



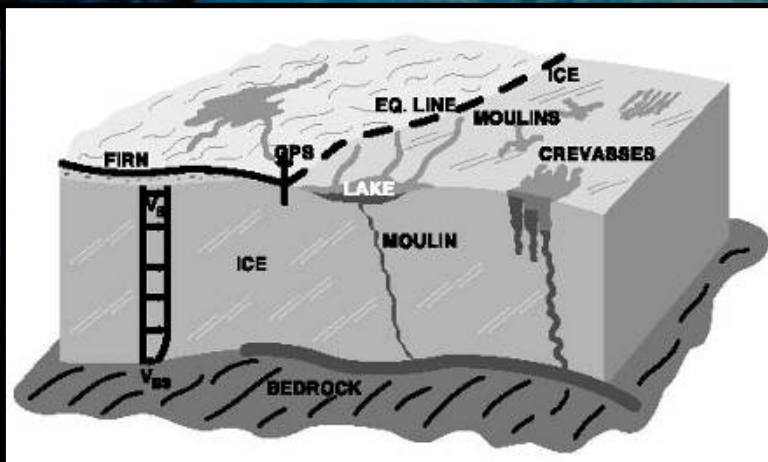
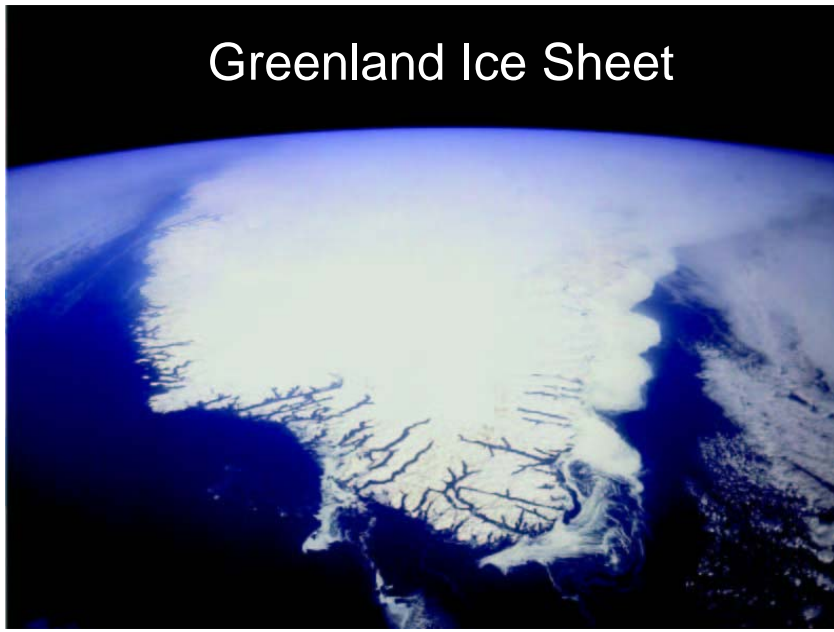
Climate History of Micronesia

Dr. John Jenson

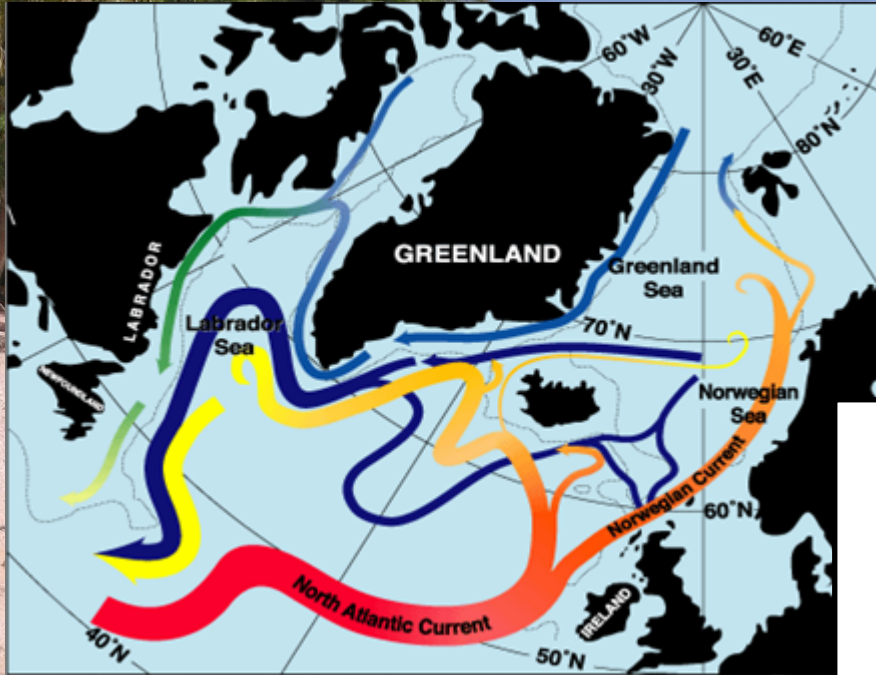
Water and Environmental Research Institute
of the Western Pacific

Ice Sheets and Abrupt Climate Change

Greenland Ice Sheet

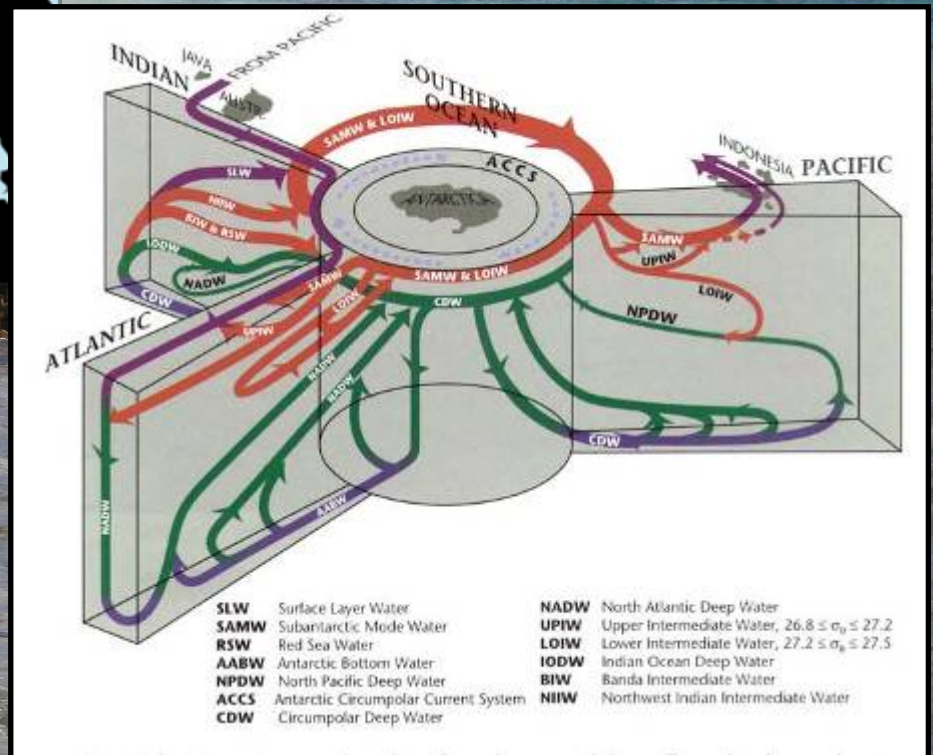


Ocean Circulation

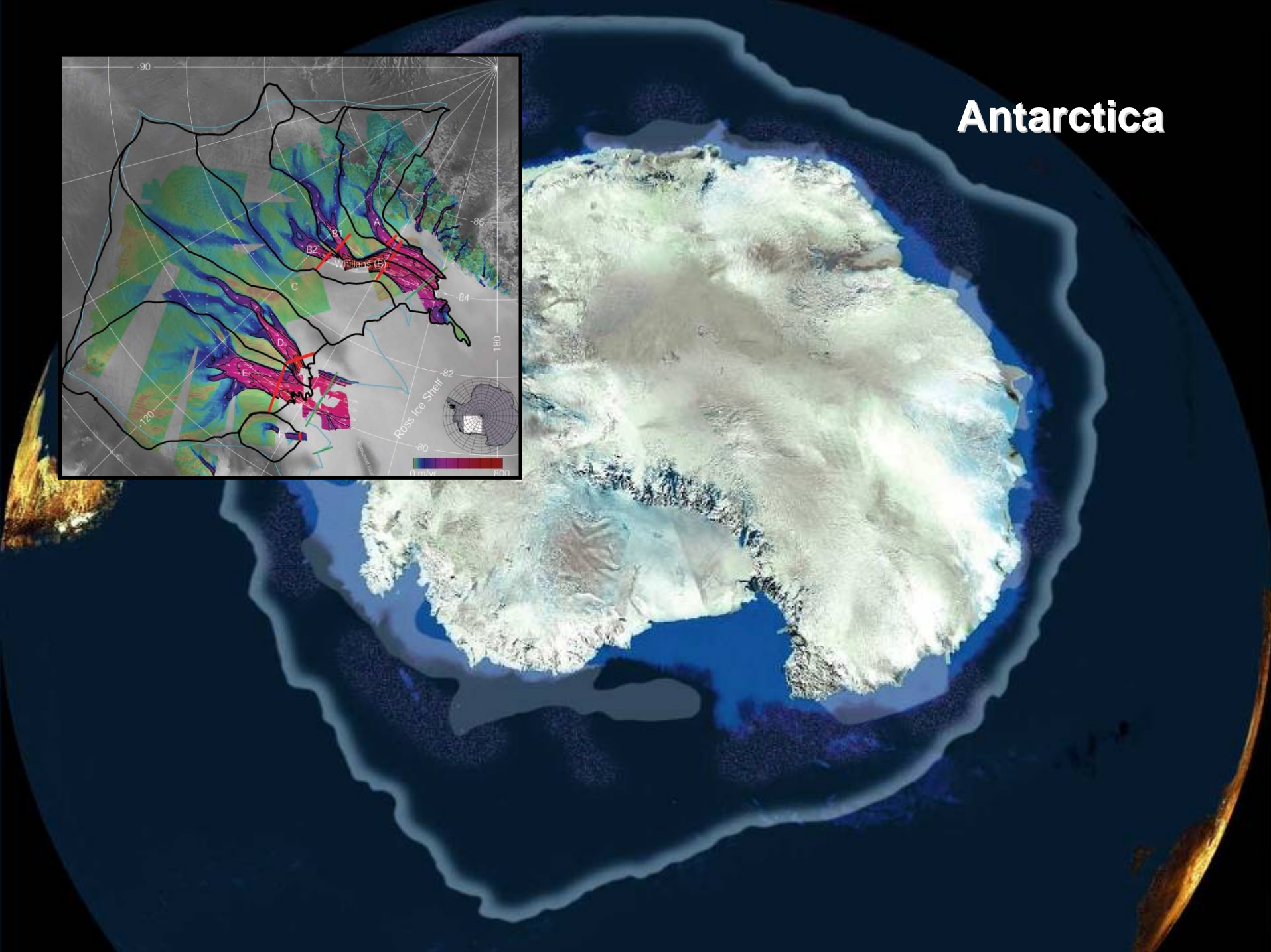
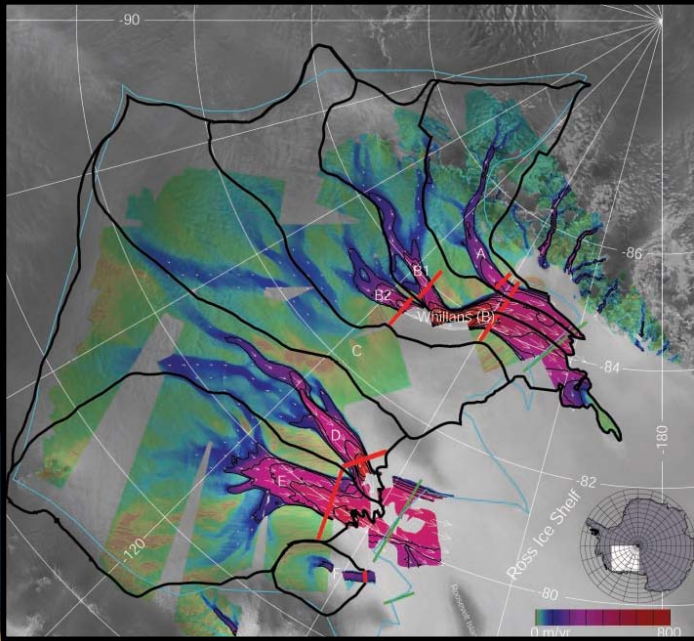


"North Atlantic Conveyor"

Global circulation



Antarctica



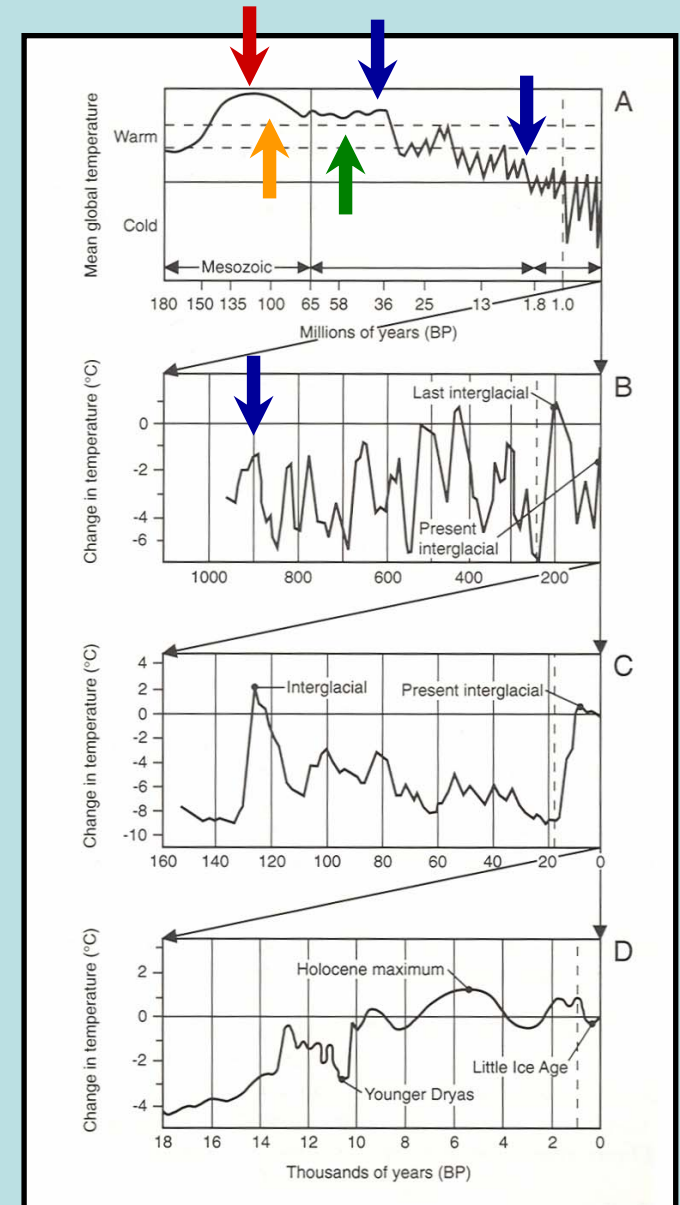
Past is Key to the Future

- Earth's climate has changed throughout its history
- Past million years, "Ice Ages"
 - 10 glacial cycles, ~100,000 years apart
- Previous interglacial, 125,000 years ago
 - Sea level 6-8 meters higher
- Last glacial maximum, ~20,000 years ago
 - Seal level 120 meters lower
- Glacial "melt-down" ~10,000 years ago
 - Mid-Holocene High-Stand 4,000-5,000 years ago

Earth's Climate History: The Big Picture

Cenozoic climate change (Fig. A)

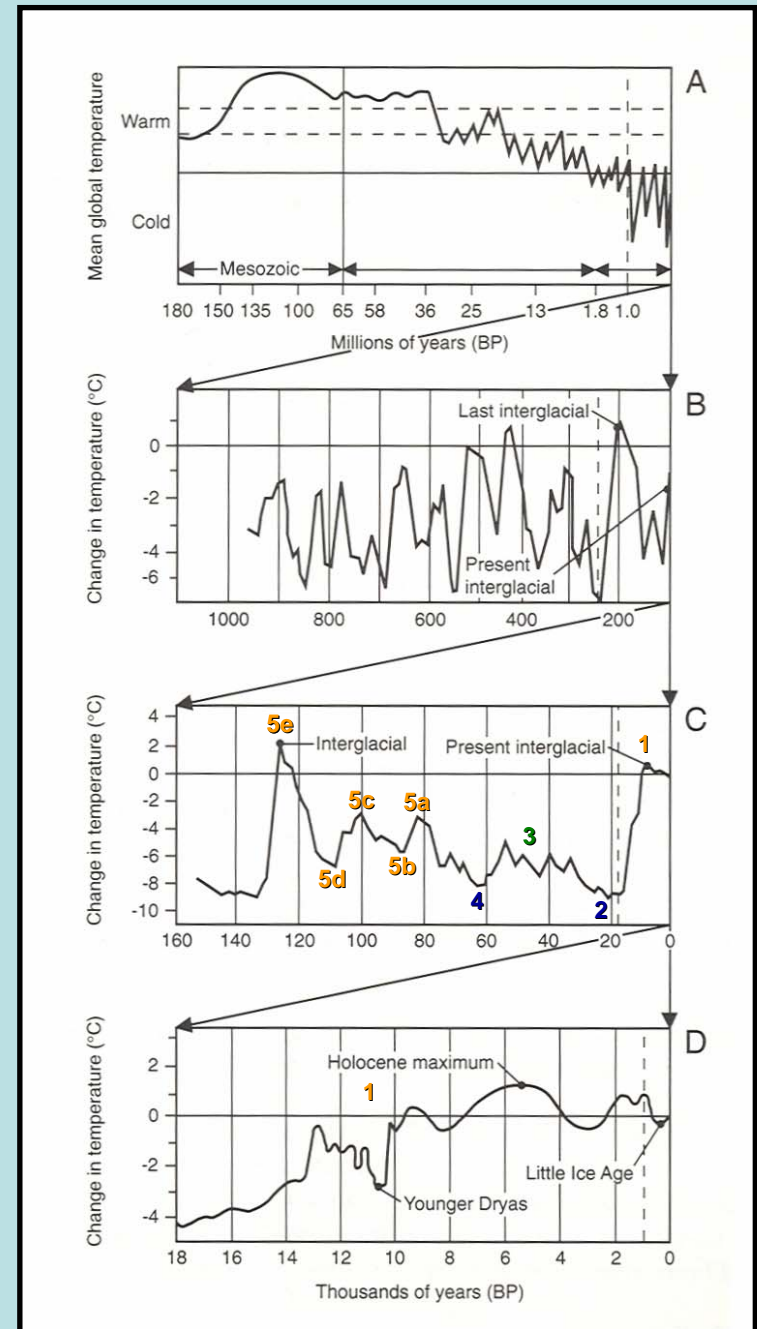
- Before 65 Ma earth was ice-free
 - Tropical vegetation at high latitudes
 - Continents dispersing
 - Pole-to-pole circulation impeded
- ~ 55 Ma general cooling began
 - 50 Ma Australia separates from Antarctica
 - Atmospheric CO₂ decline
- 38 Ma ice sheets on Antarctica
 - 25 Ma Antarctic circumpolar current
- 2.4 Ma Arctic glacial cycles begin
 - Small sheets, 41,000-yr periodicity
- 0.9 Ma “Mid-Pleistocene transition”
 - Large sheets, 100,000-yr periodicity (Fig. B)



The Big Picture, cont'd

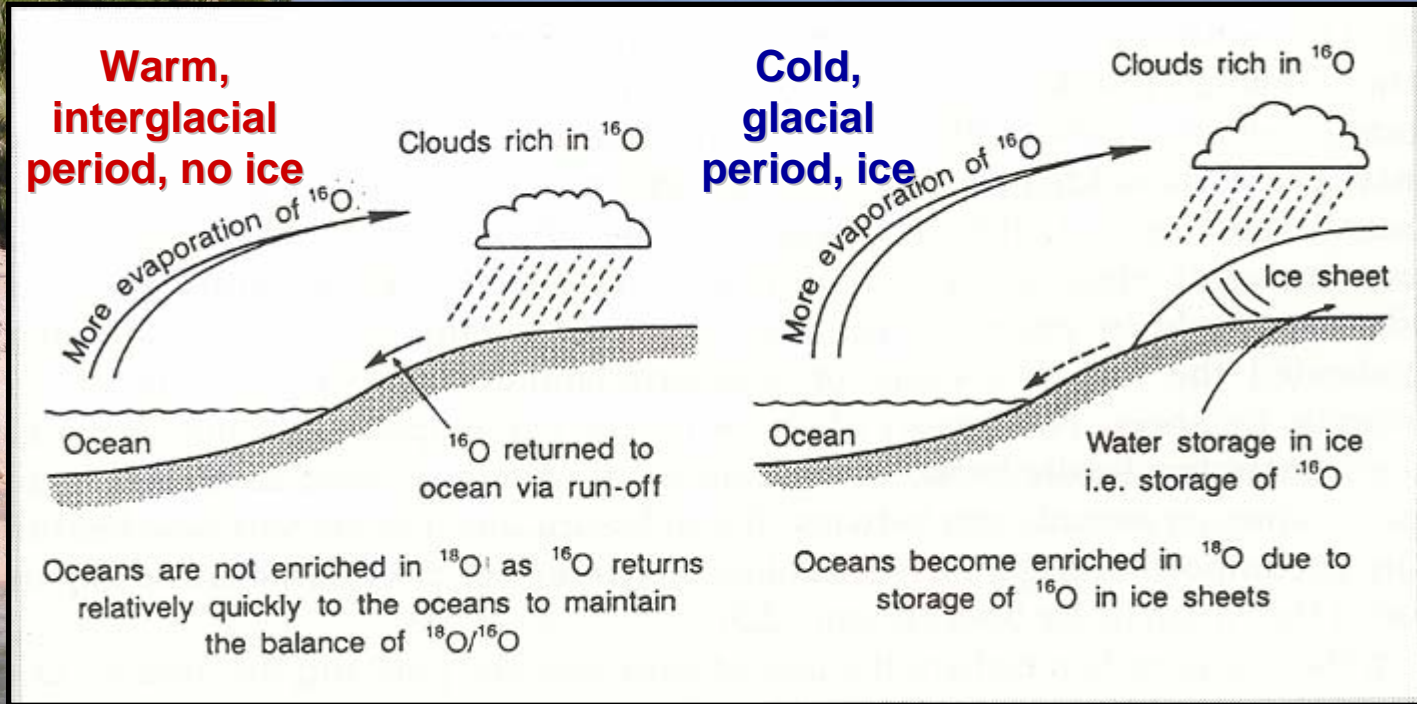
Late Pleistocene (last full cycle, Fig. C)

- 130 ka: Last interglacial ($\delta^{18}\text{O}$ stage 5)
 - Warmer than now
 - Ocean ~ 6 m higher
 - 3 fluctuations (5e-5a)
- 80-60 ka: northern ice sheets (stage 4)
- 60-25 ka: slight warming (stage 3)
- 18 ka: Last Glacial Maximum (stage 2)
- 10 ka: Holocene, Fig. D (stage 1)
 - Sudden, rapid retreat of ice
 - Ice gone from NA, Europe by 6 ka
 - Millennial-scale oscillations seen



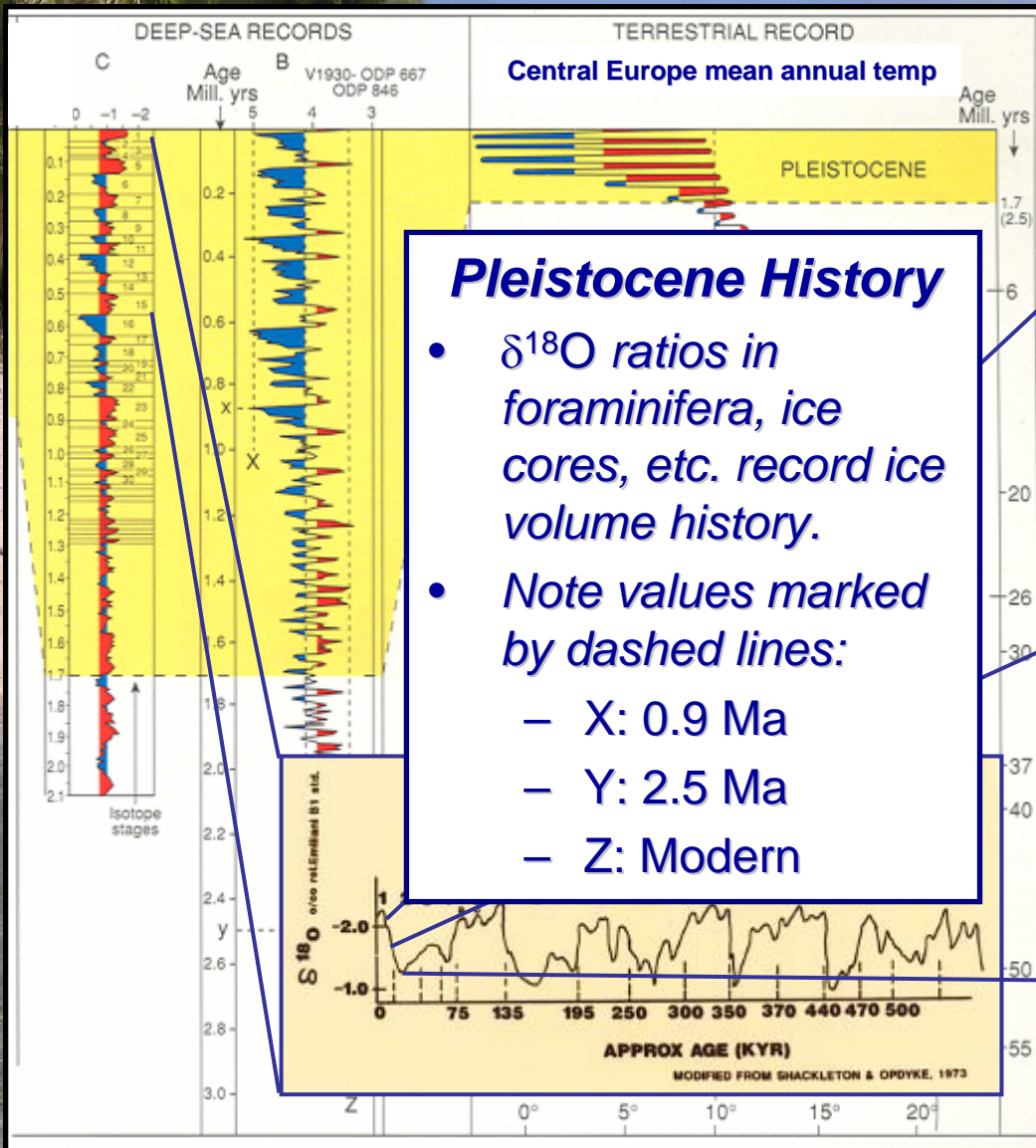
Stable oxygen isotope record

More rapid turnover of lighter isotope in evaporation from ocean surface.



$$\delta^{18}\text{O} = \frac{\left(\frac{^{18}\text{O}}{^{16}\text{O}}\right)_{\text{sample}} - \left(\frac{^{18}\text{O}}{^{16}\text{O}}\right)_{\text{icefree}}}{\left(\frac{^{18}\text{O}}{^{16}\text{O}}\right)_{\text{icefree}}} \times 1000$$

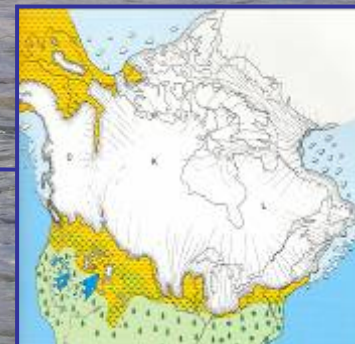
The $\delta^{18}\text{O}$ climate record



11,500
years ago



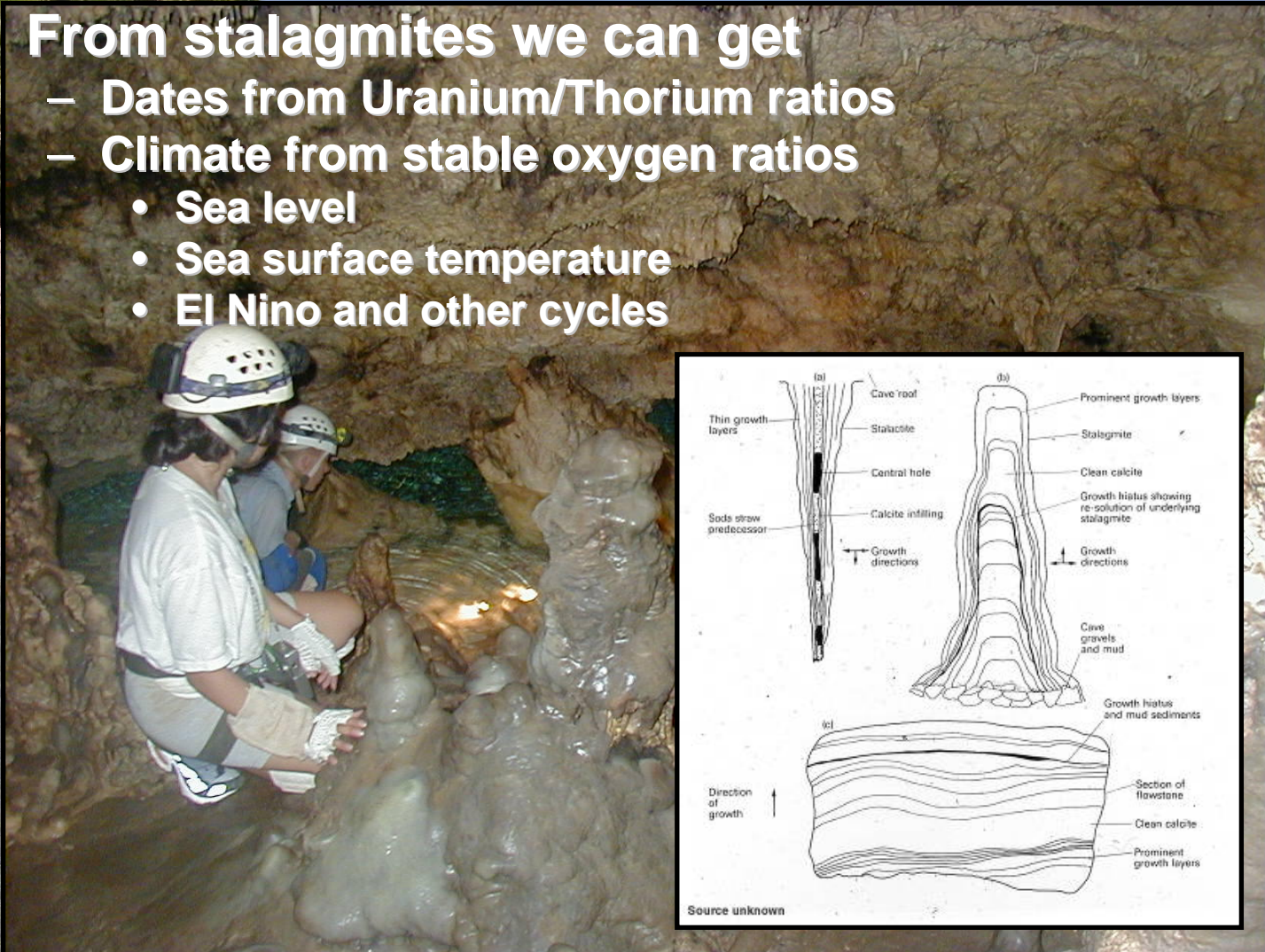
15,000
years ago



Last
Glacial
Maximum
(LGM or
Stage 2)

The Cave Record

- From stalagmites we can get
 - Dates from Uranium/Thorium ratios
 - Climate from stable oxygen ratios
 - Sea level
 - Sea surface temperature
 - El Nino and other cycles



Jinapsan Cave, NW Guam



Current Work & Plans



- **Stalagmites at University of Texas**
 - U/Th dating and $\delta^{18}\text{O}$ work by Dr. Jay Banner
- **If current work yields promising results....**
 - Will seek funding for multi-year study
 - Guam, Saipan, Tinian, Rota, and Fais
 - Would reveal climate history of the northern fringe of the WPWP