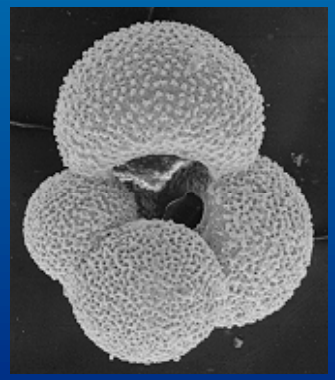
Linkages between climate variability and foraminifera sedimentation in Santa Barbara and Cariaco Basins

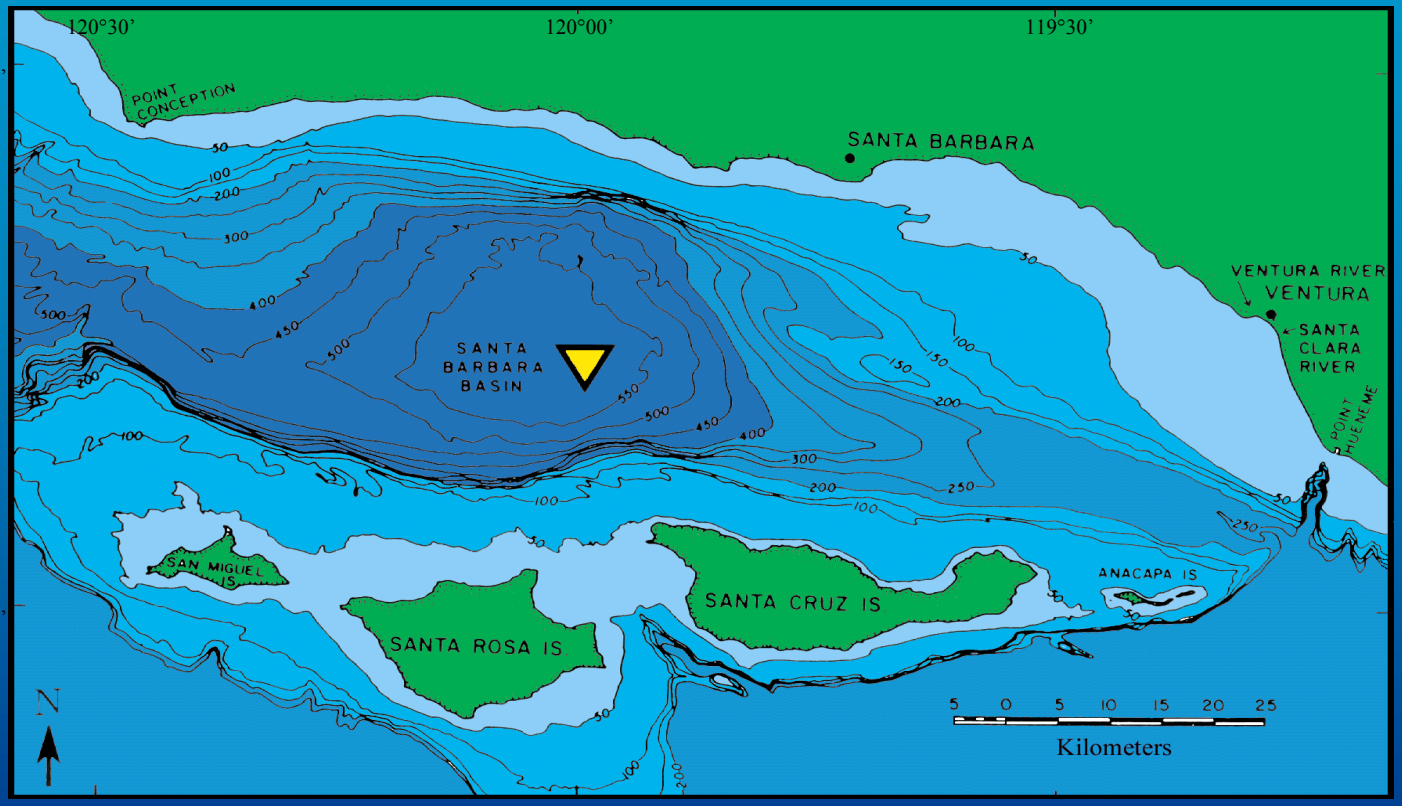
- David E. Black (School of Marine and Atmospheric Sciences, Stony Brook University, NY)



Marine Sediments : Earth's History Book

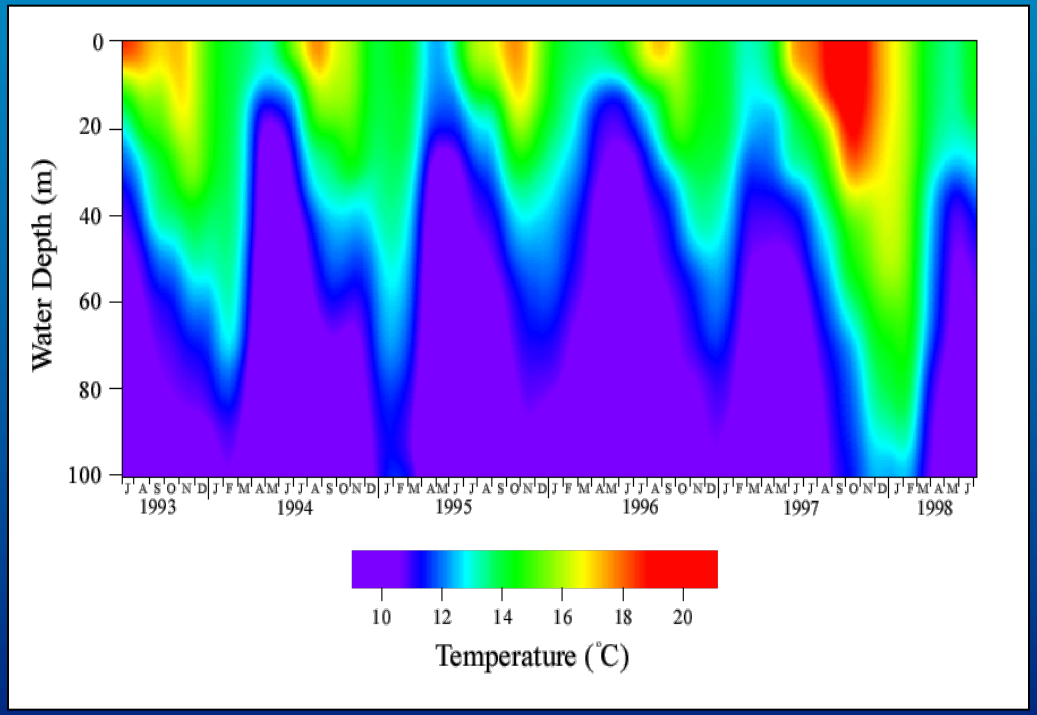
- Interested in establishing baselines of variability.
- Modern (including last 50-100 years) data likely contains an anthropogenic component.
- Microfossil assemblages, trace element, stable isotope, and organic geochemistry, *etc.*
- A bottom-up view of the world, but an integrated one.

Santa Barbara Basin, California

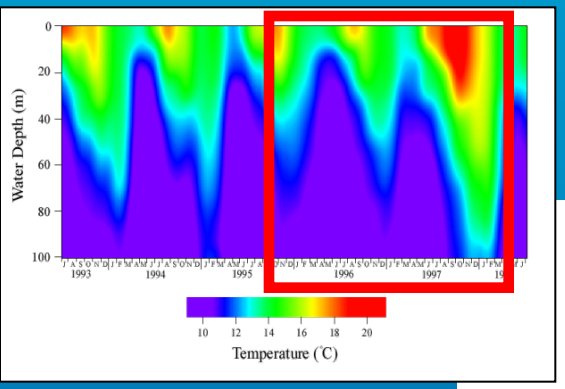


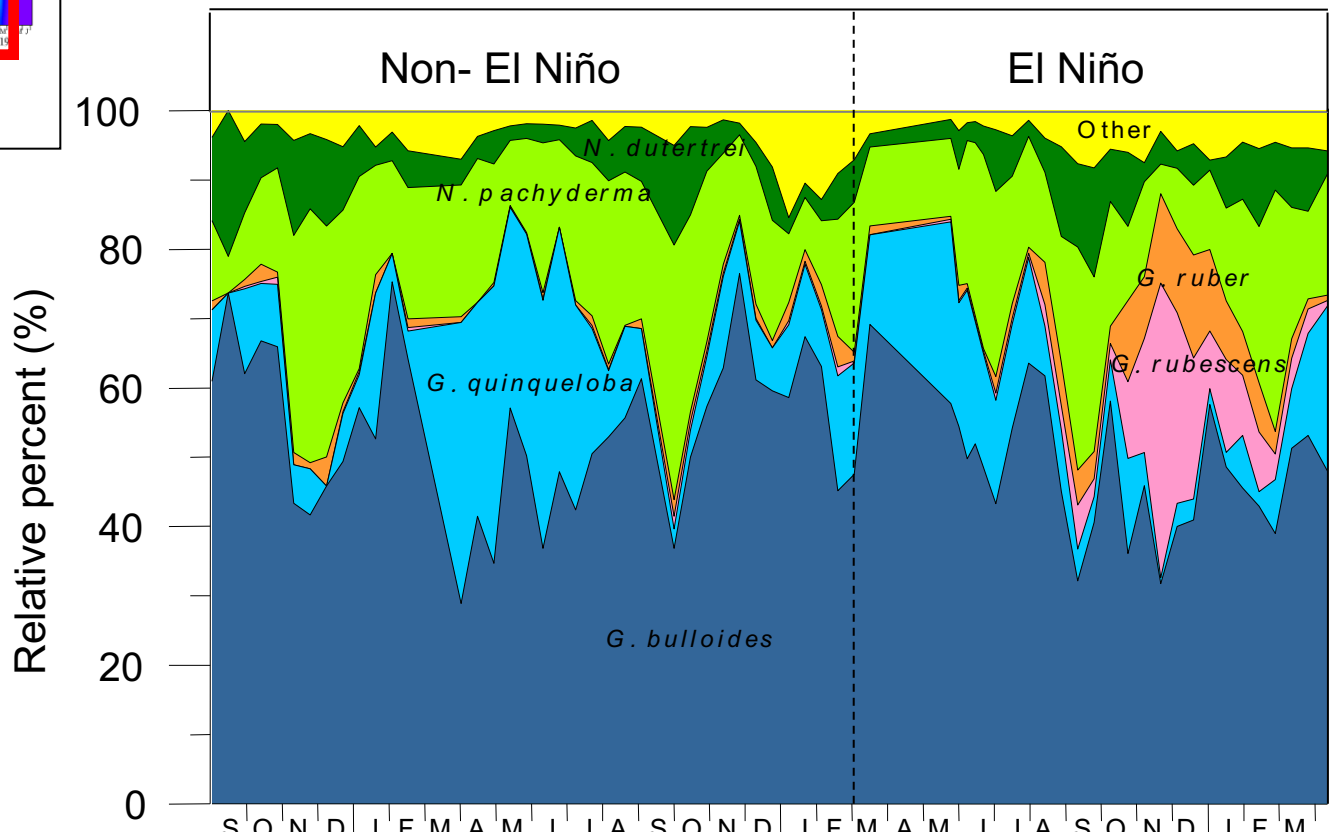
Santa Barbara Basin – Trap Data

1997-1998 El Niño

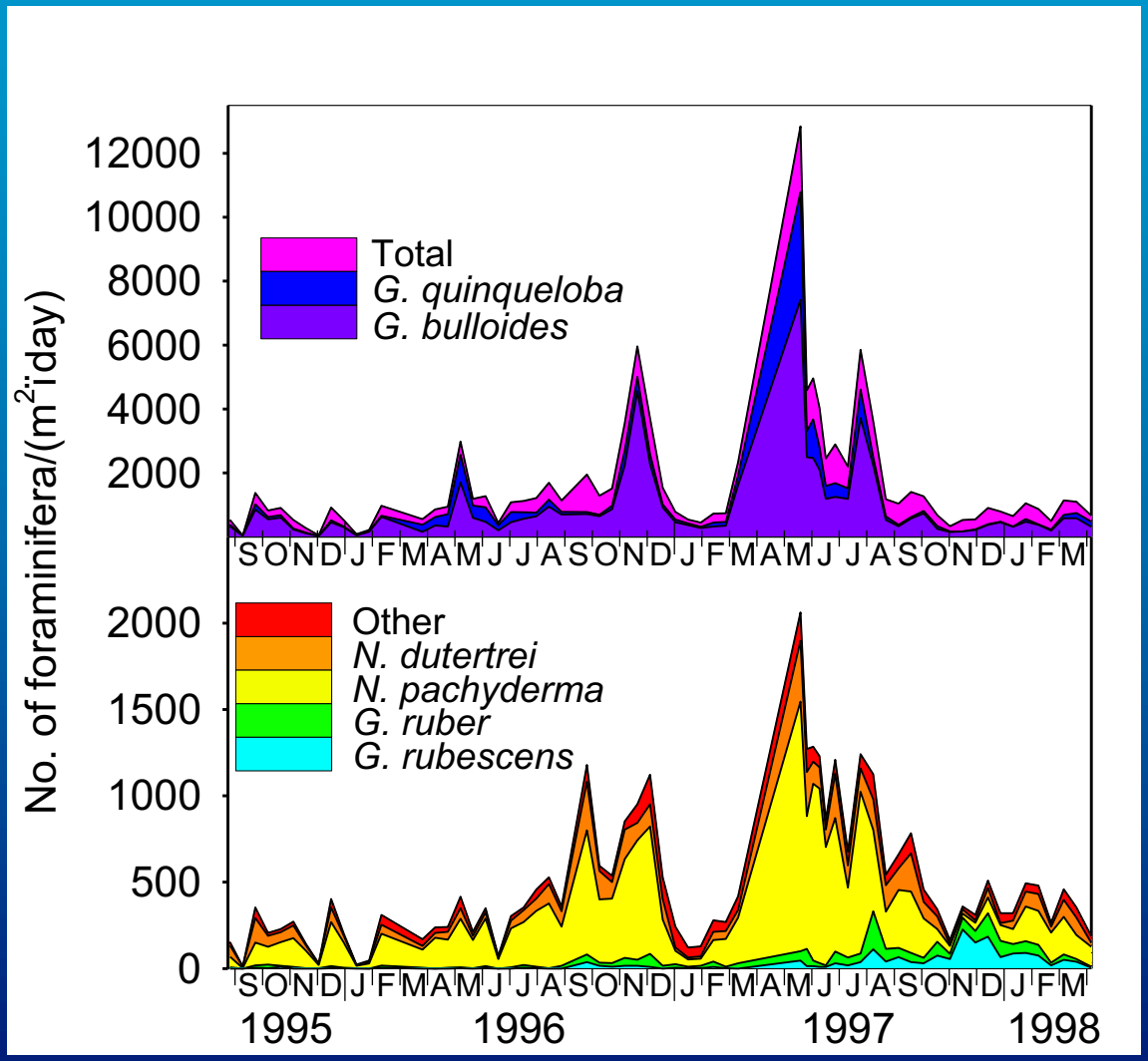


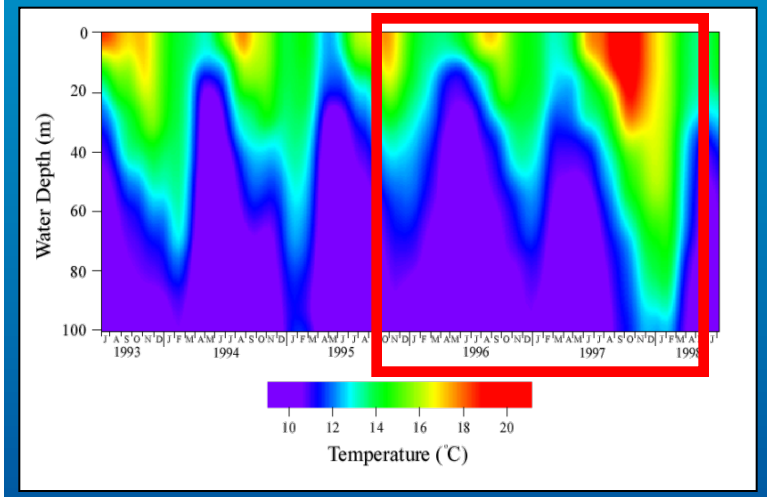
Santa Barbara Basin – Population Changes



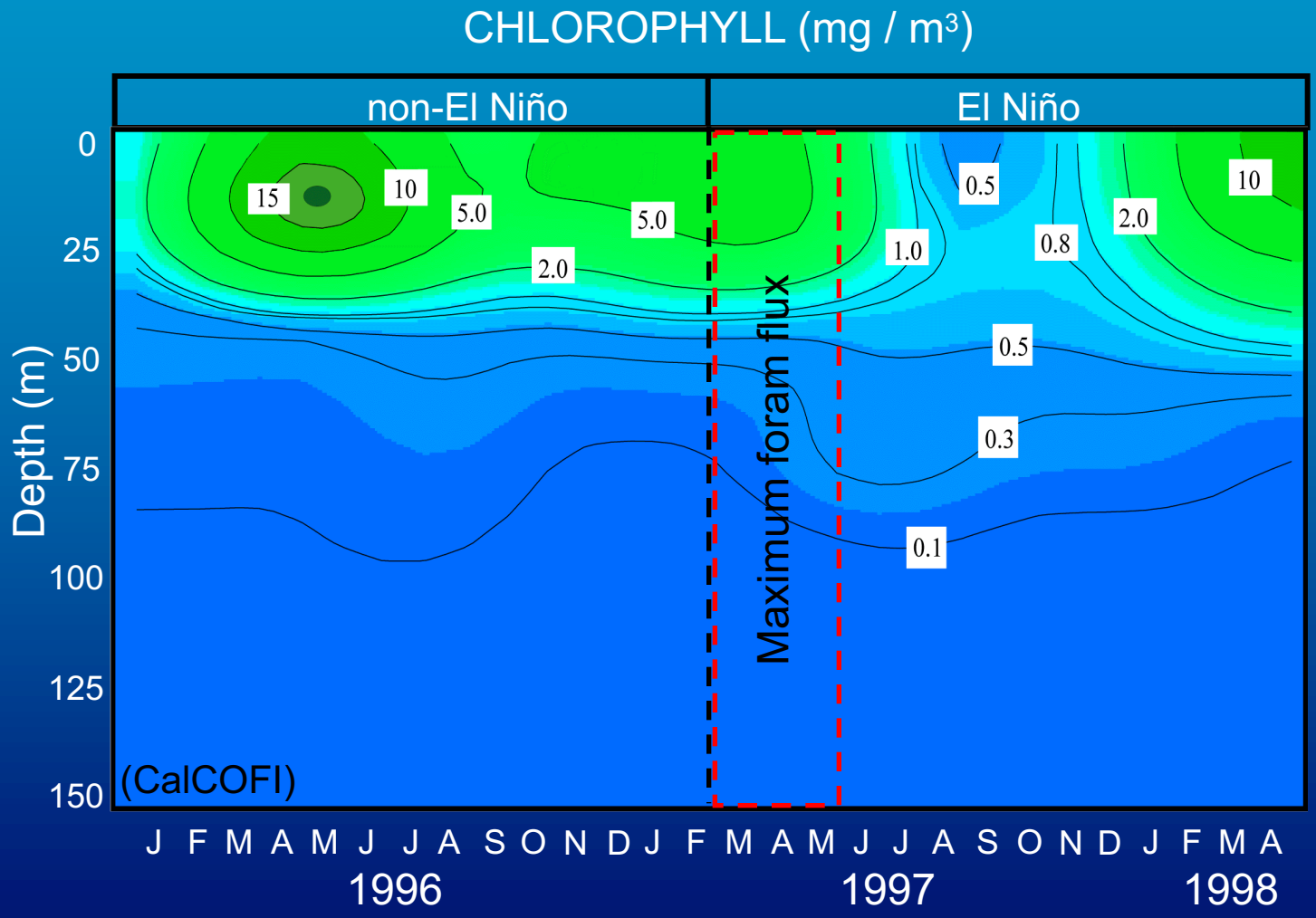


Santa Barbara Basin – Flux Changes



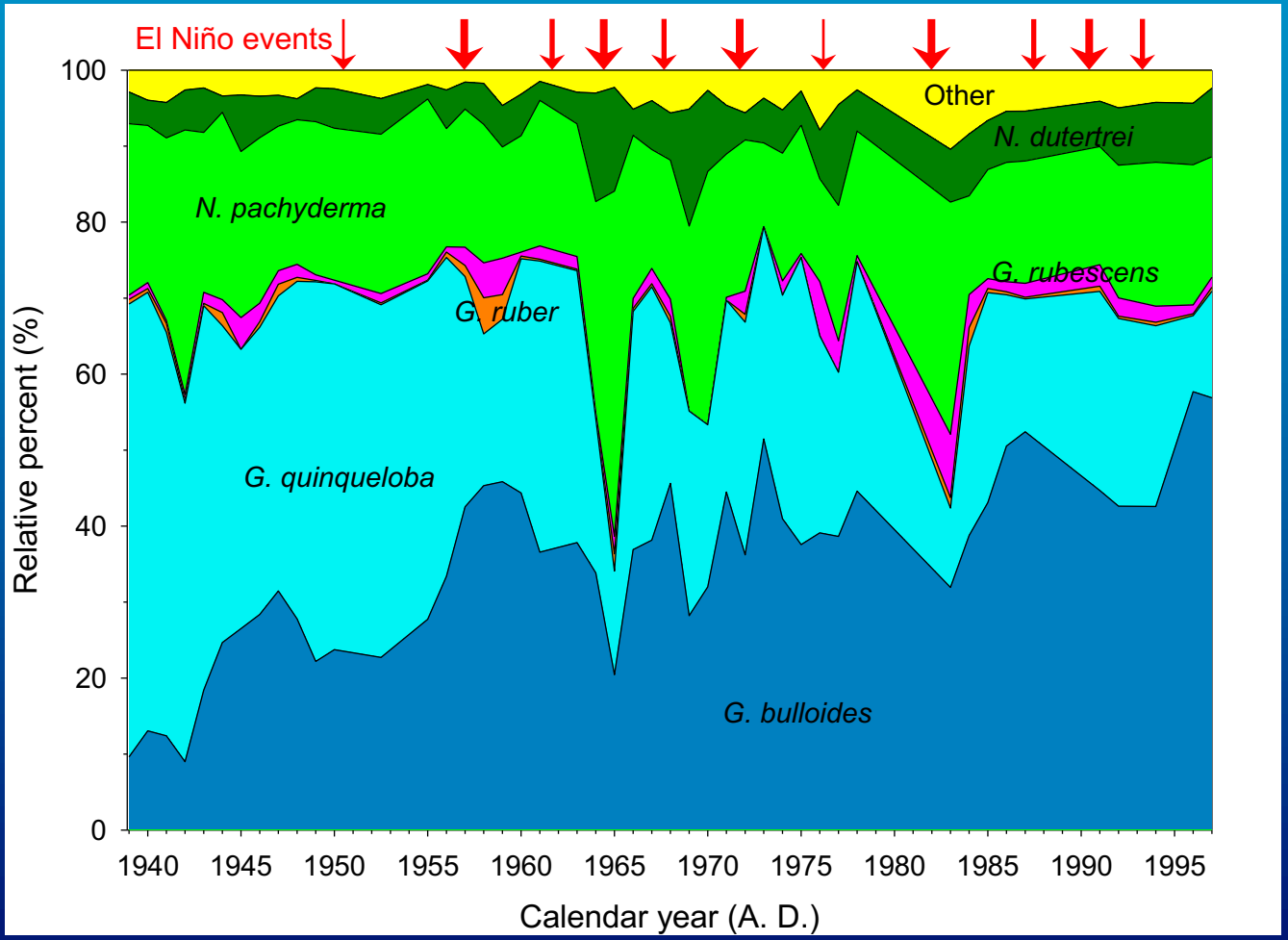


Santa Barbara Basin – High Foram Fluxes?

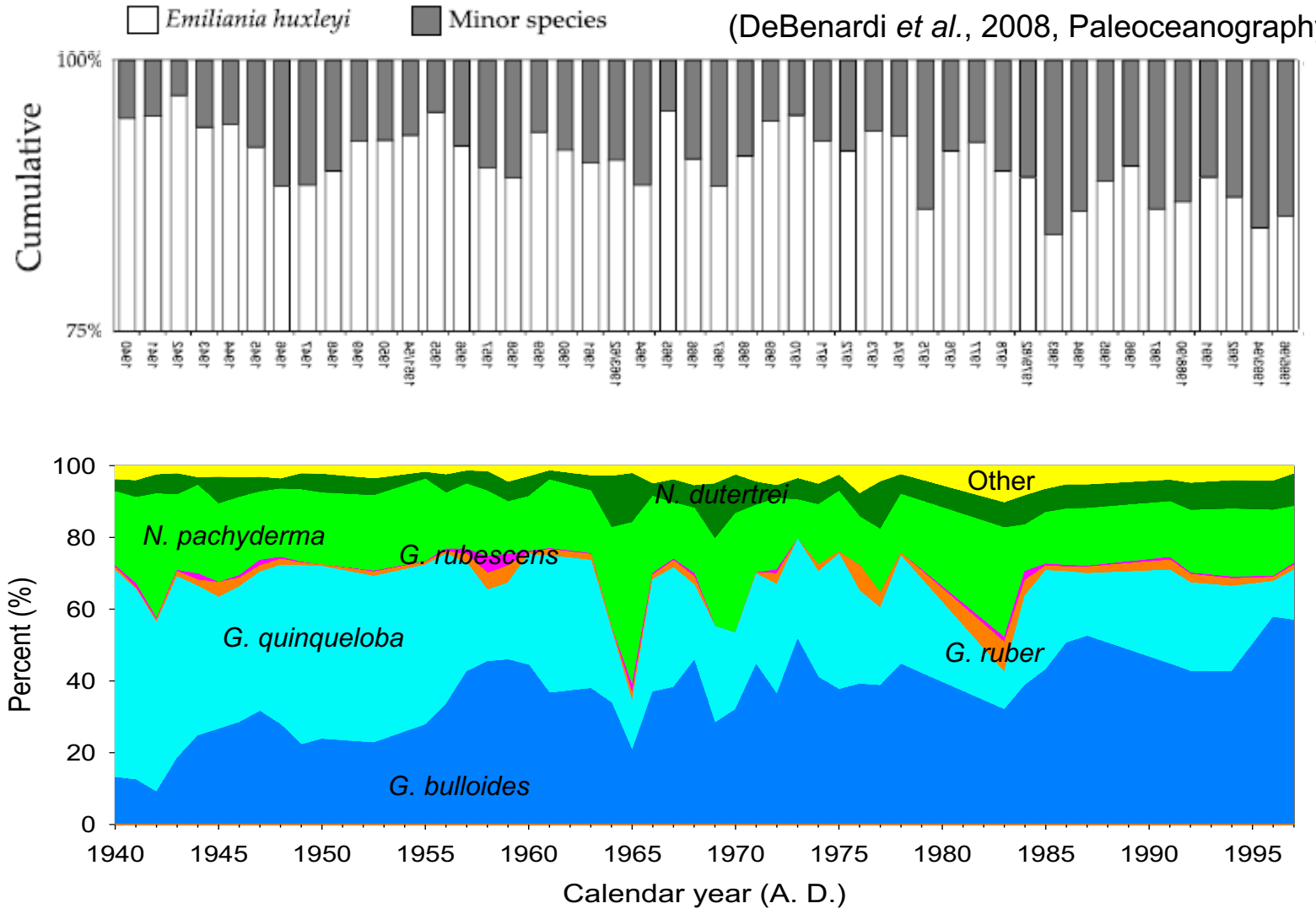


Santa Barbara Basin – Sediment Record

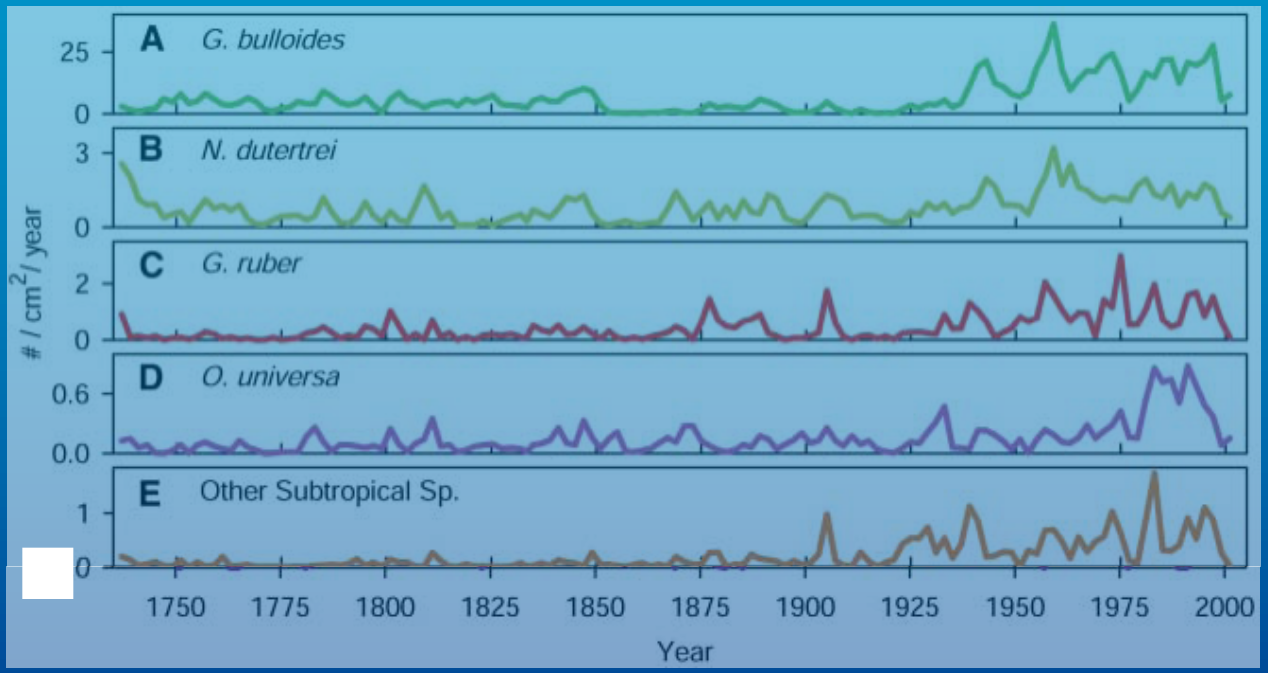
- Box core, x-rayed and sampled varve by varve.
- PDO?



Santa Barbara Basin – Sediments

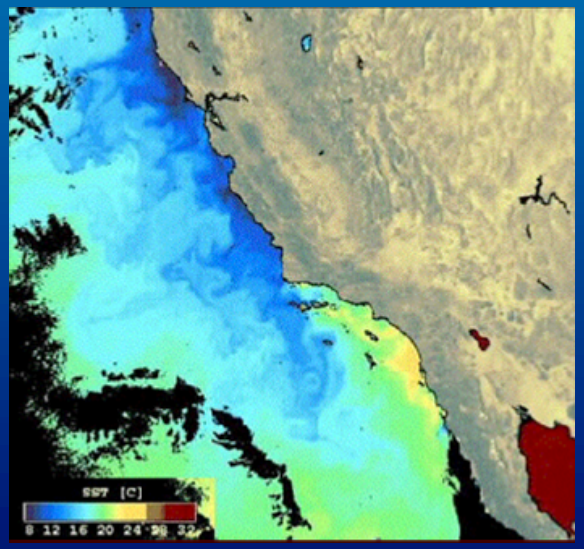


Santa Barbara Basin – Sediment Record



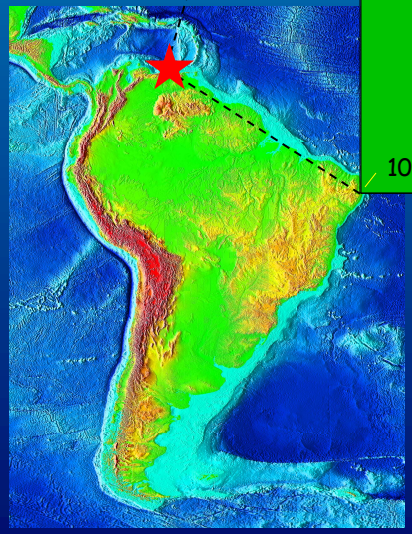
(Field *et al.*, 2006, Science)

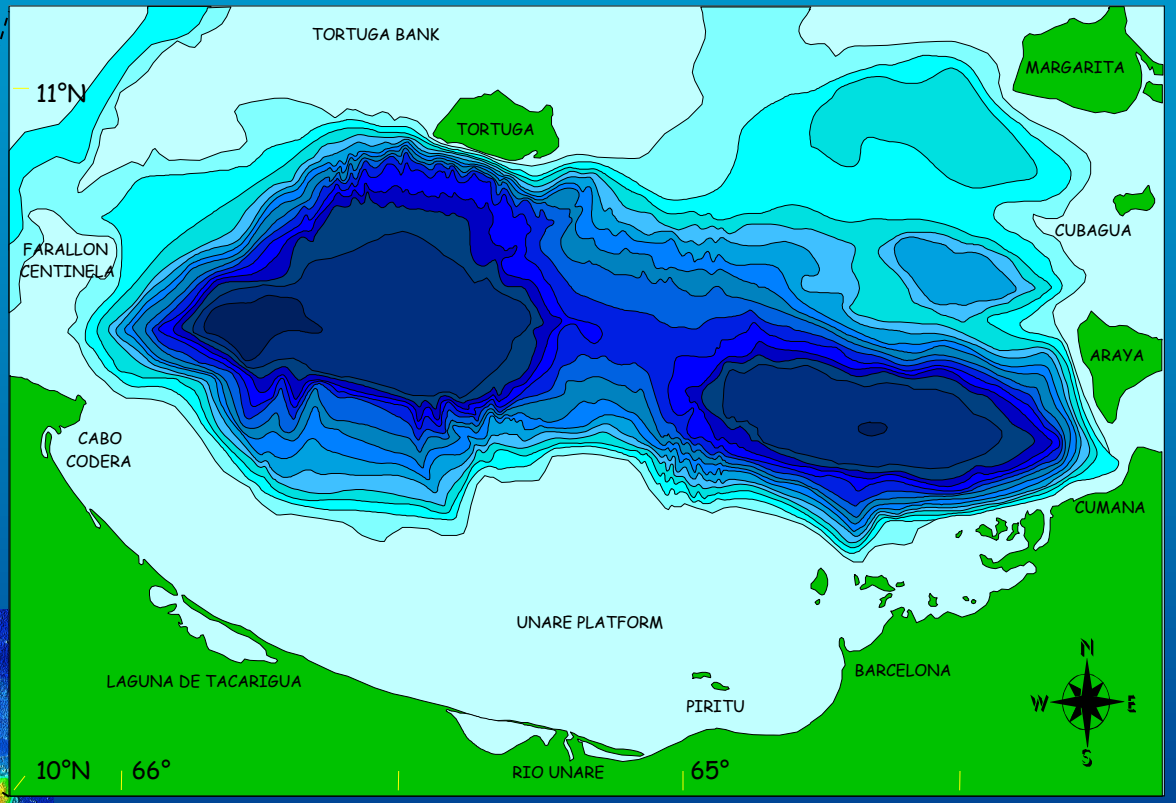
- 20th century changes attributed to warming of the California Current.

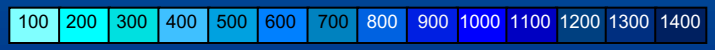


(NASA, http://oceanmotion.org/html/background/timeline1978-88.htm)

The Cariaco Basin

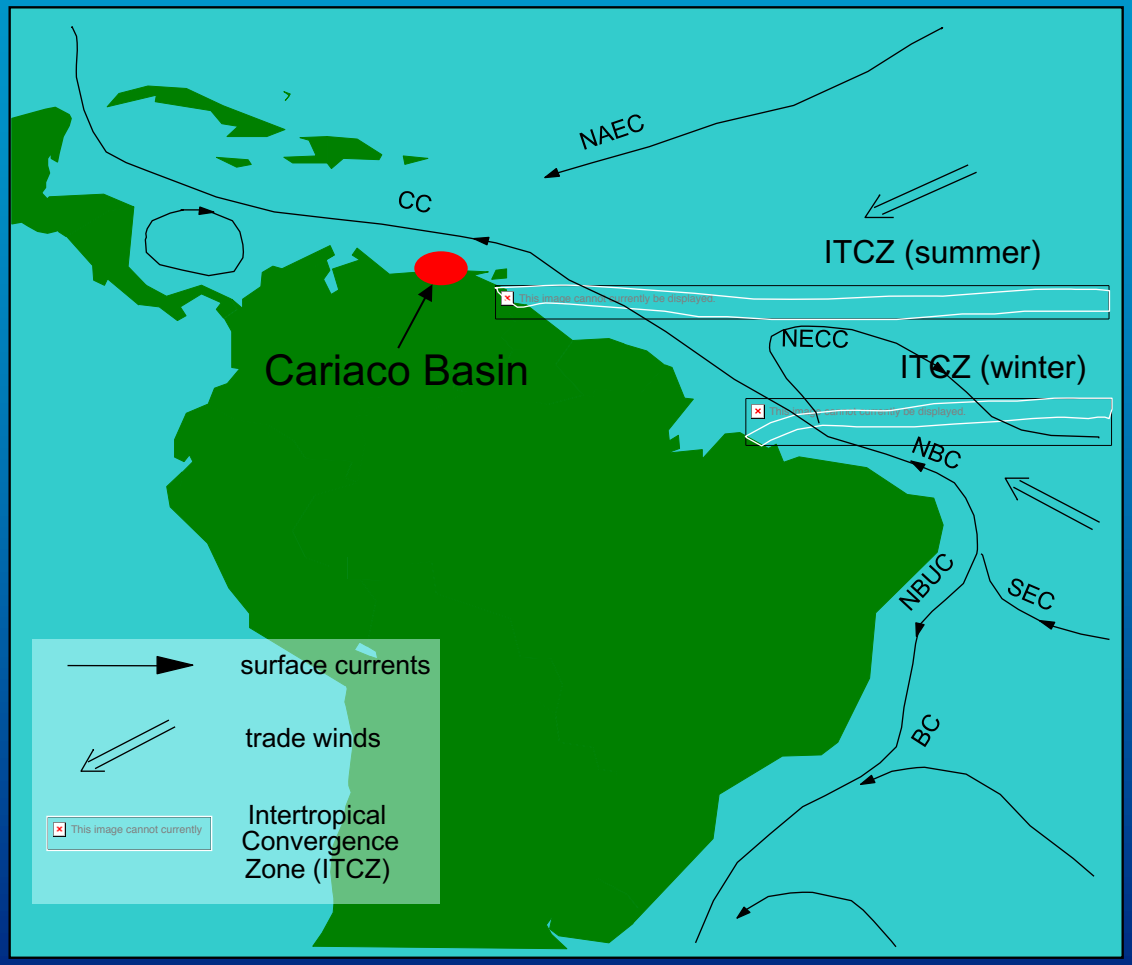






Depth (m)

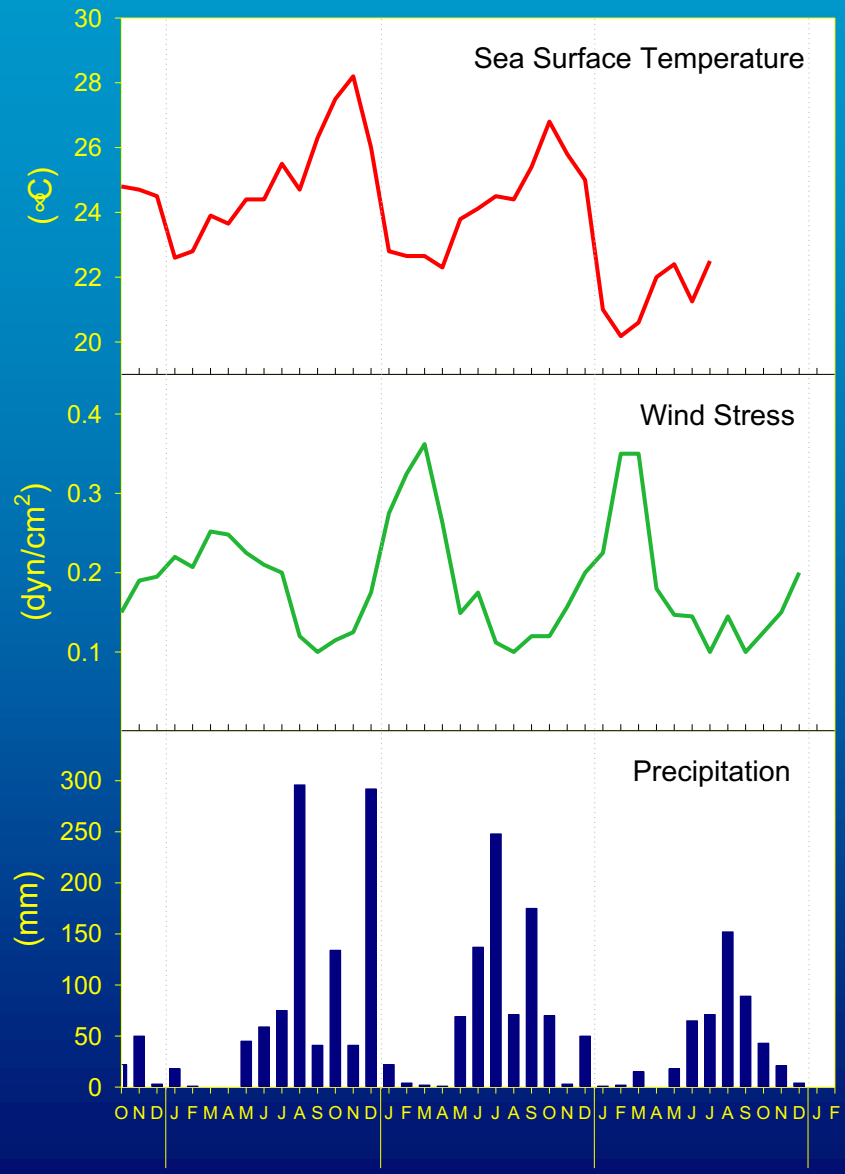
Cariaco Basin - Climatology

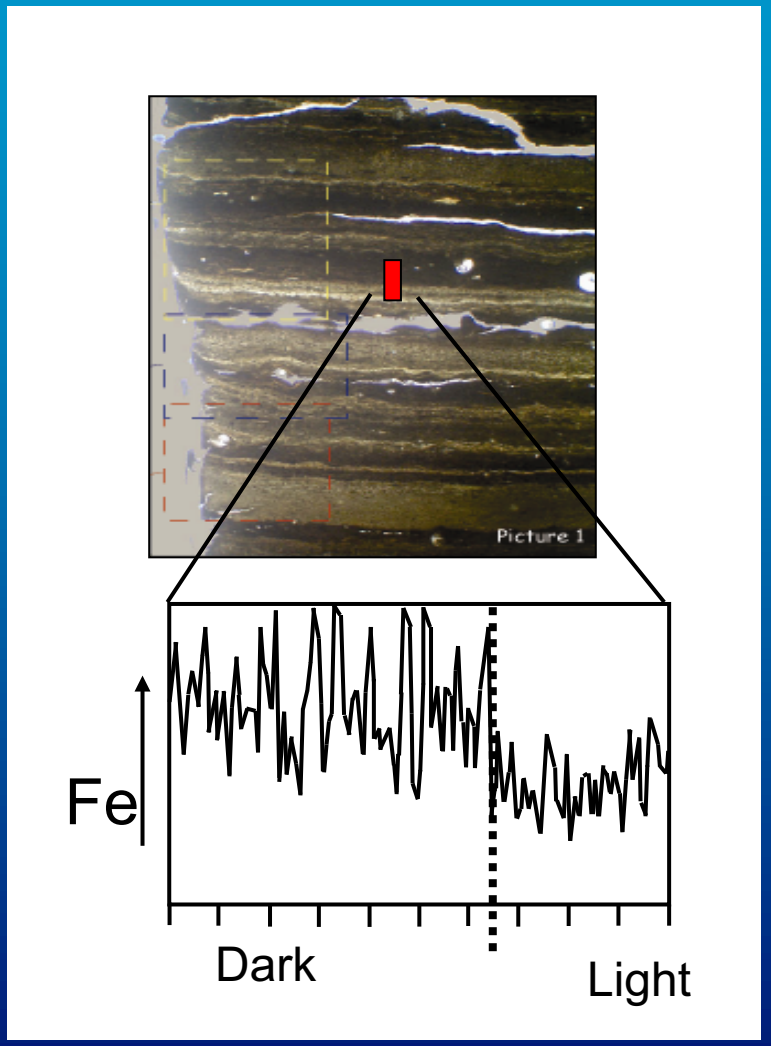


BC - Brazil Current, CC - Caribbean Current, NBC - North Brazil Current,
NBUC - North Brazil Undercurrent, NAEC - North Atlantic Equatorial Current,
NECC - North Equatorial Countercurrent, SEC - South Equatorial Current

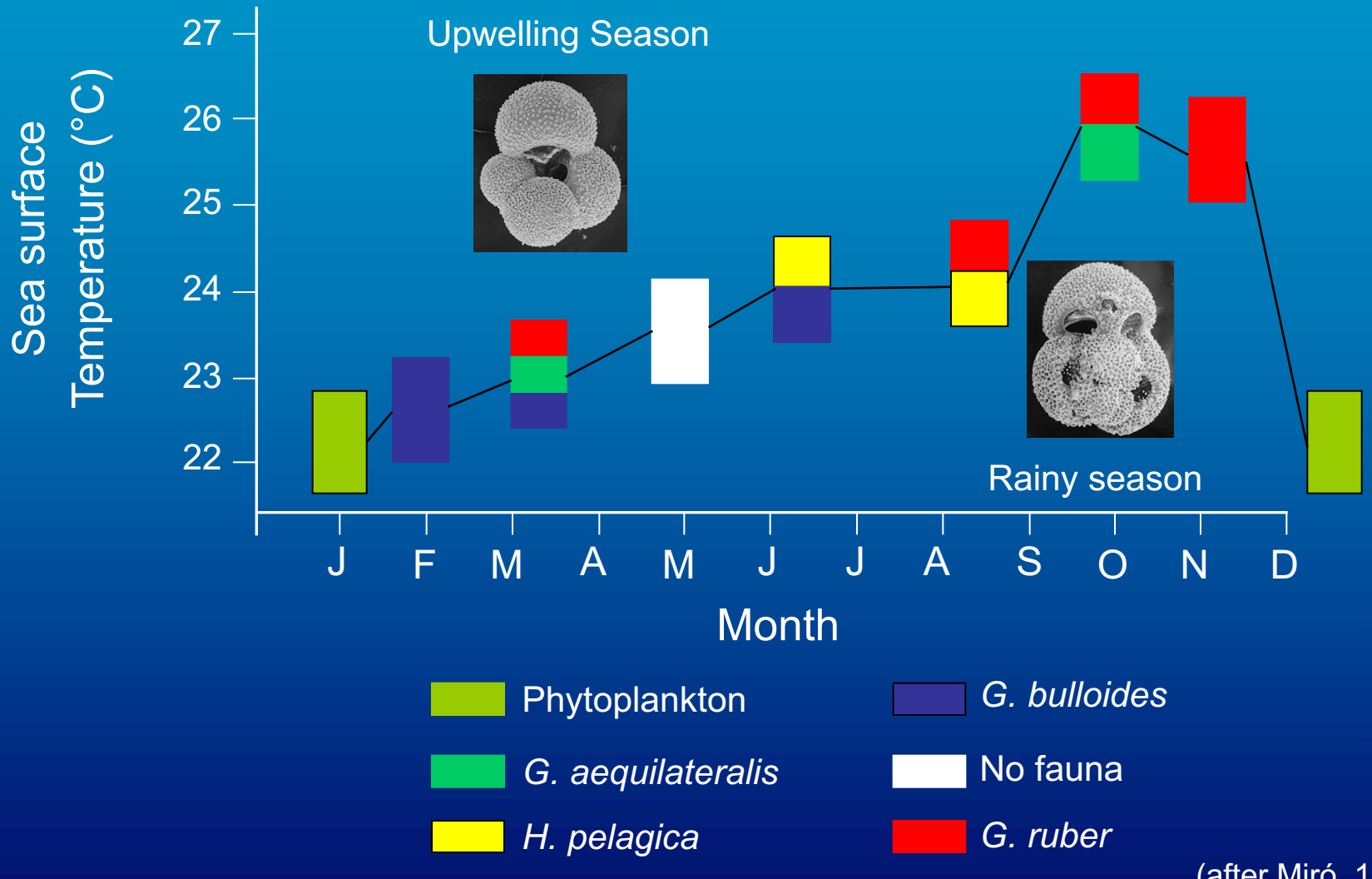
(after Dürkoop *et al.*, 1997)

Cariaco Basin - Climatology



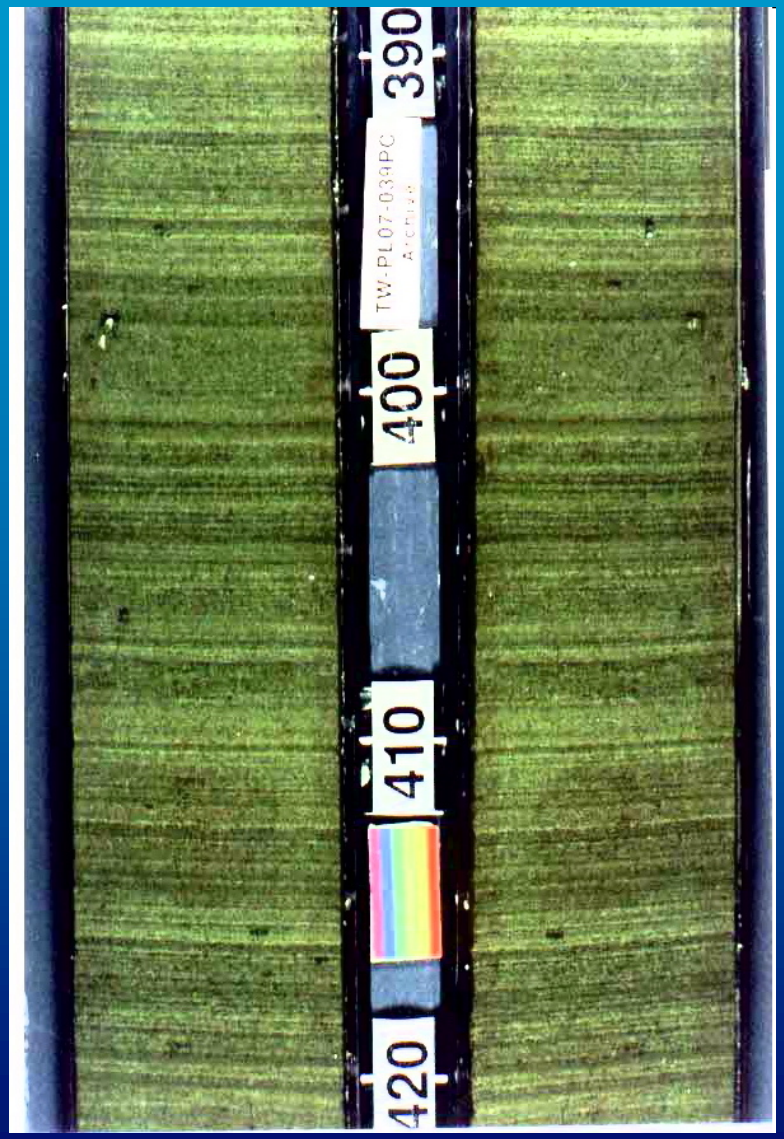


Cariaco Basin – Seasonal Biology



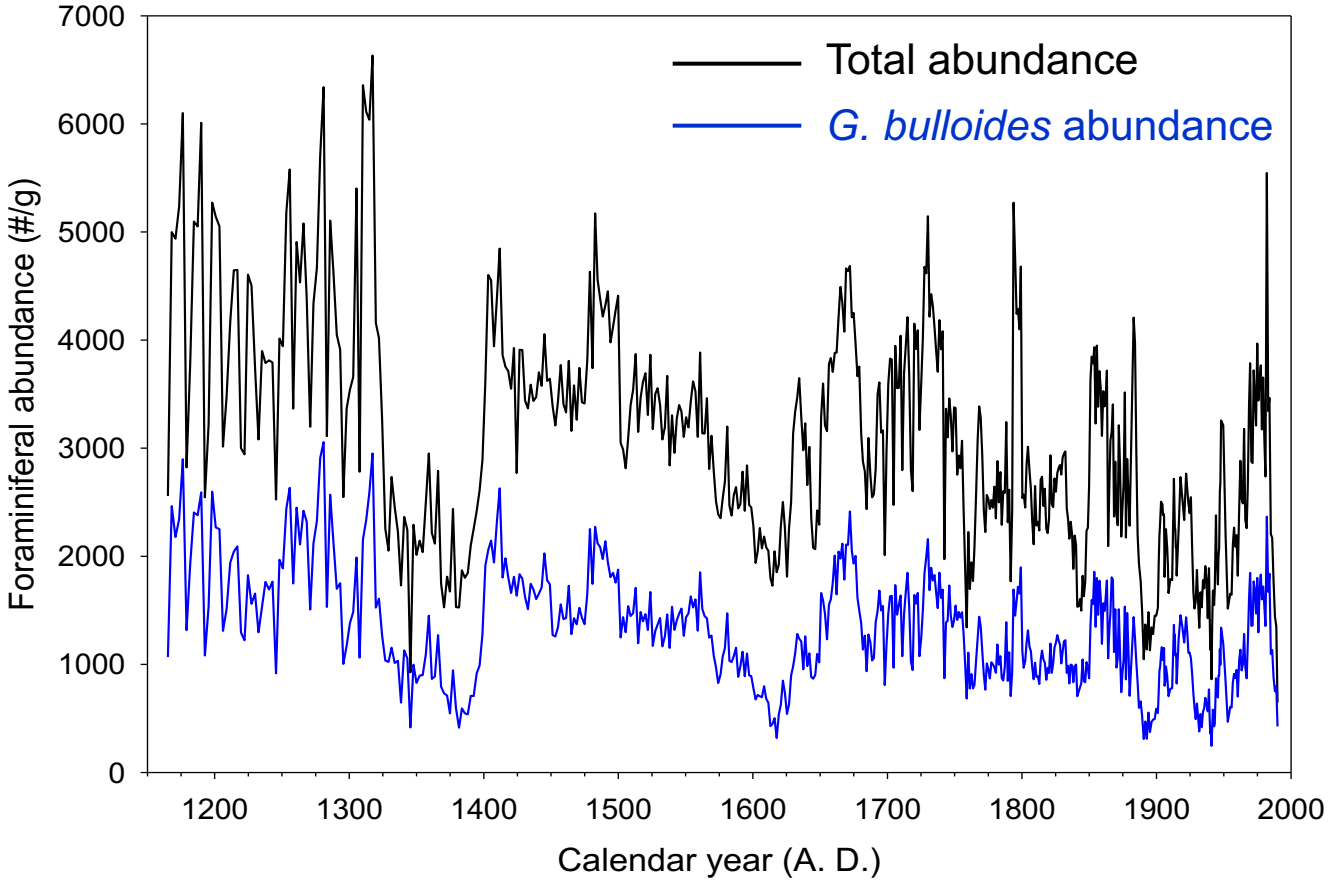
(after Miró, 1971)

Cariaco Basin – Varved Sediments

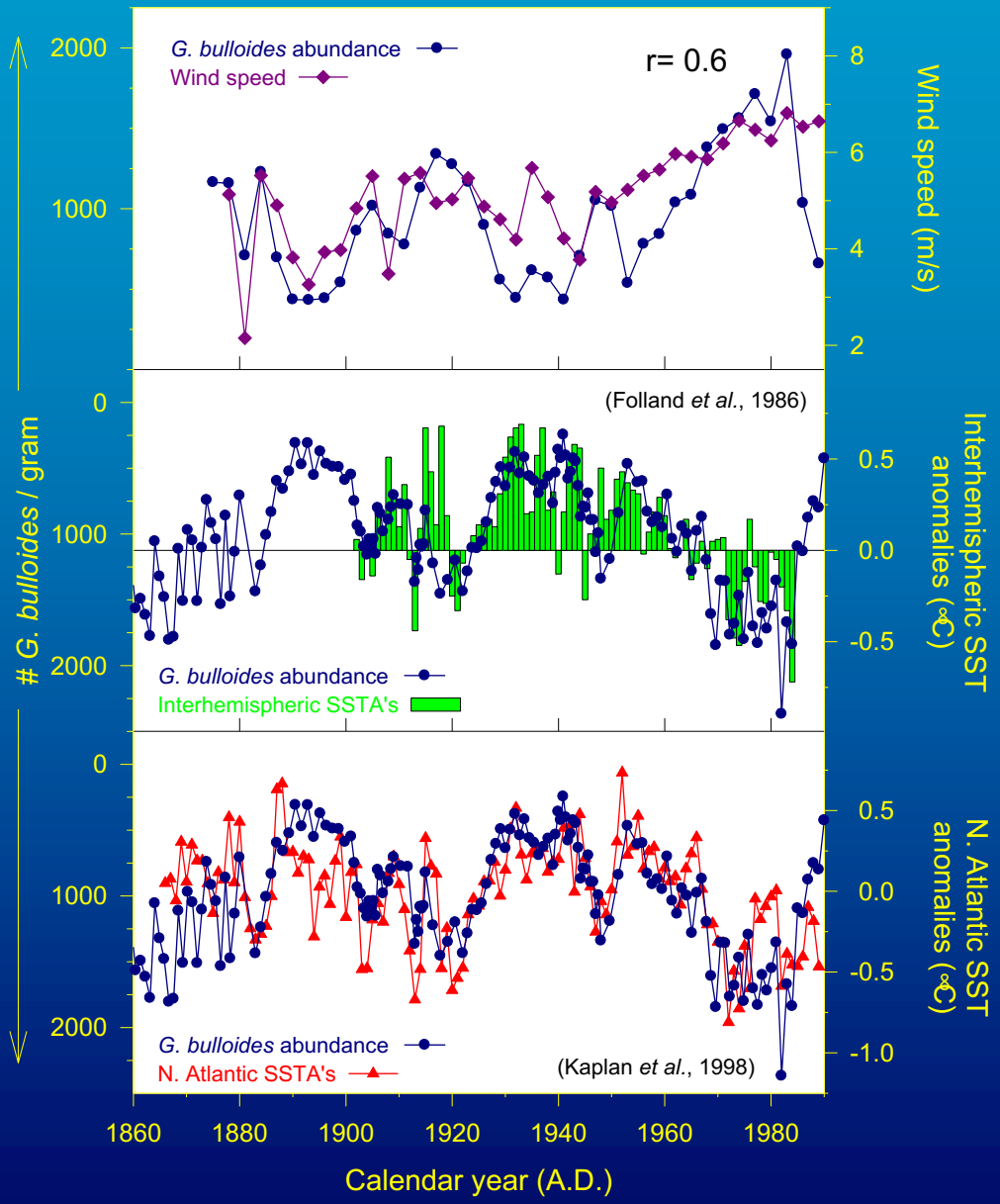


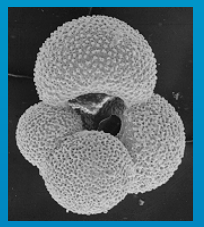
- Annual varves composed of a sediment couplet – a light-colored silica-rich laminae and a dark-colored terrigenous-rich laminae.
- Verified by ^{210}Pb and comparison to historical earthquake data.

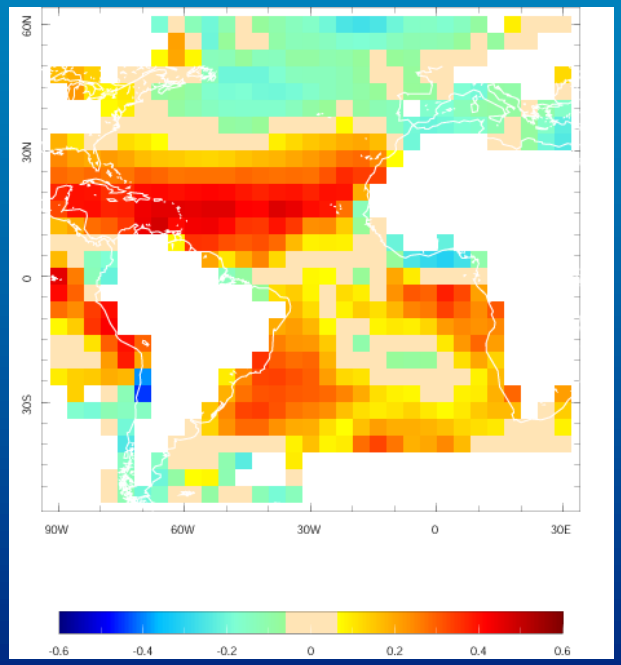
Cariaco Basin – Foram Abundance



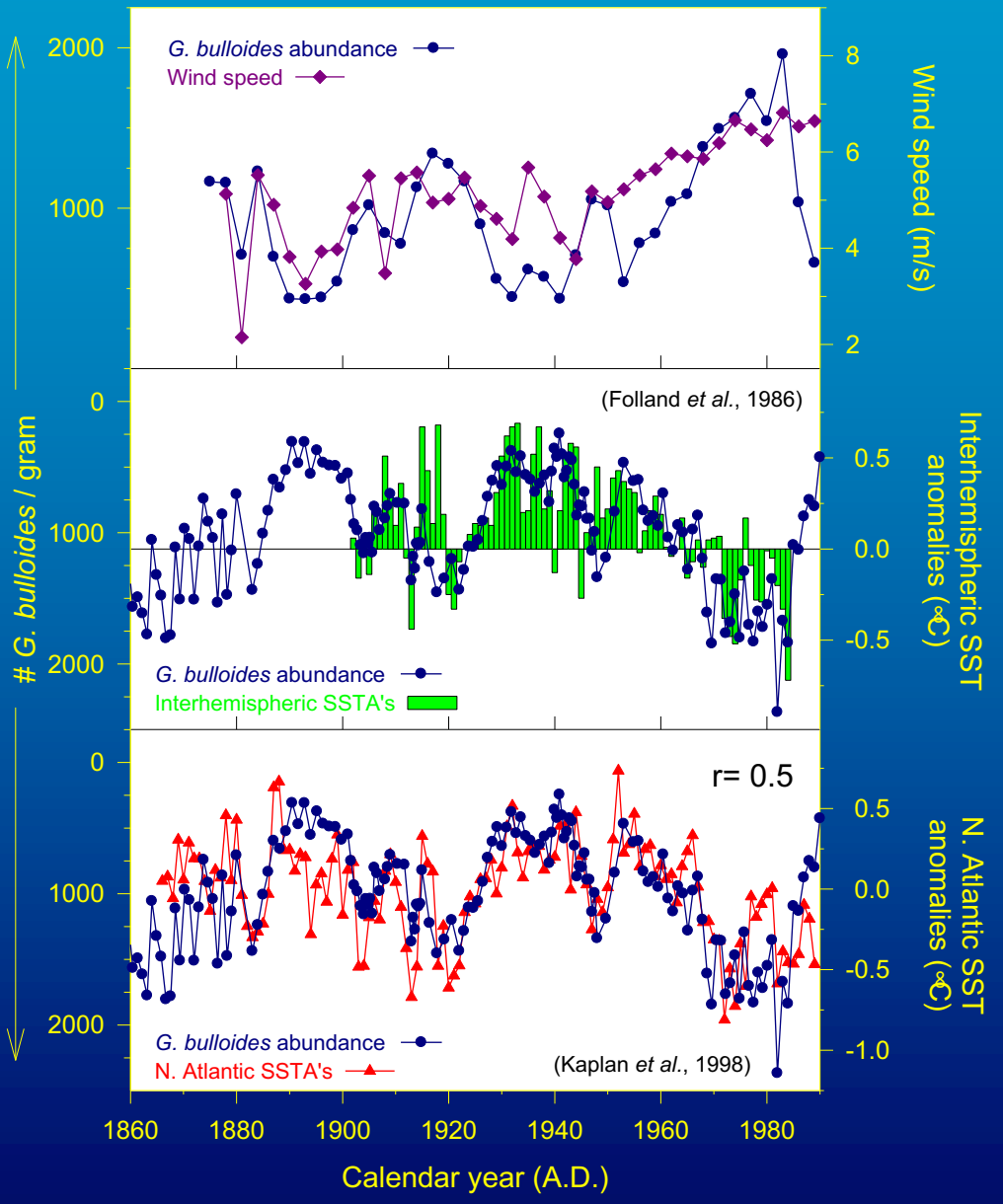
Cariaco Basin – Foram Abundance

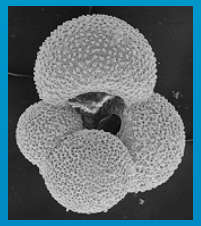


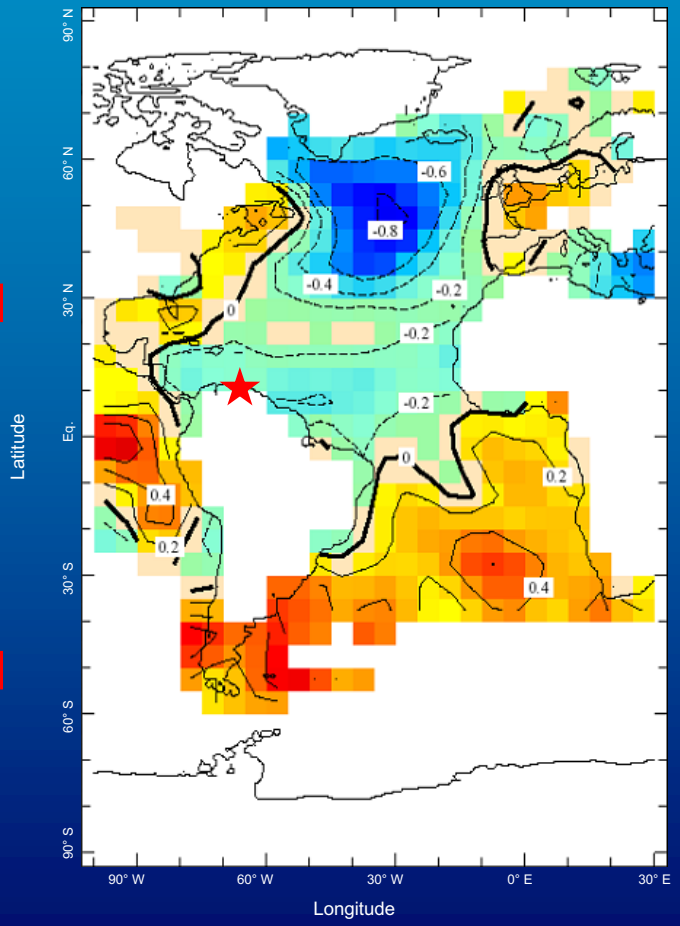




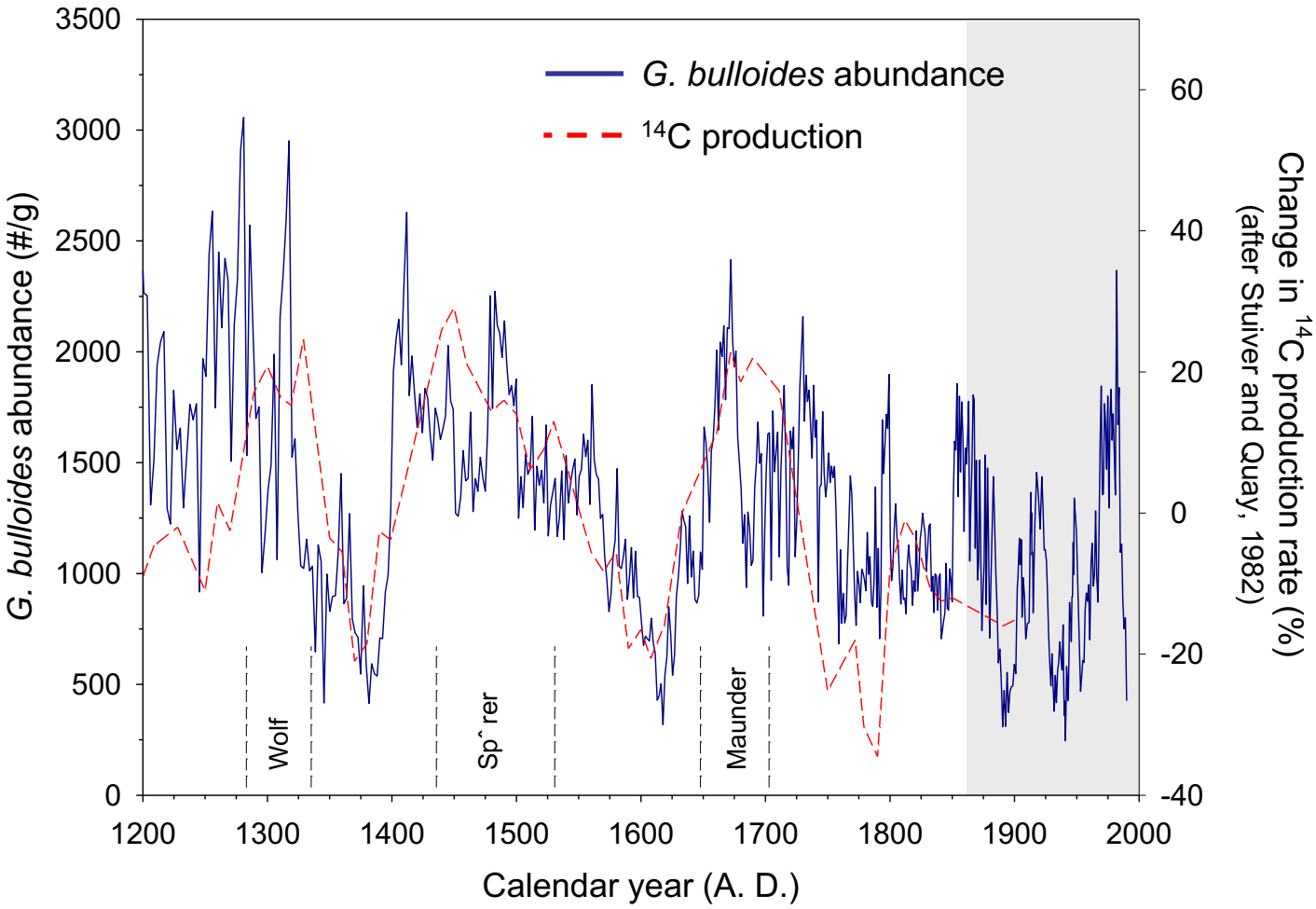
Cariaco Basin – Foram Abundance



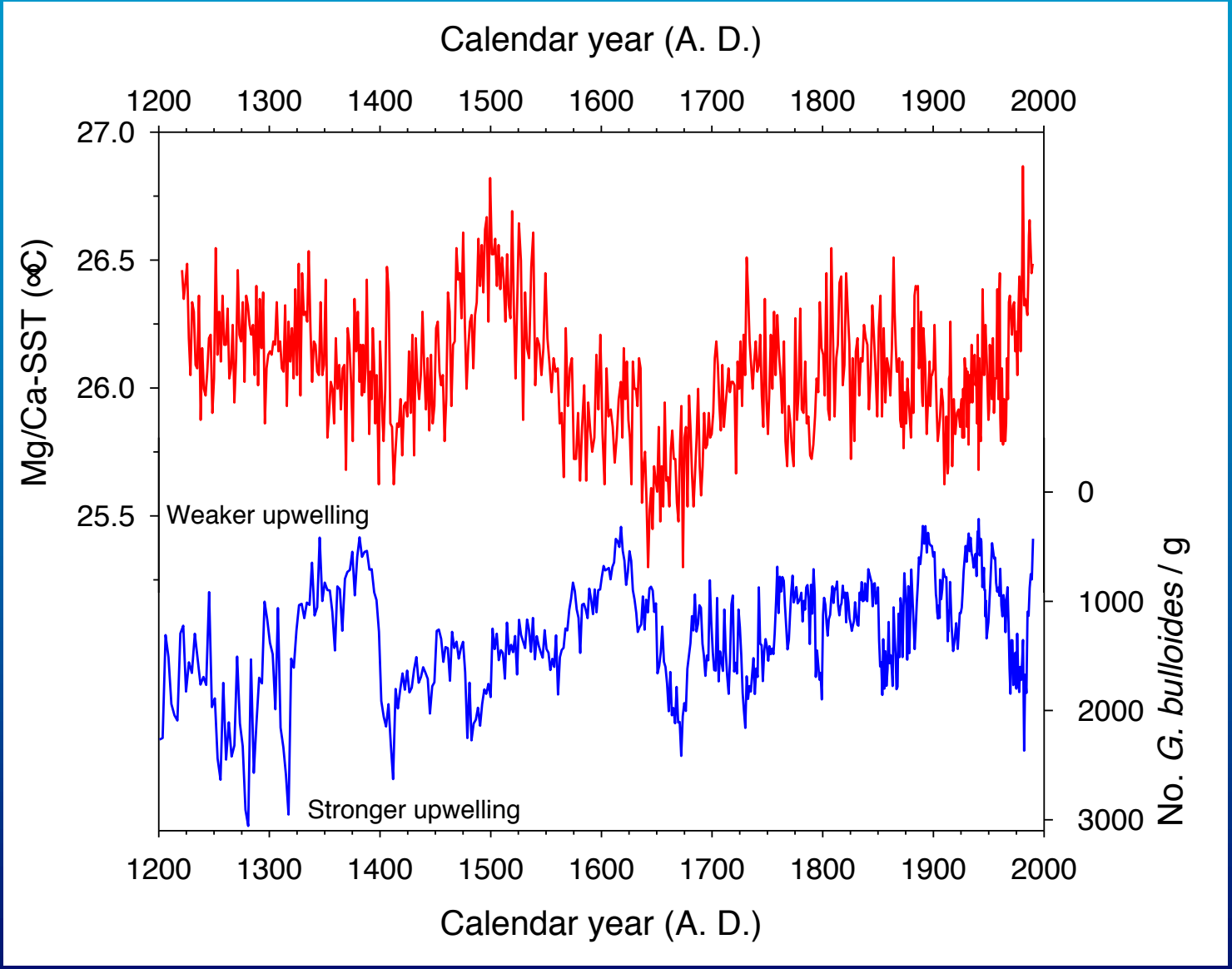




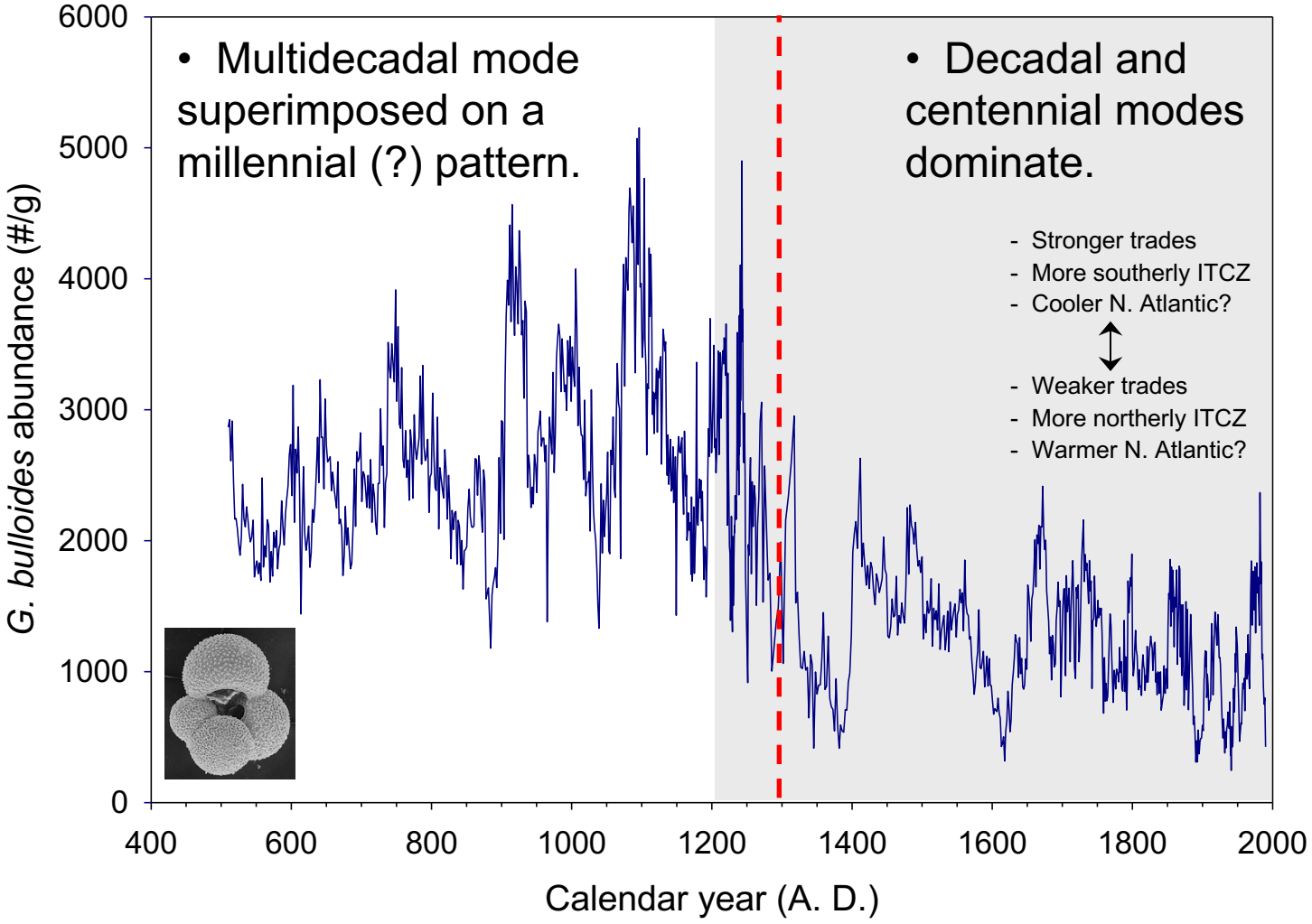
Cariaco Basin – Foram Abundance



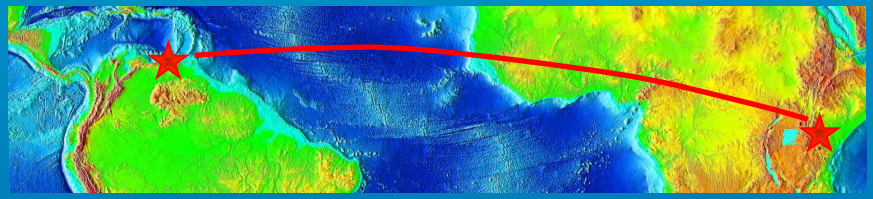
Cariaco Basin – Foram Abundance

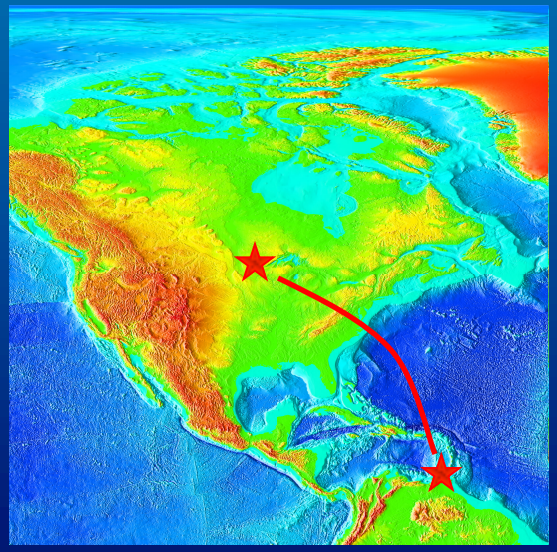


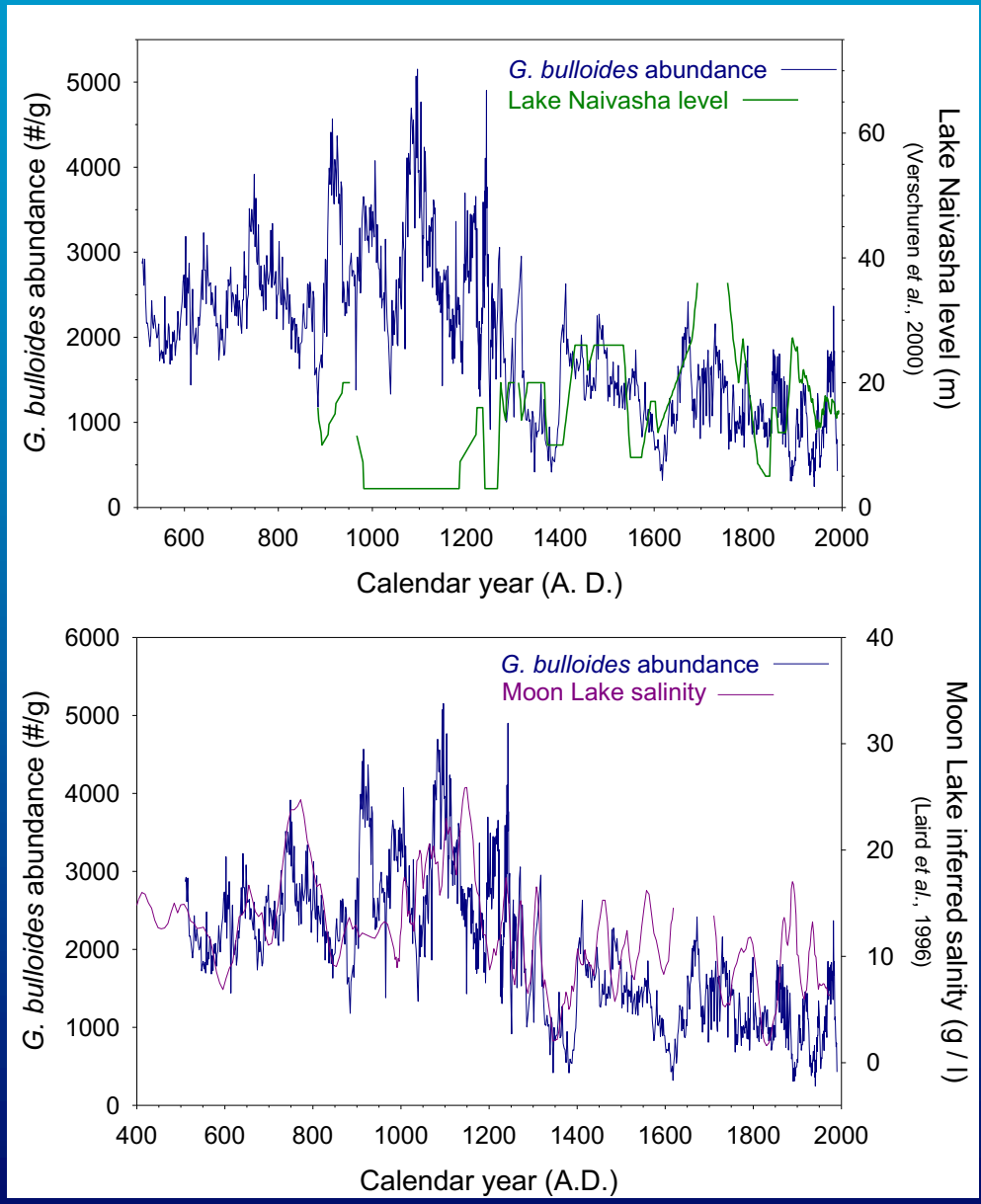
Cariaco Basin – Foram Abundance



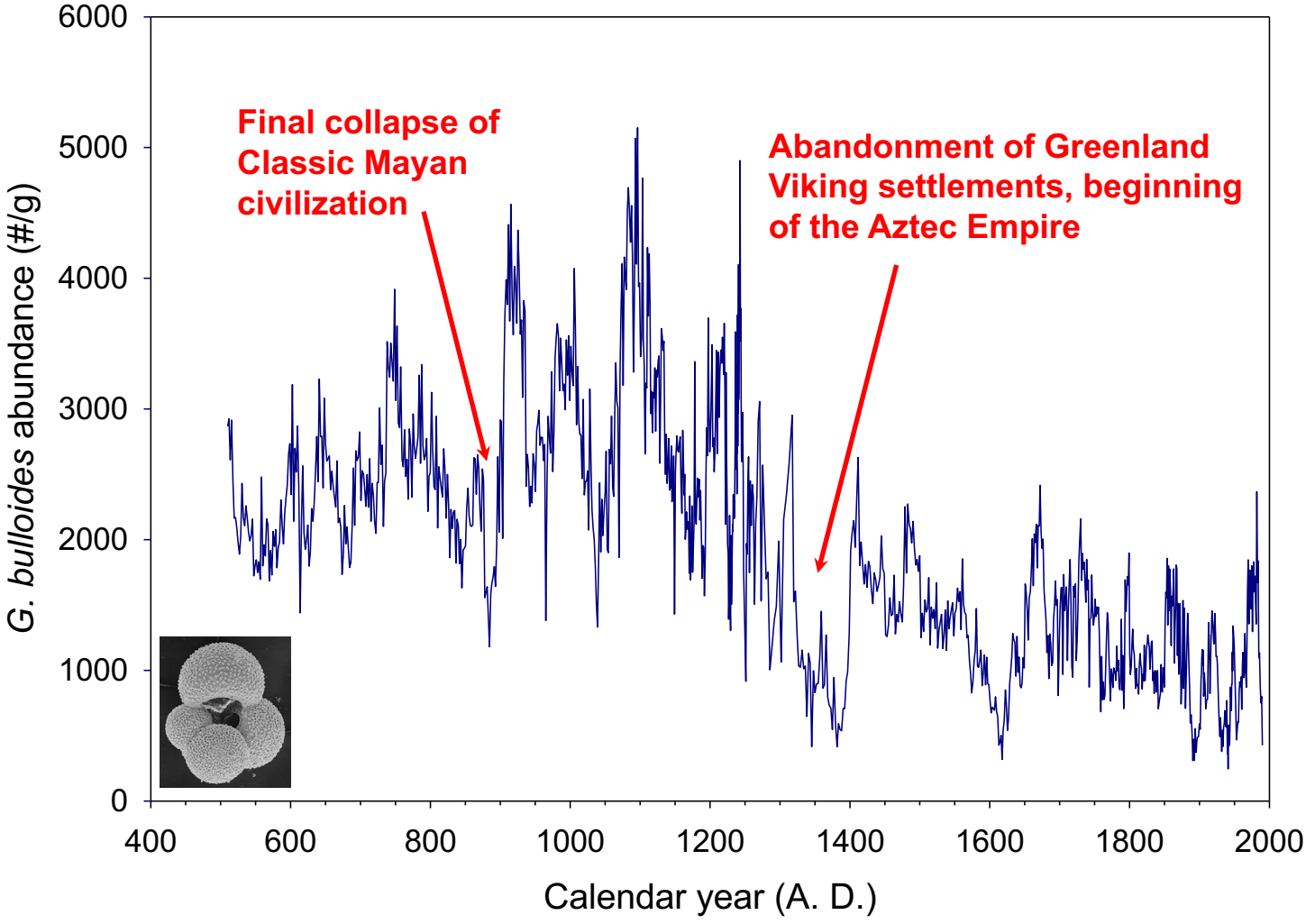
The Cariaco Basin – Teleconnections



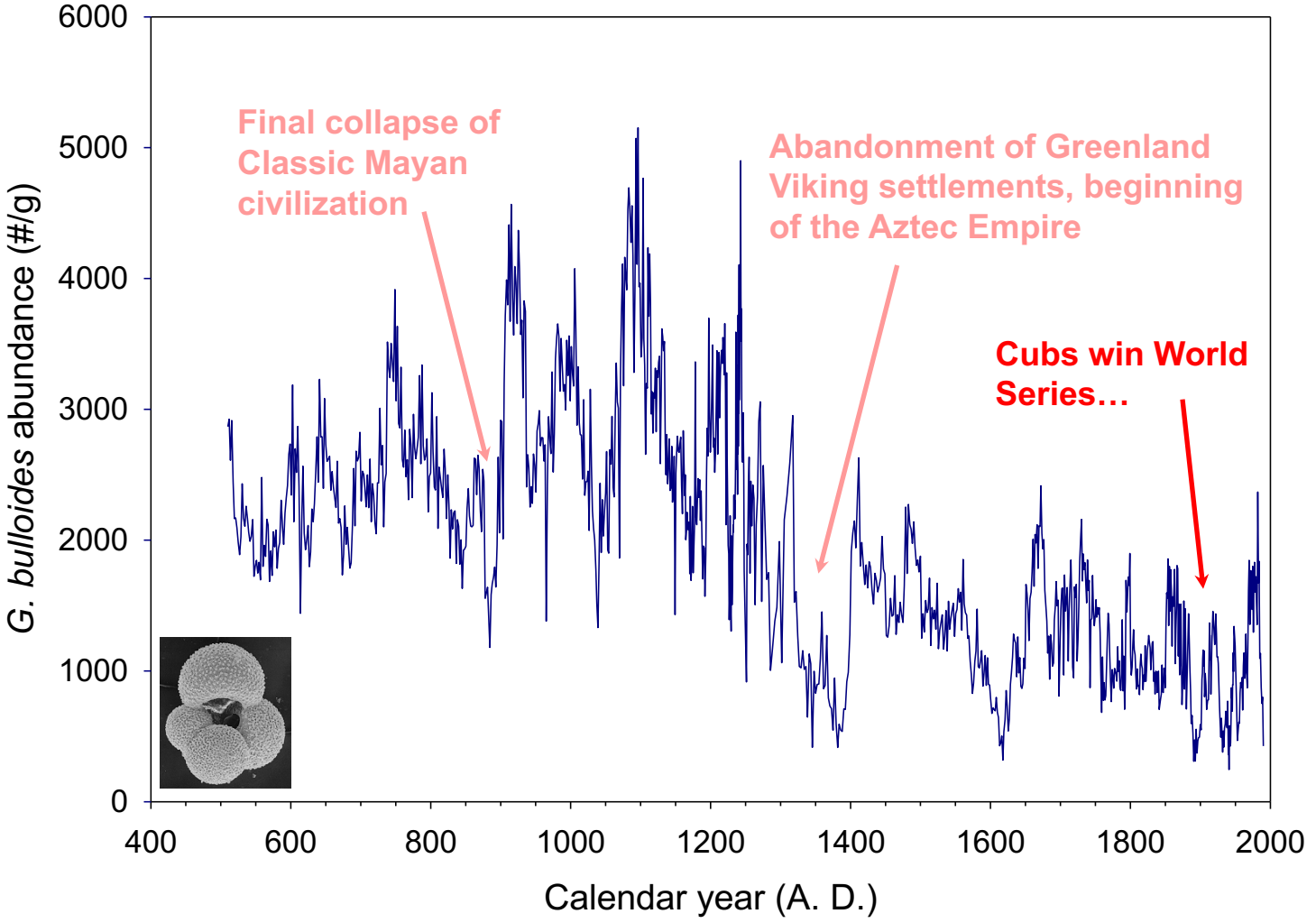




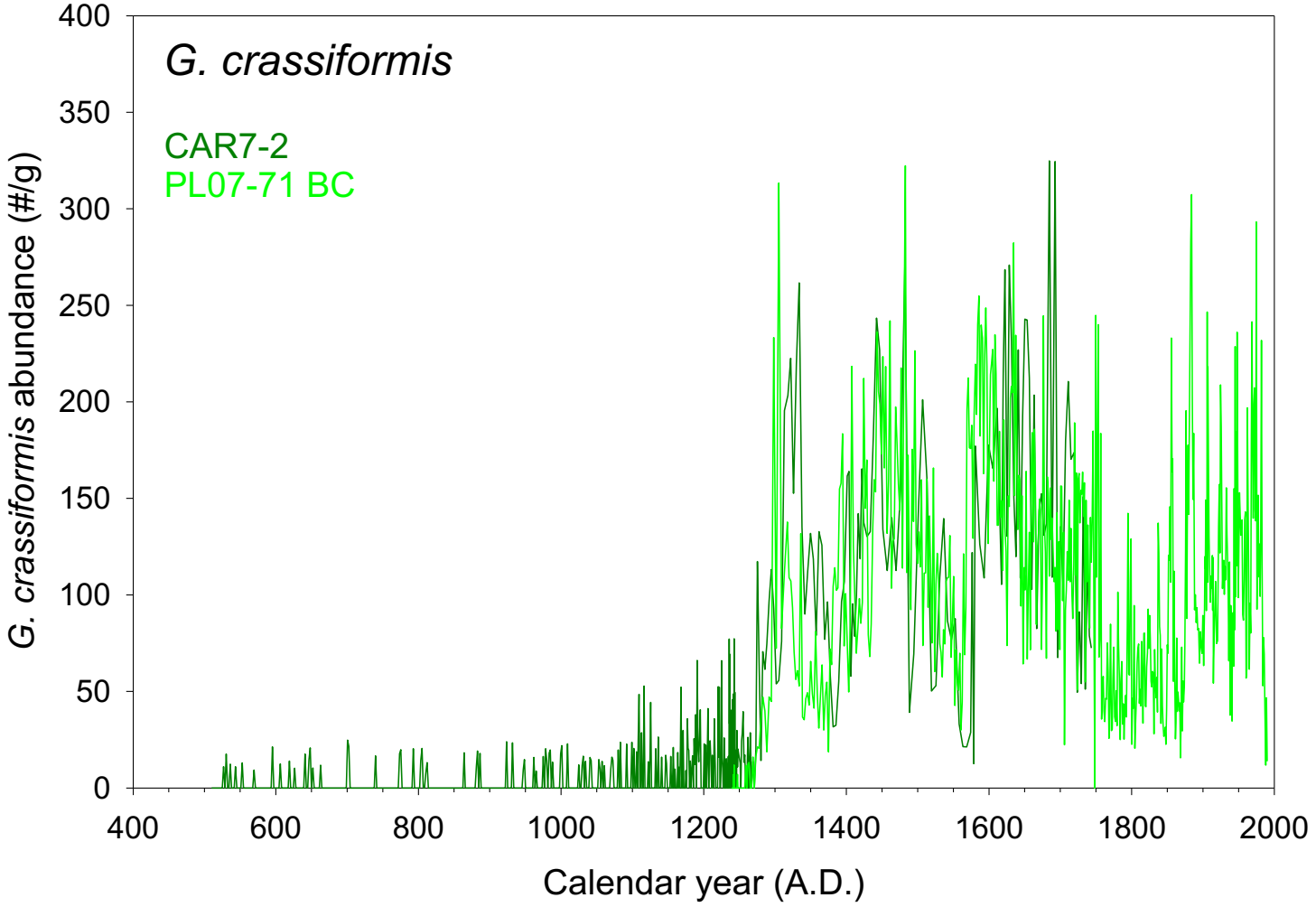
Cariaco Basin – Foram Abundance



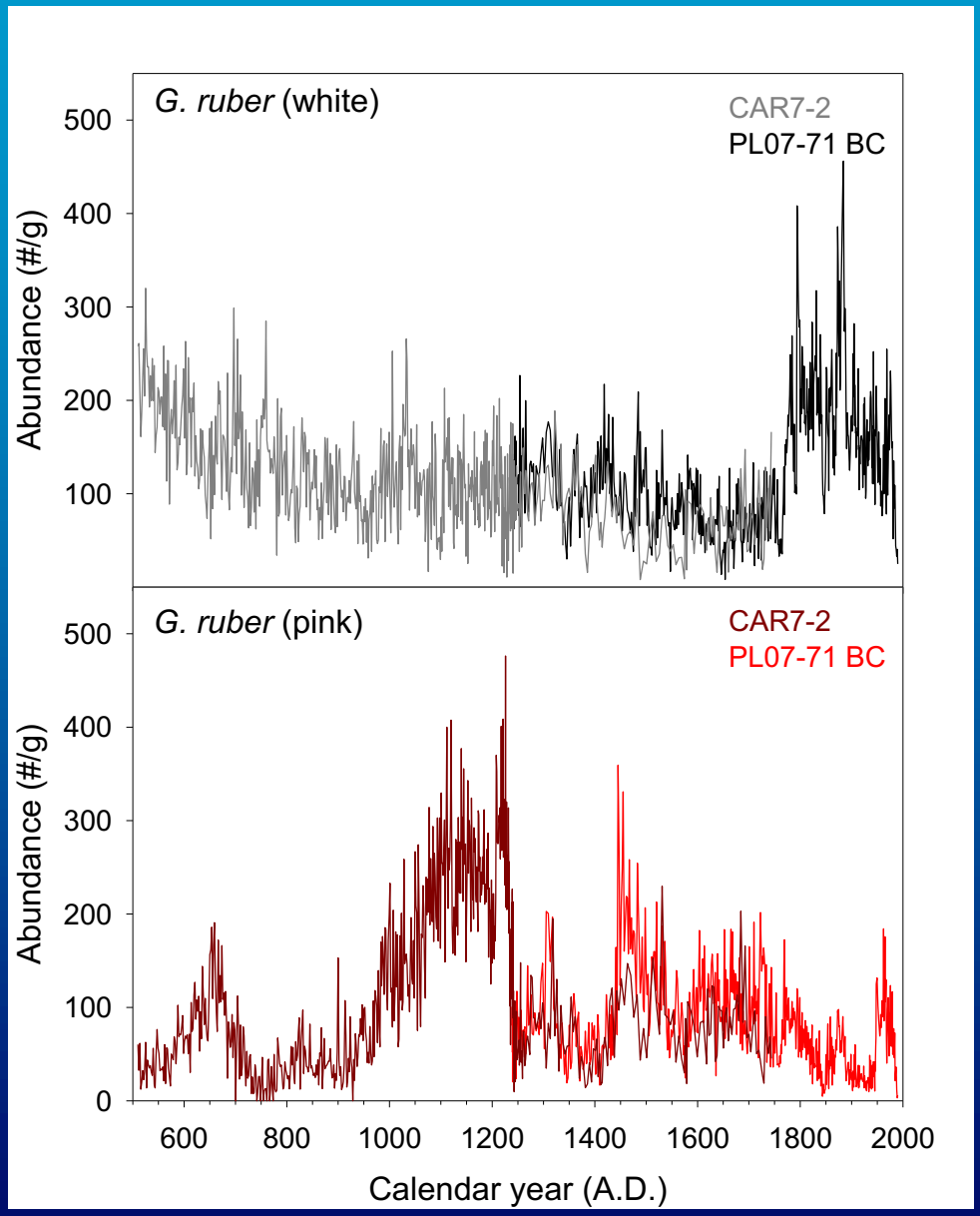
Cariaco Basin – Societal Impacts?

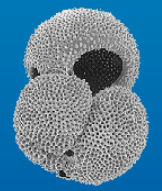


The Cariaco Basin – Other Species

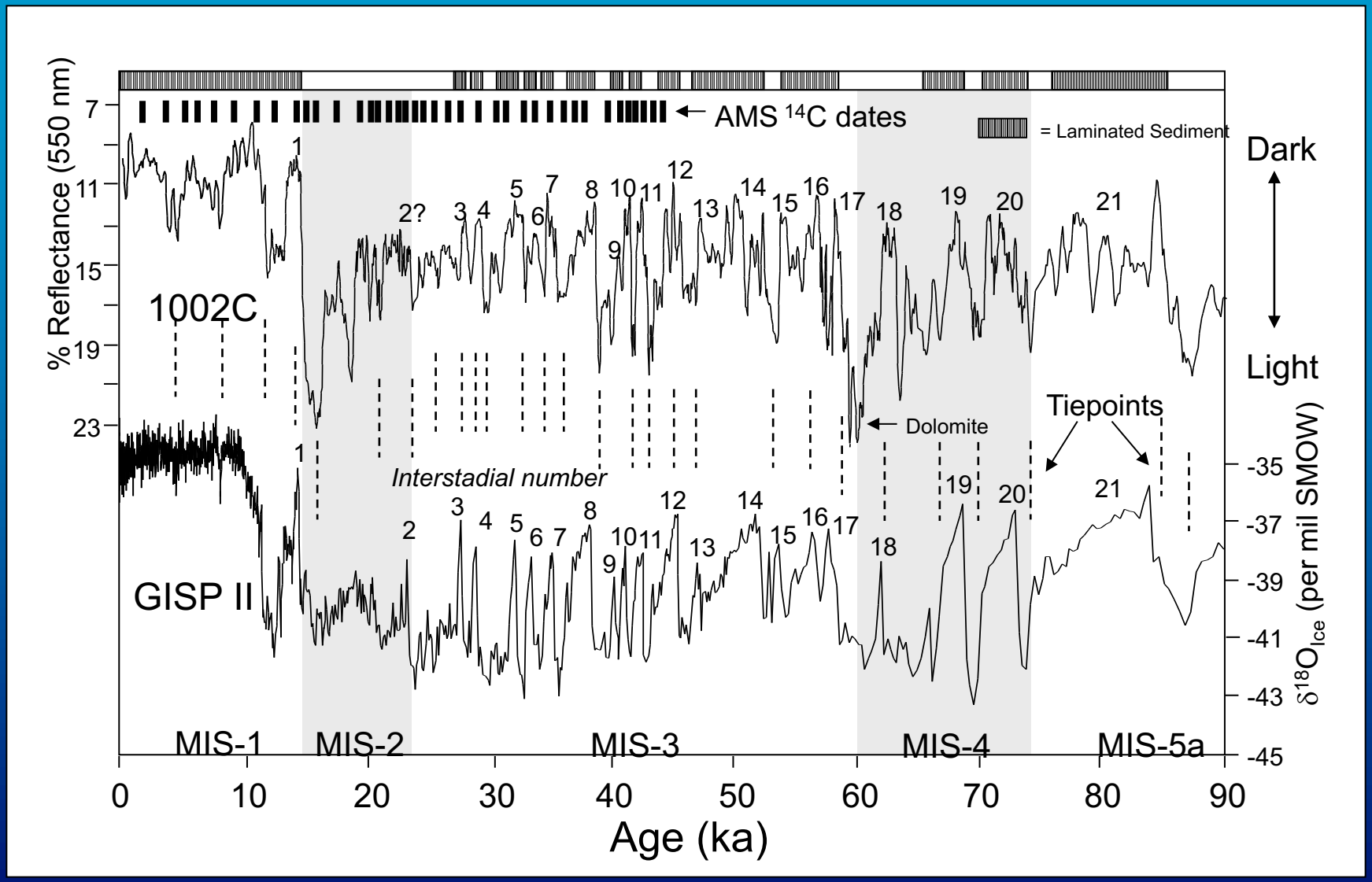


The Cariaco Basin – Other Species



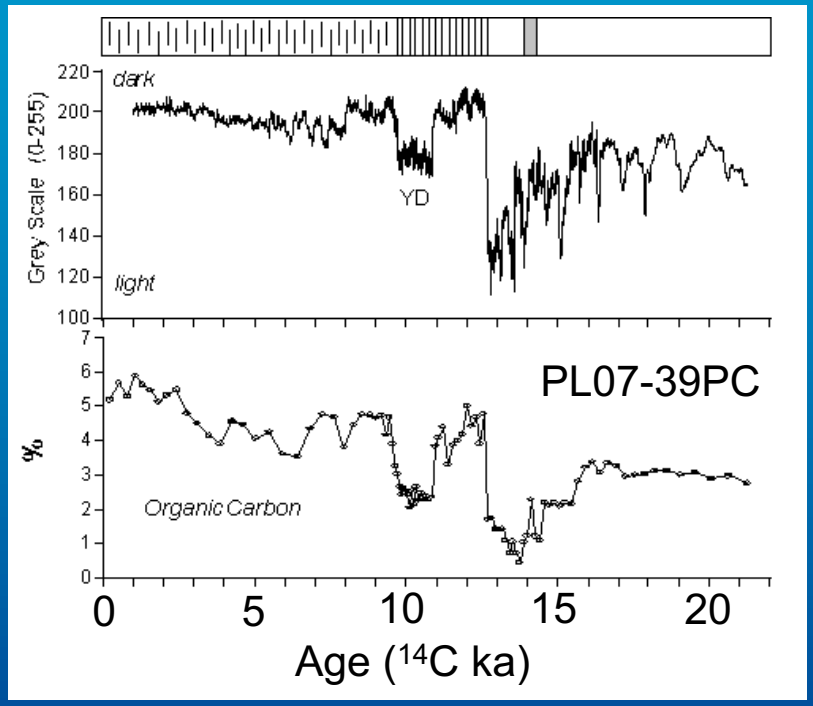


The Cariaco Basin – Reflectance

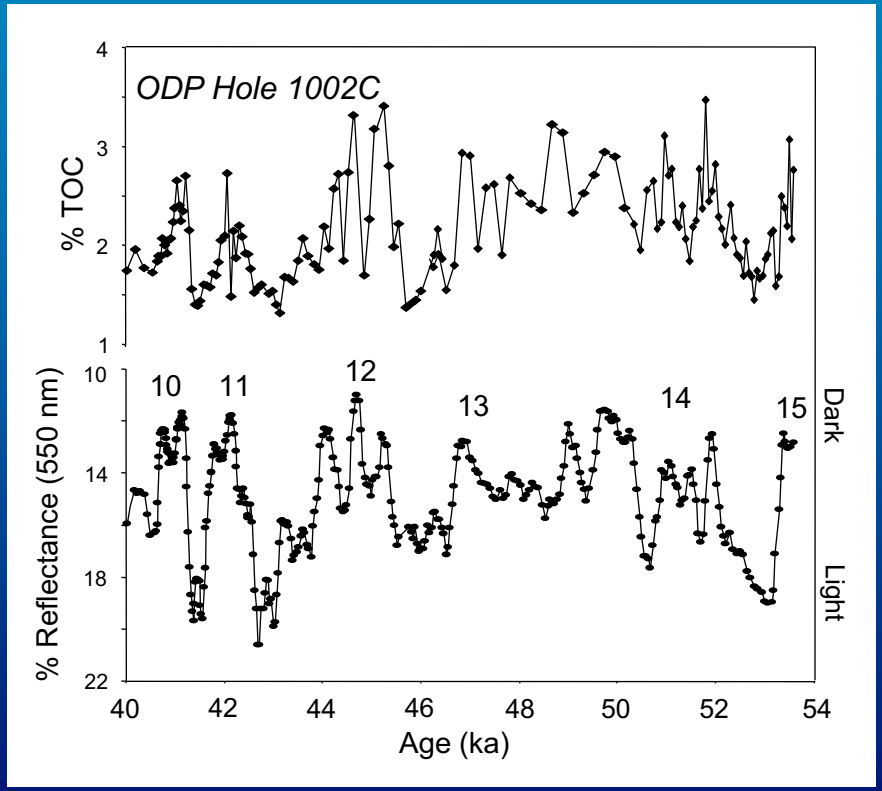


(Peterson *et al.*, 2000, Science)

The Cariaco Basin – Reflectance



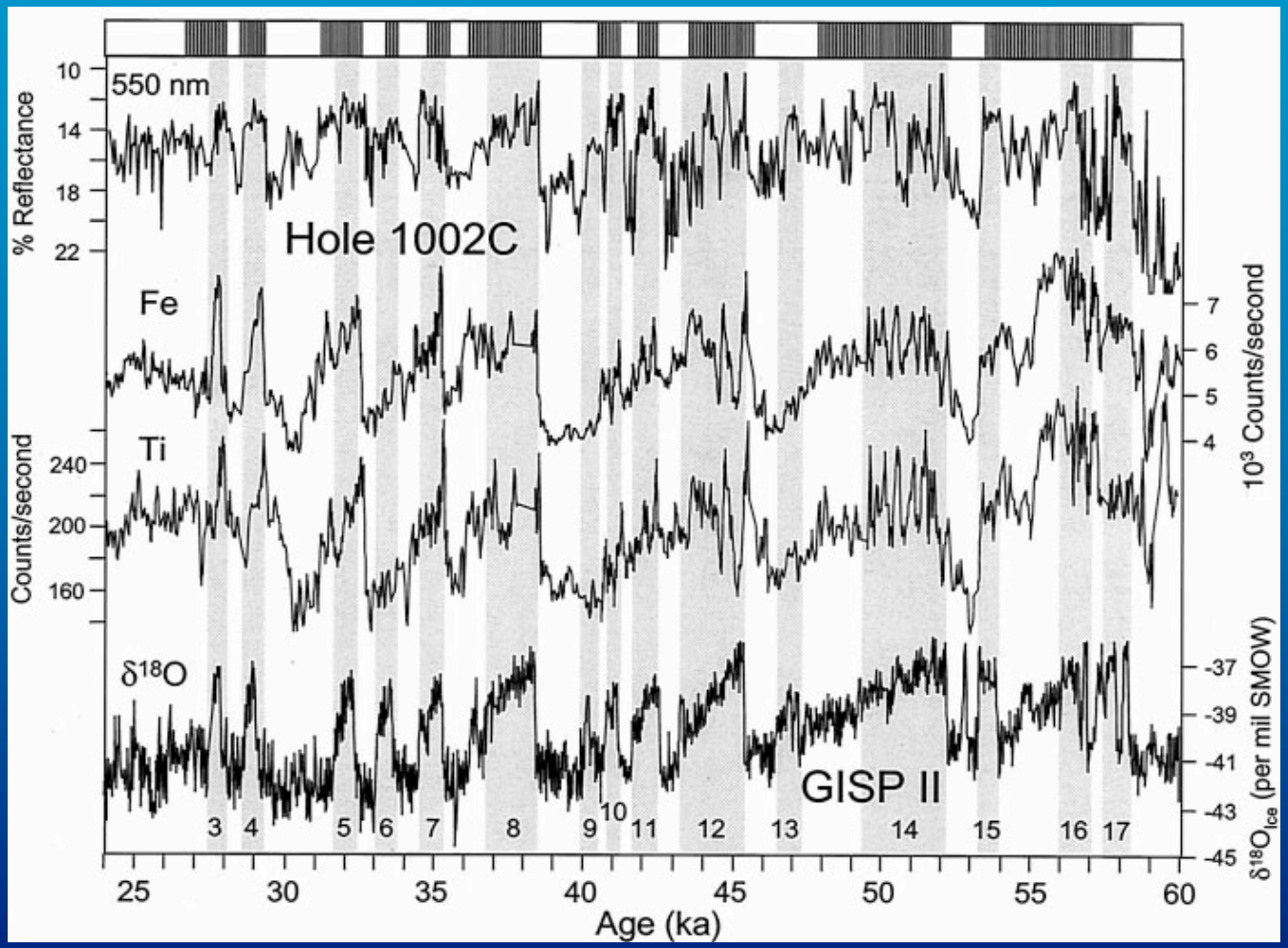
- What controls sediment reflectance (color)?

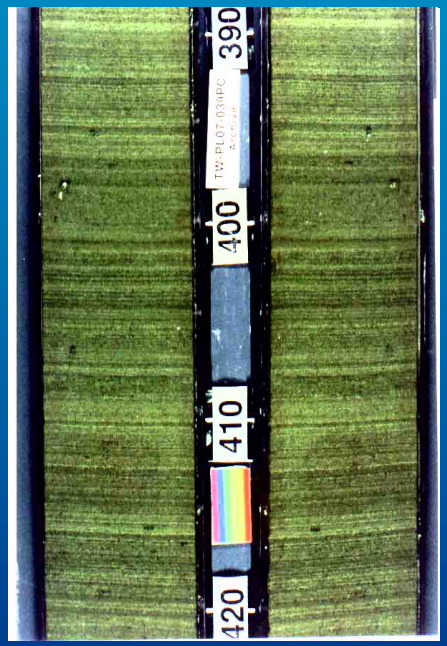


(Peterson *et al.*, 2000, EOS, Trans. AGU)

- *Organic carbon content is a prime candidate, but hard to imagine other variables not important!*

The Cariaco Basin – Other





(Peterson *et al*., 2000, Science)

Conclusions

- Sediment records are needed to provide baseline variability – need to expand geographic coverage where possible.
- Change is occurring all the time, with substantial climate-driven fluctuations even within a relatively small taxonomic group such as foraminifera.
- These population variations likely influence geochemical cycling within the water column through total fluxes and/or relative fluxes of different ballast materials.
- Choose your “representative” taxa carefully!

Collaborators

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Cindy Lee

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