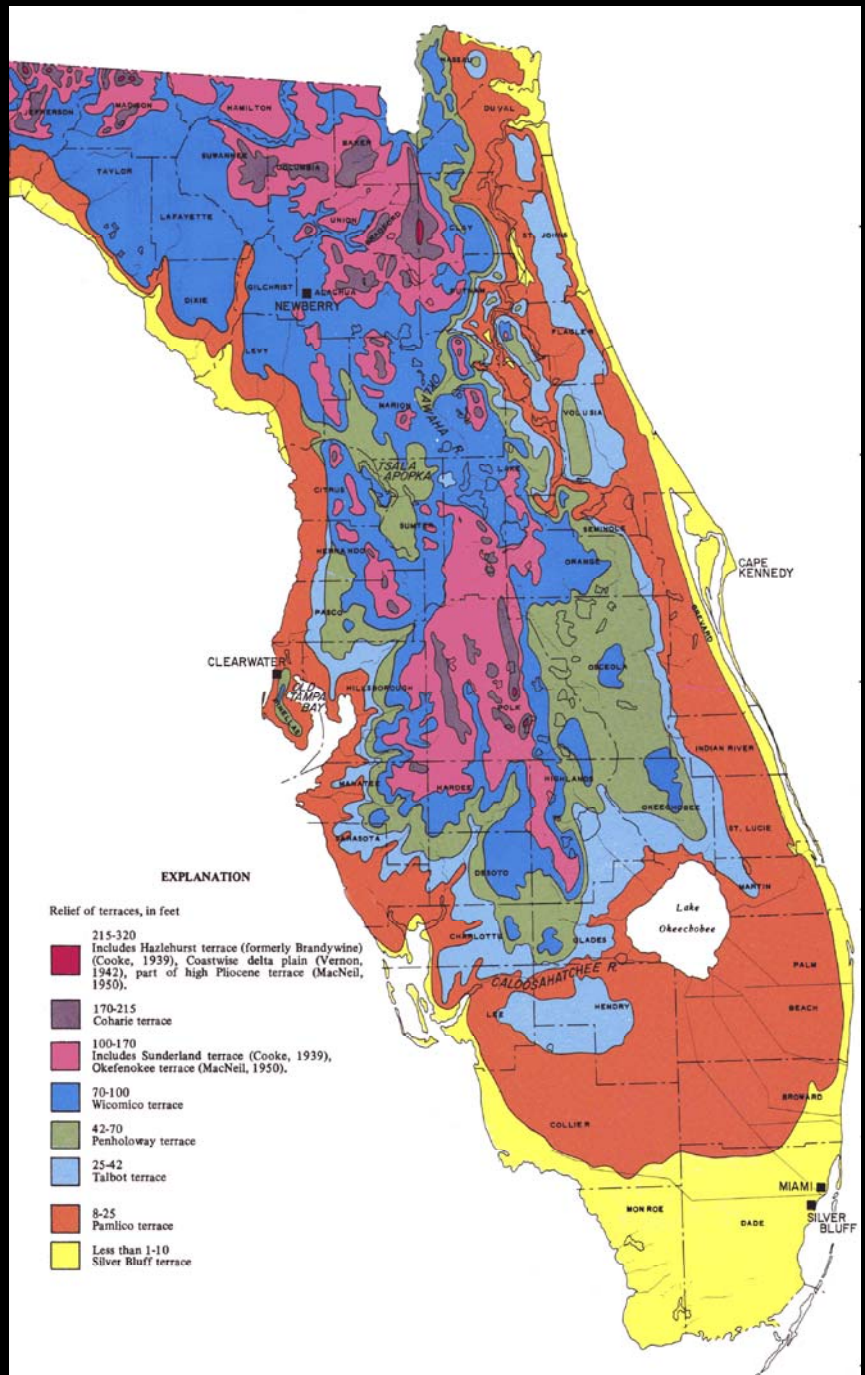


After Hine (1997)

Previous Four Interglacial Highstands

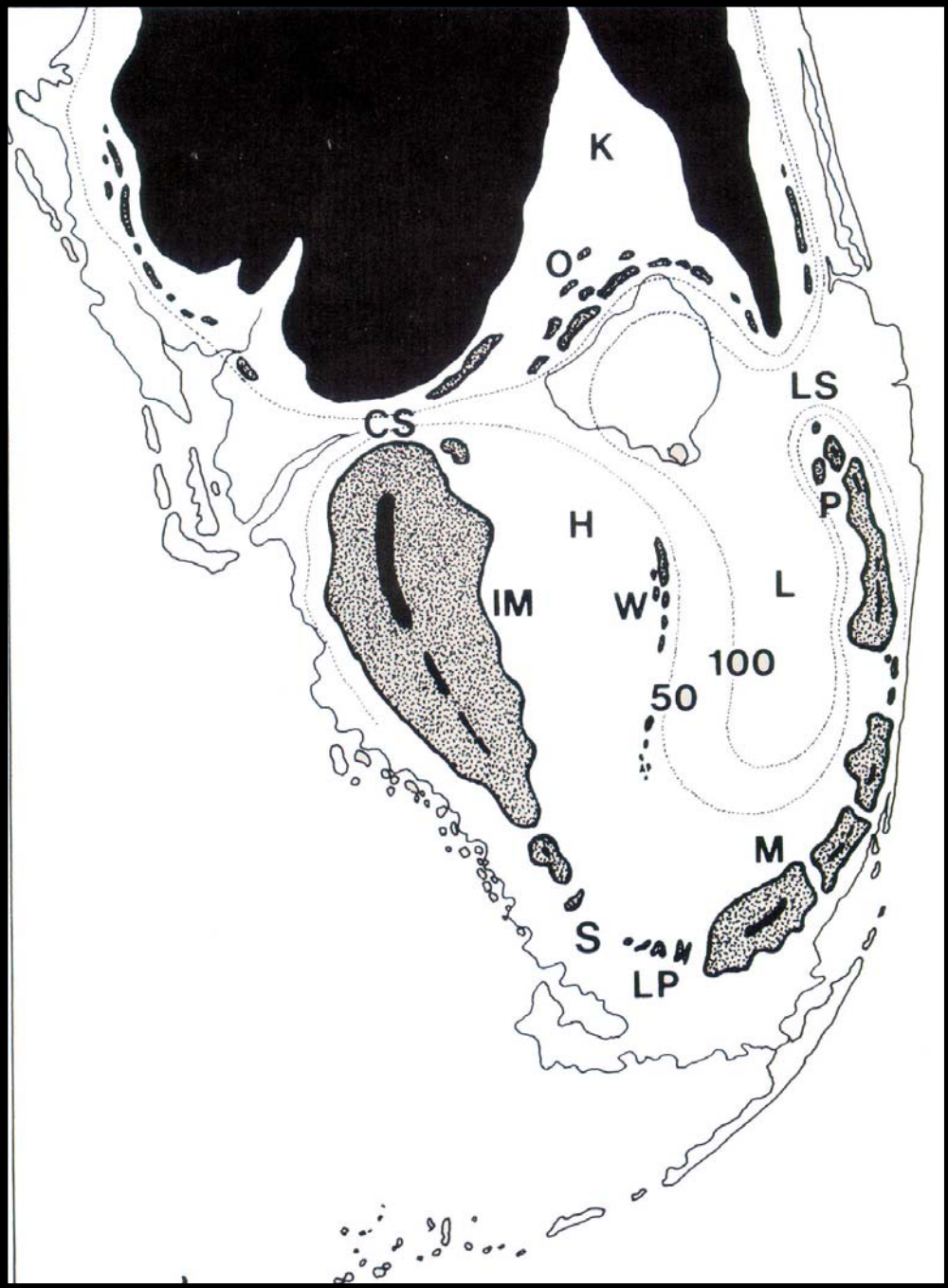


Recent Sea Level Fluctuations and Creation of Terraces



(Healy)1975 –FGS Map 71

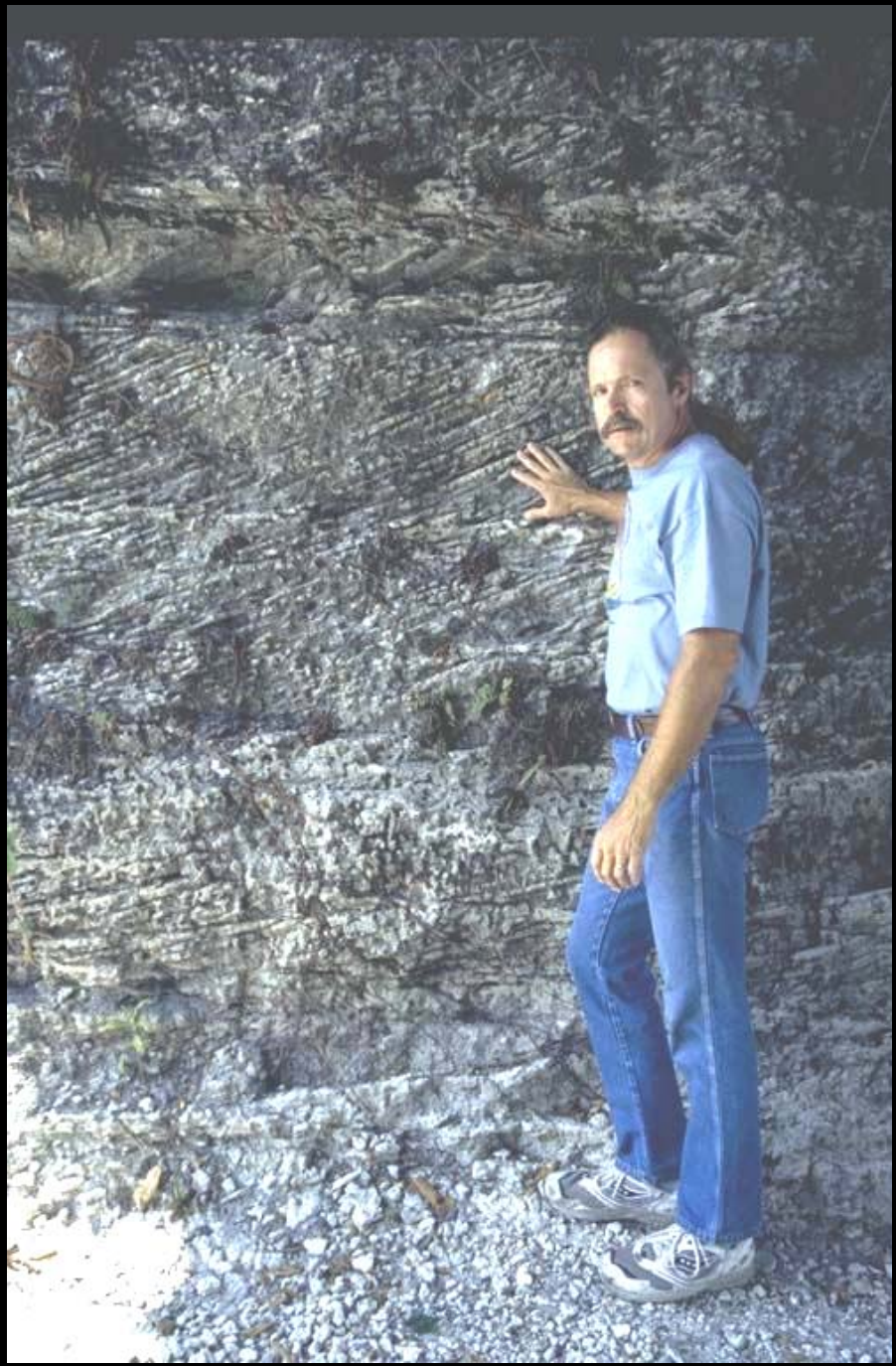
Atlantic Coastal Plain Pliocene-Pleistocene Ridges



South Florida Plio-Pleistocene Coral “Atolls”

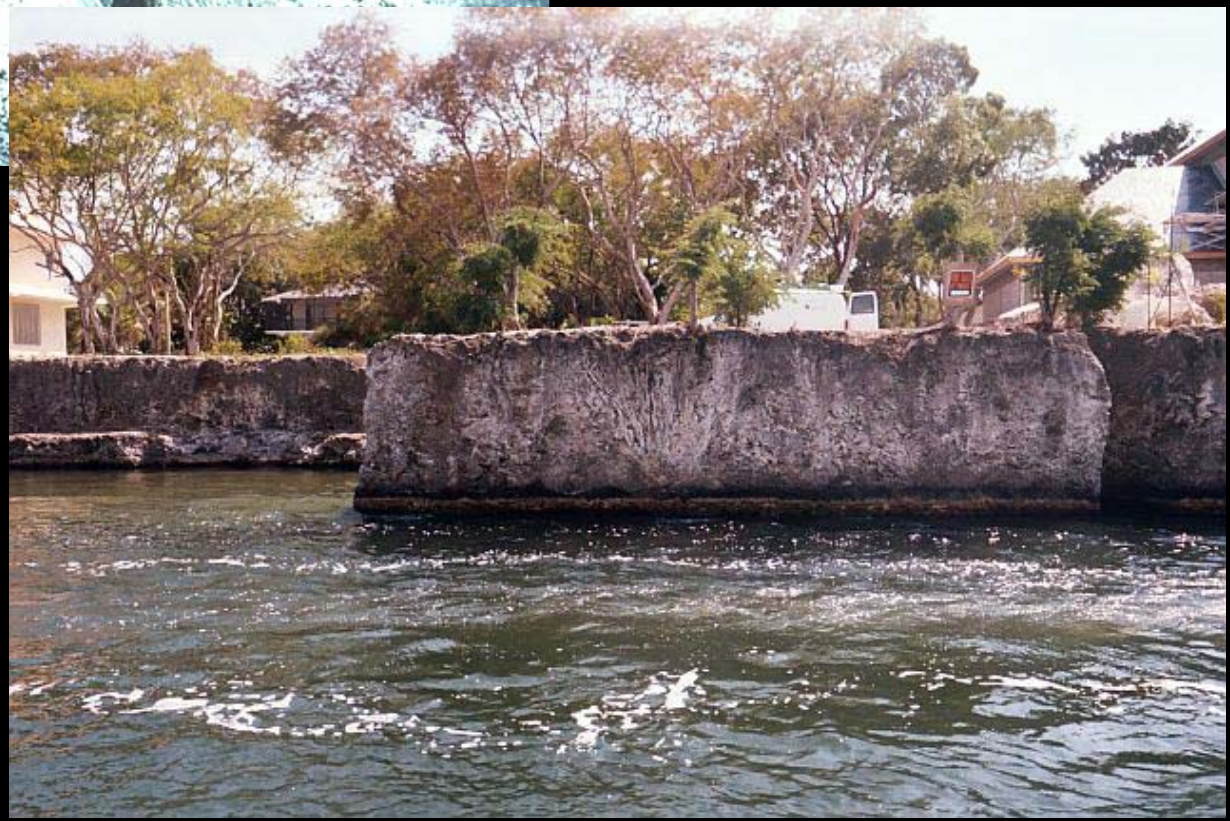
After Meeder (1979) and Petuch (1982)

Old Tidal Channels Transverse Glades in Miami-Dade County



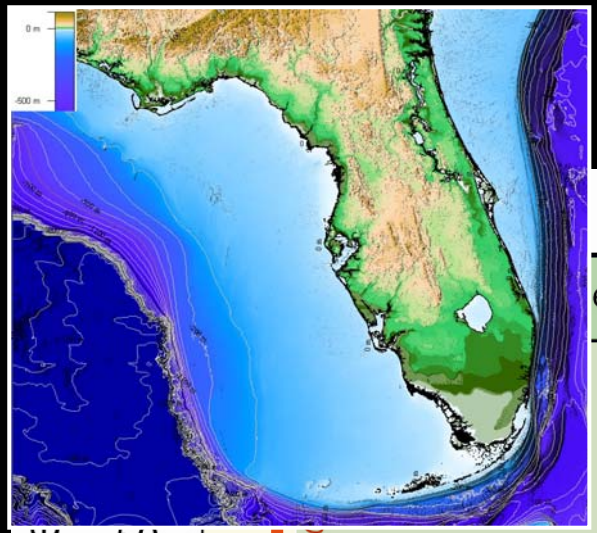
Oolite Phase of Miami Limestone

Key Largo Limestone at Windley Key Quarry



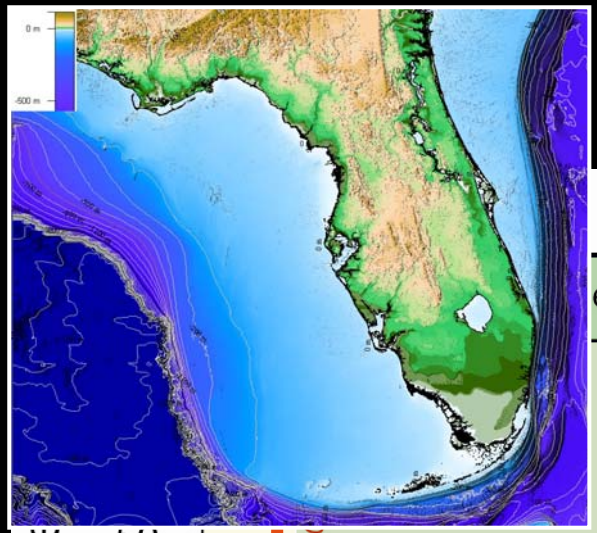
Anastasia Formation showing dune/offshore bar cross bedding and unconformity at Town of Palm Beach

Conclusions



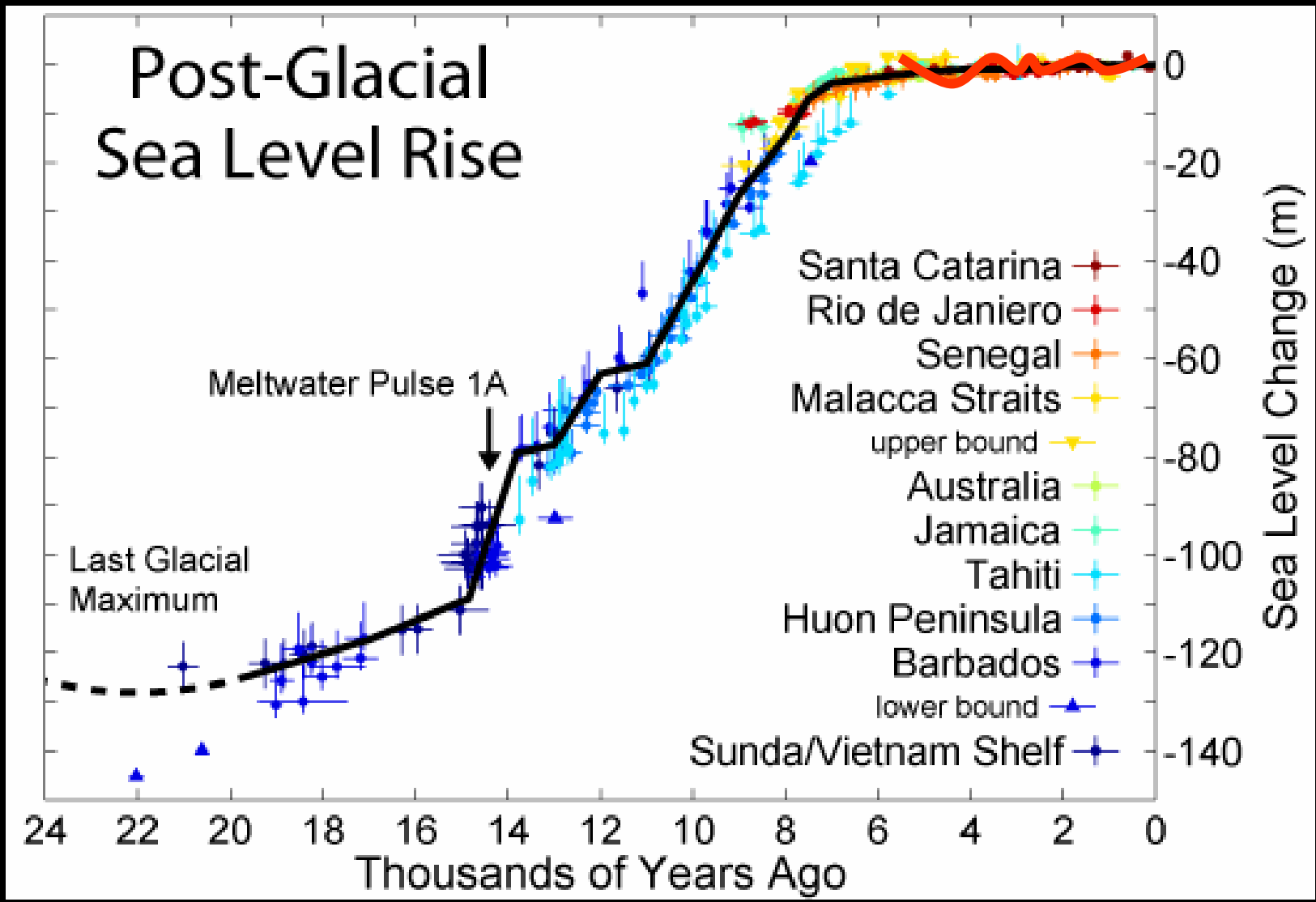
After Miller et al. (2005), *Science* v. 310, p.1293

Conclusions

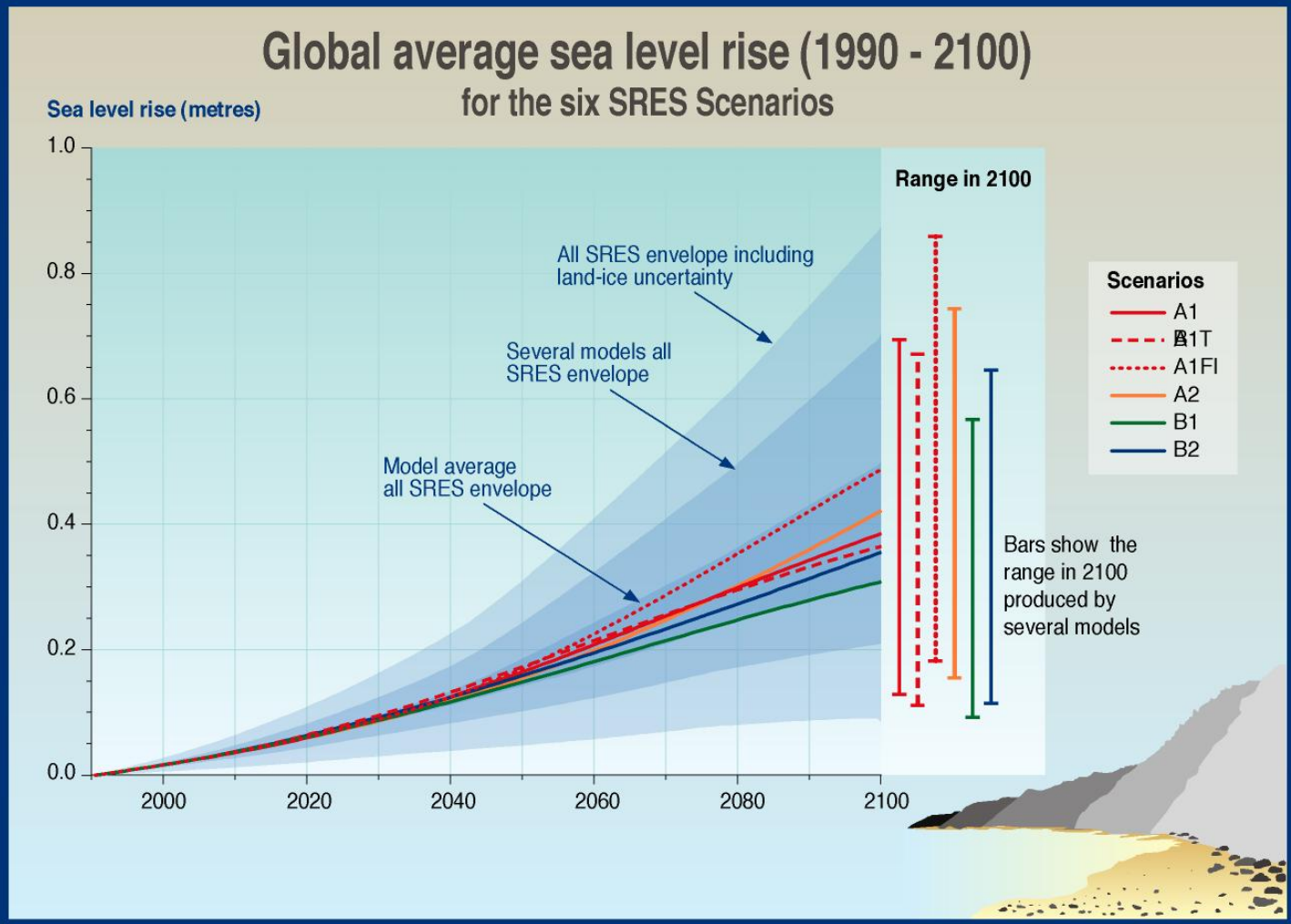


After Miller et al. (2005), *Science* v. 310, p.1293

Accommodation Space – – Relative Sea Level



After Fleming et al. 1998, Fleming 2000, & Milne et al. 2005



WG1 TS FIGURE 24

Projected Sea Level Rise