

# Do Fossil Bivalve Shells From Seymour Island (Antarctic Peninsula) Provide Evidence For Eocene El Niño ?

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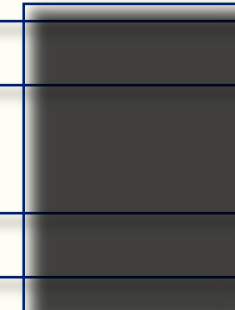
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Liverpool High School, Syracuse, NY, USA

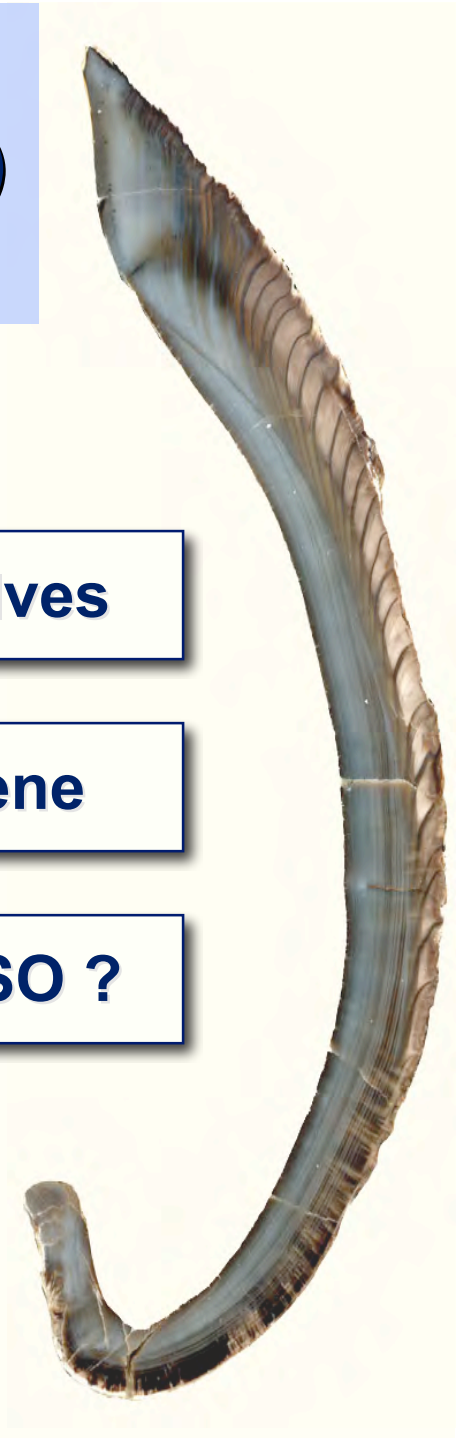


# Do Fossil Bivalve Shells From Seymour Island (Antarctic Peninsula) Provide Evidence For Eocene El Niño ?

- Present day ENSO effects on southern bivalves

- Existing evidence for ENSO during the Eocene

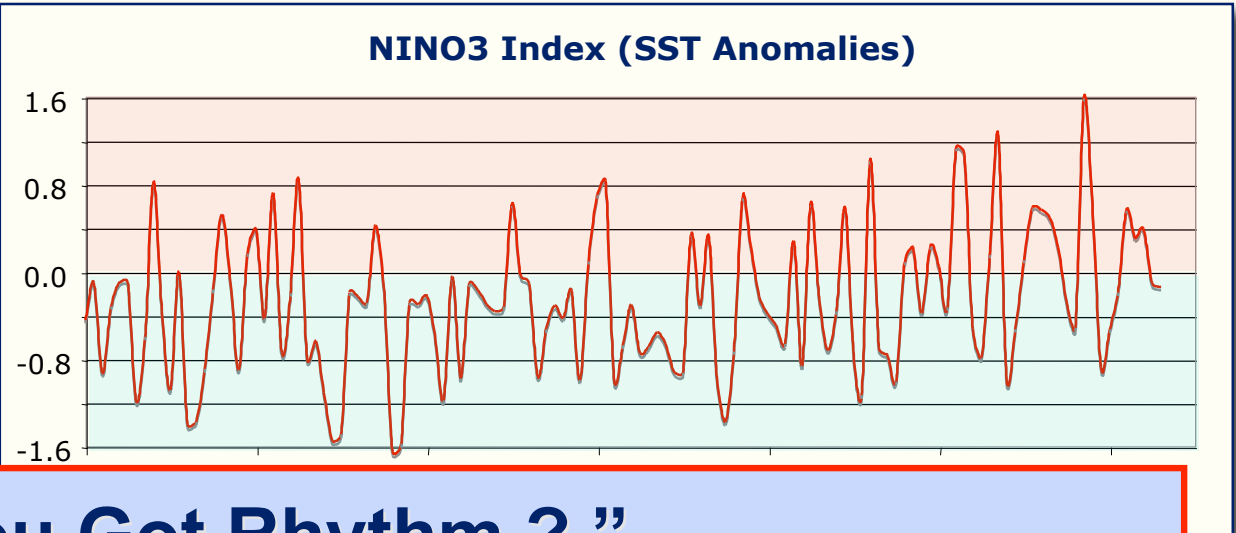
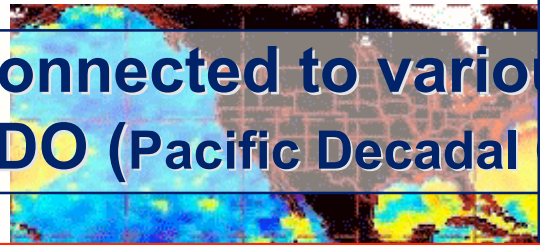
- Eocene bivalve shell growth patterns → ENSO ?



# Present Day ENSO

El Niño Southern Oscillation = “heartbeat” of the climate system

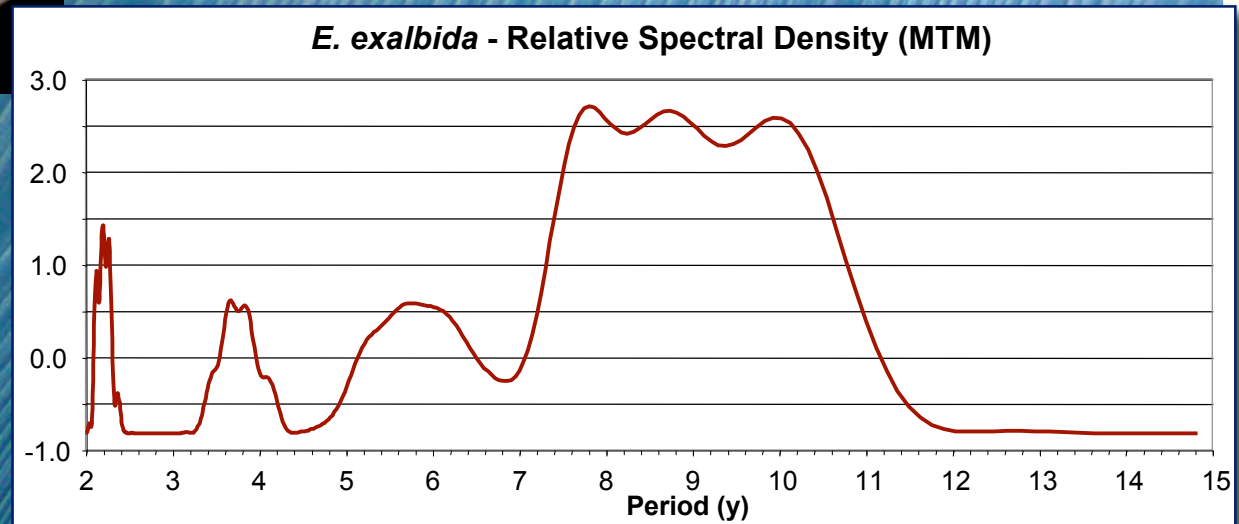
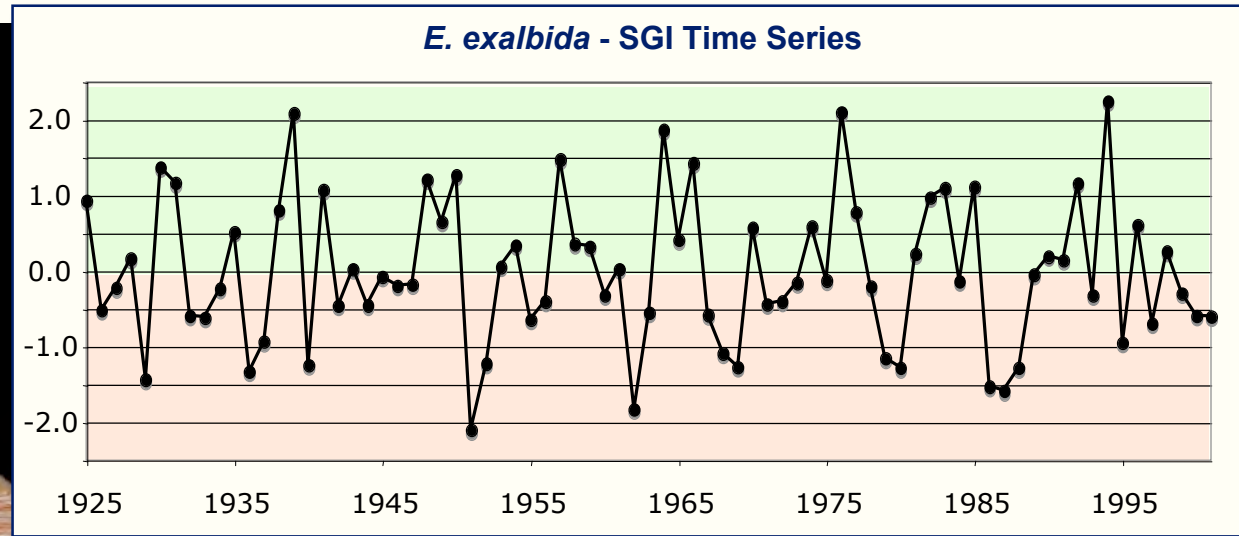
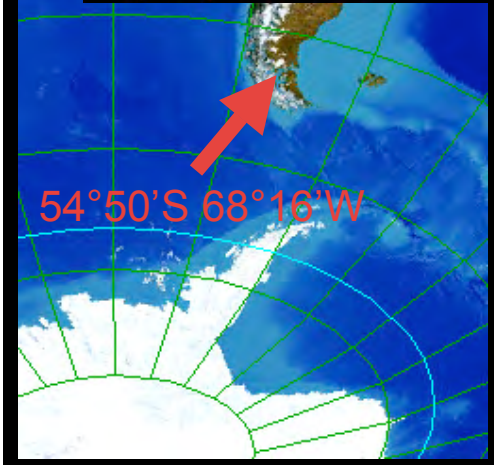
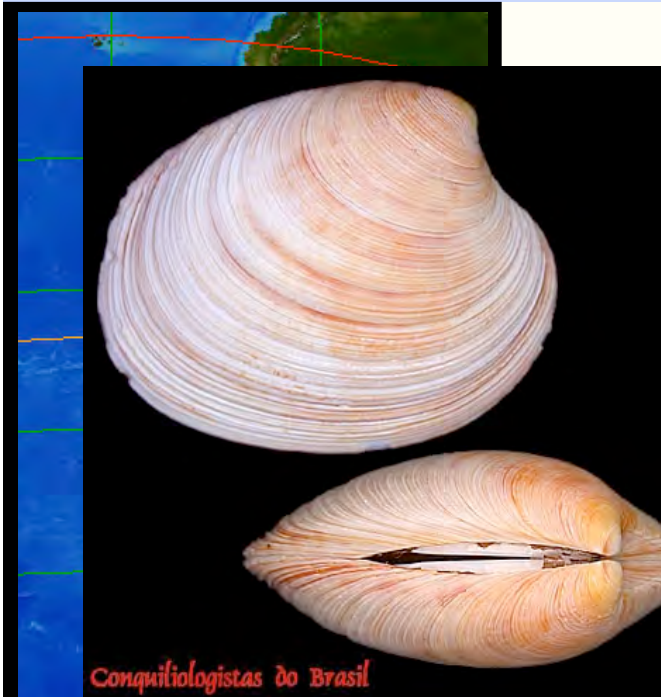
Connected to various modes of climate variability including the PDO (Pacific Decadal Oscillation)



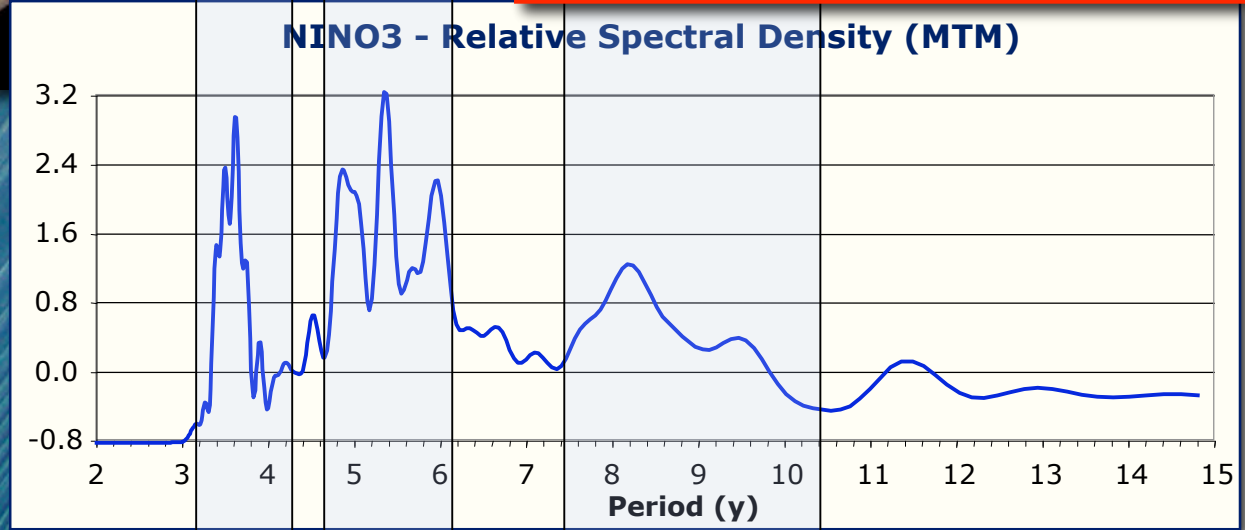
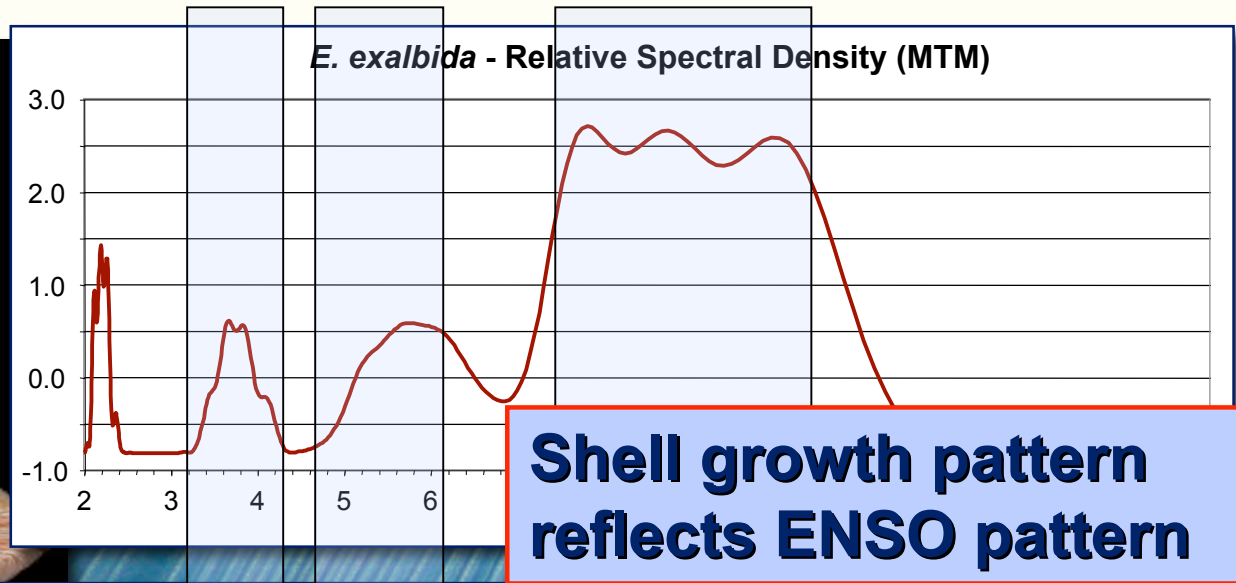
“ You Got Rhythm ? ”



# ENSO Effects on Bivalves in the Far South ?



# *Eurhomalea exalbida* - Beagle Channel



# Back to the Eocene

Middle Eocene 50 Ma

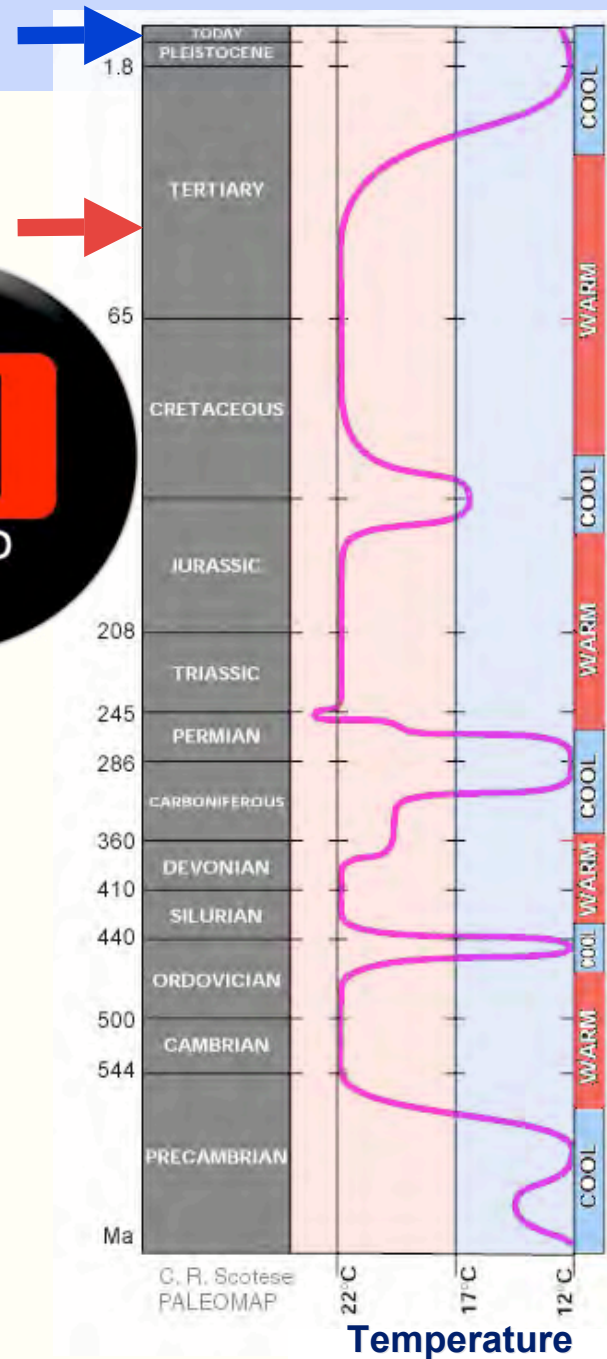


Seymour Island



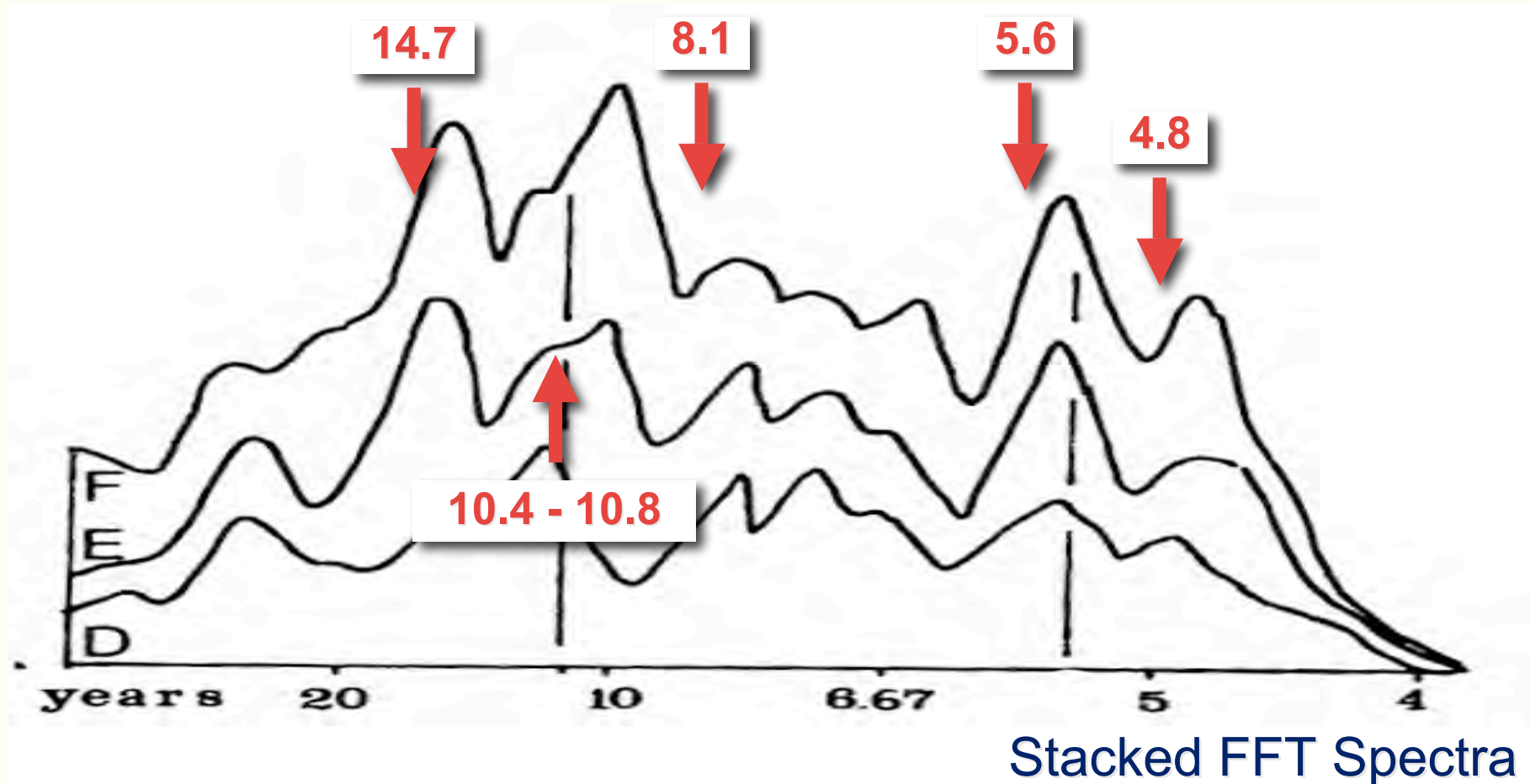
(c) Maryland Geological Survey

Eocene Enso - ISC 2007



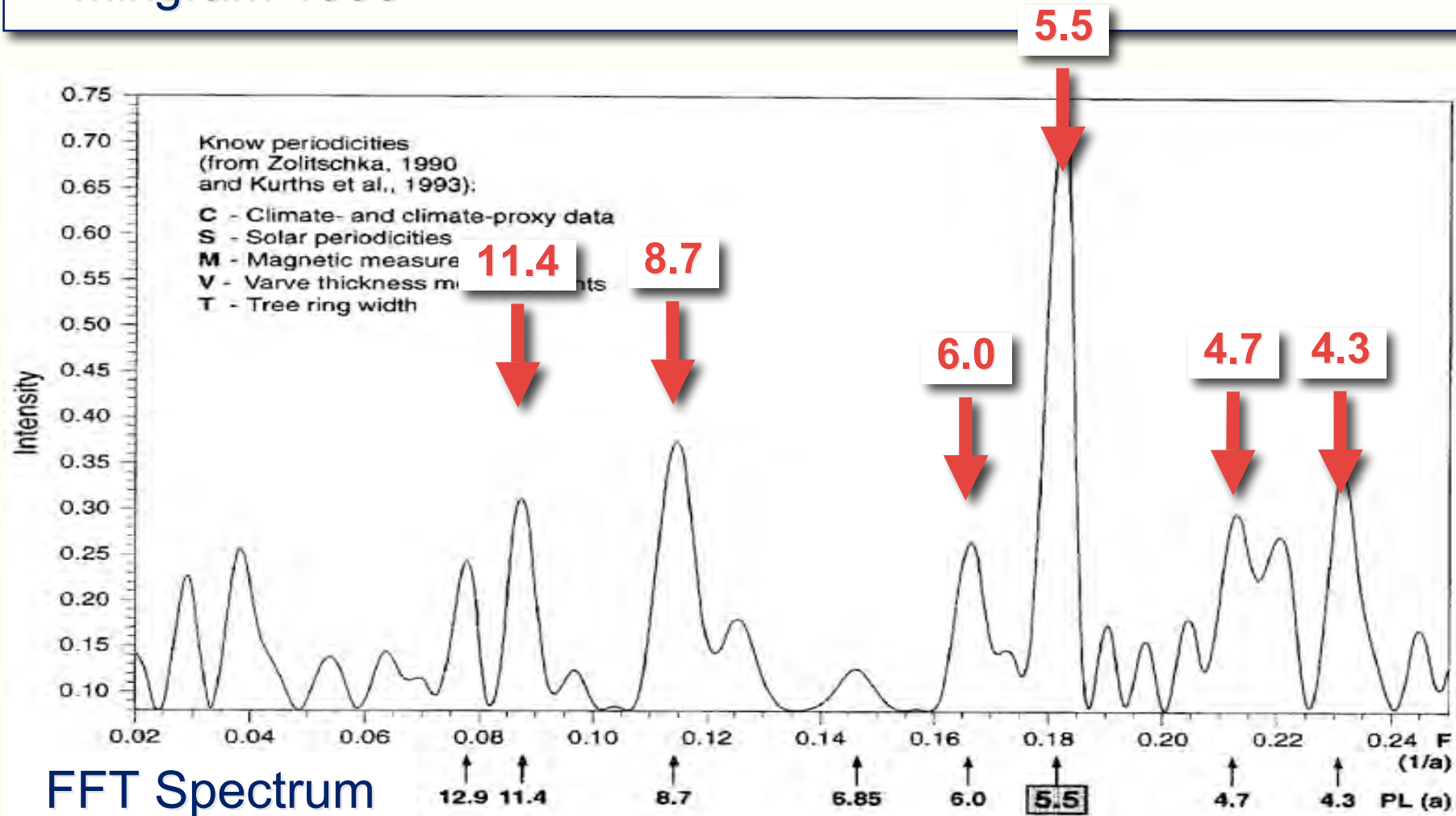
# ENSO during the Eocene ?

- **Green River Formation Oil Shales (Wyoming)**  
Ripepe et al. 1991, Crowley et al. 1986



# ENSO during the Eocene ?

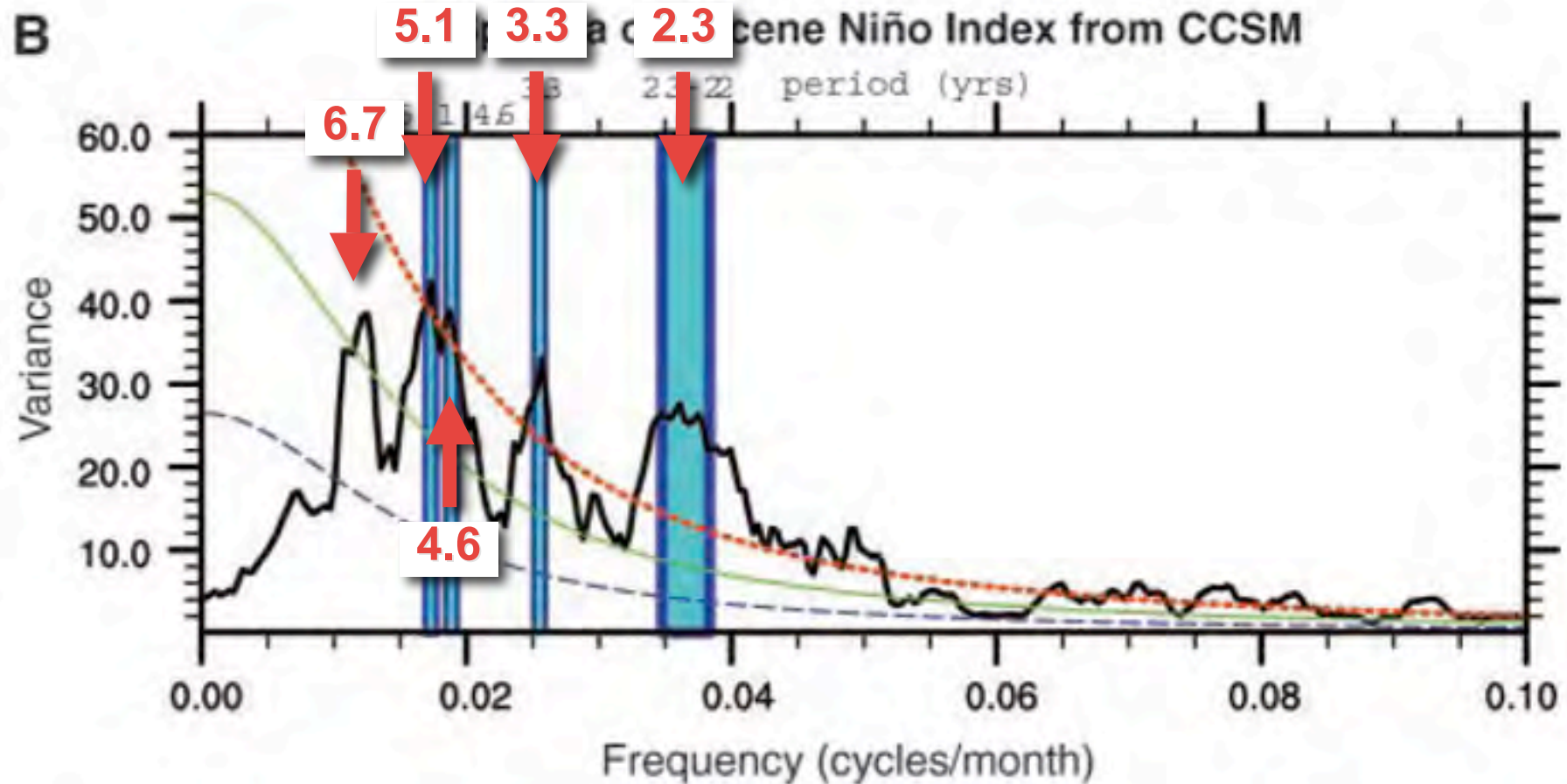
- Eckfeld Dry Maar Deposits (Germany)  
Mingram 1998



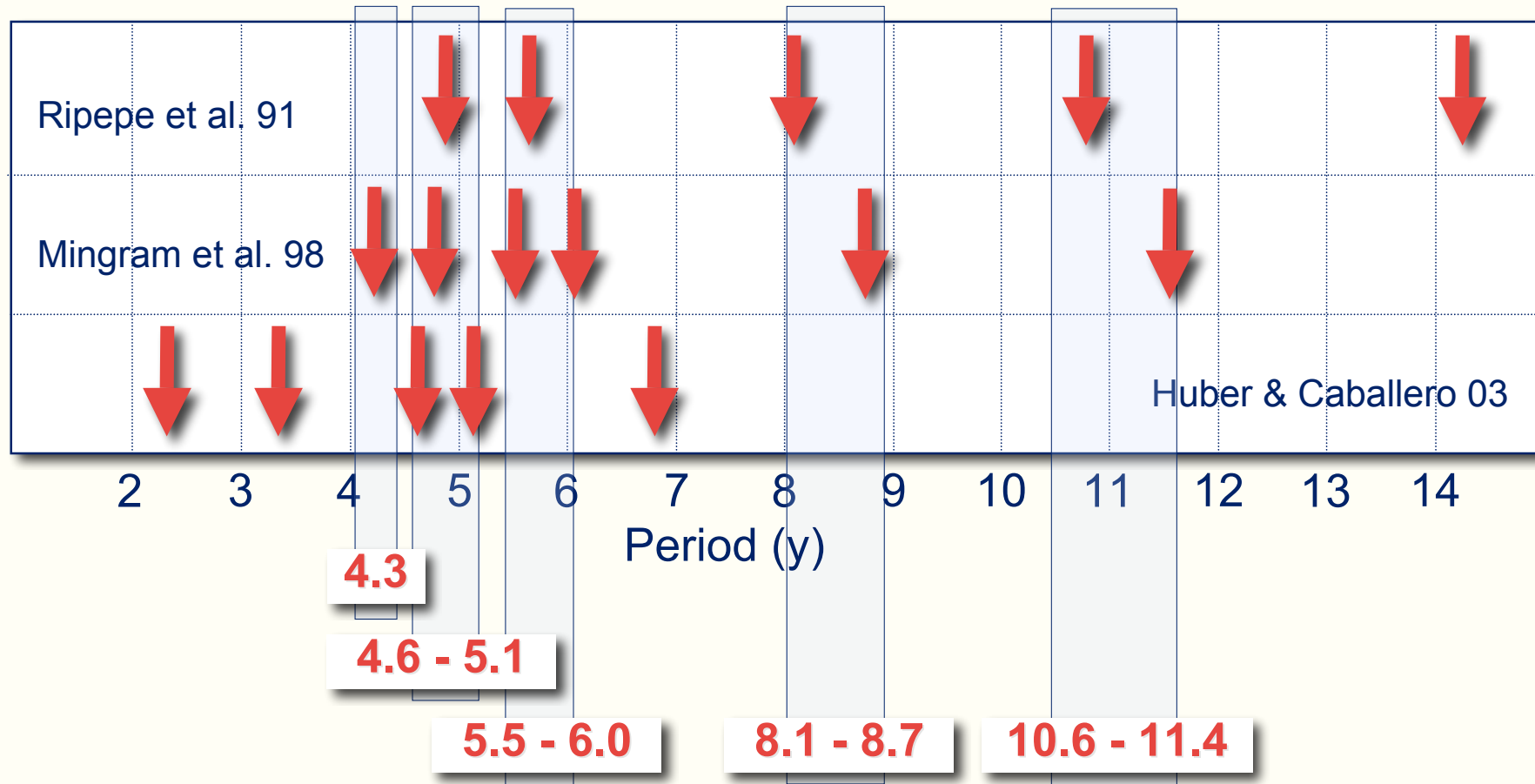


# ENSO during the Eocene ?

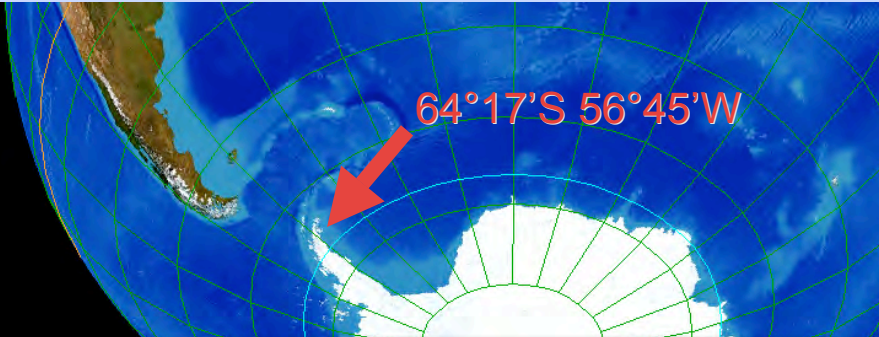
- Eocene Coupled Climate Simulation Model  
Huber & Caballero 2003



# Evidence Summary

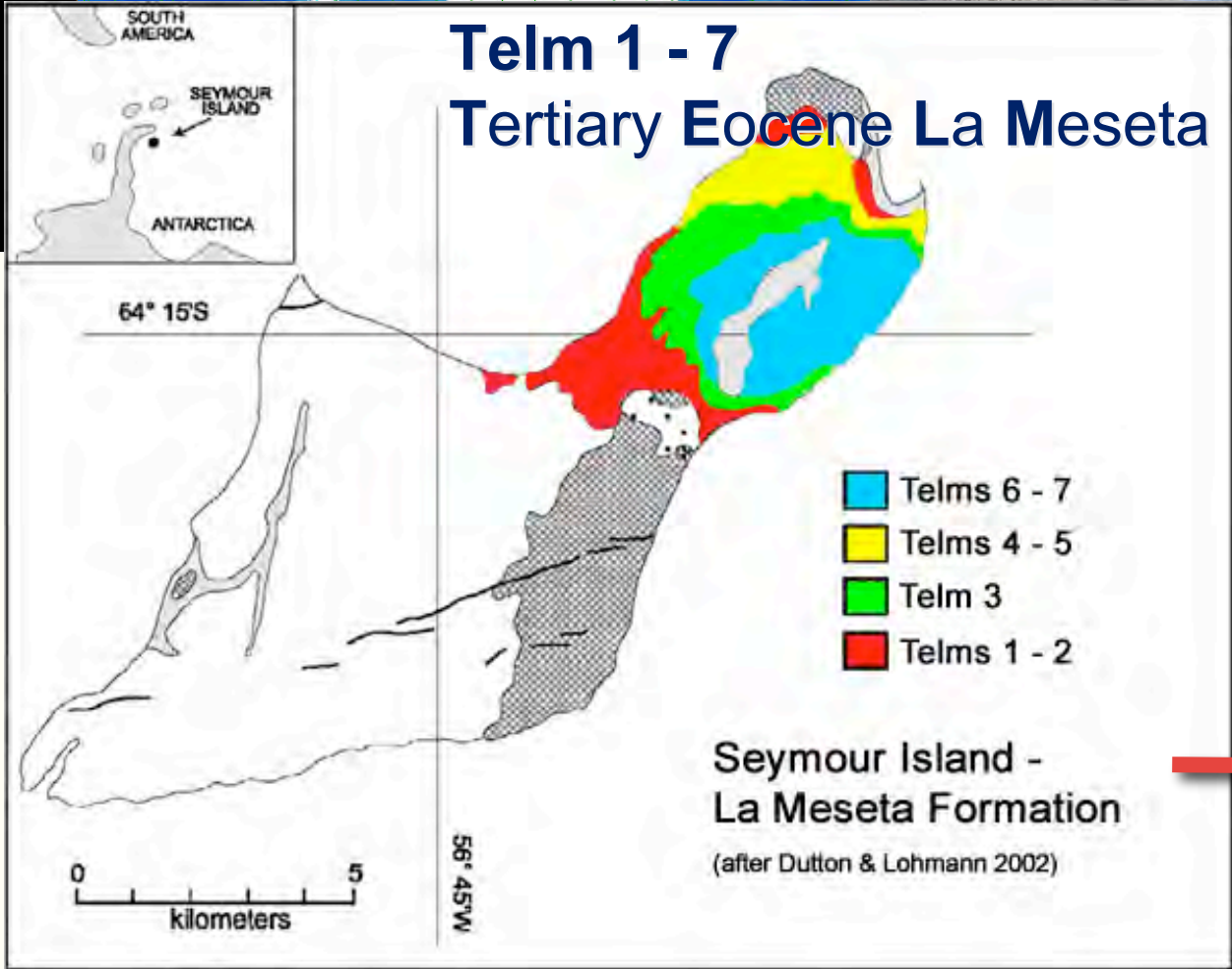
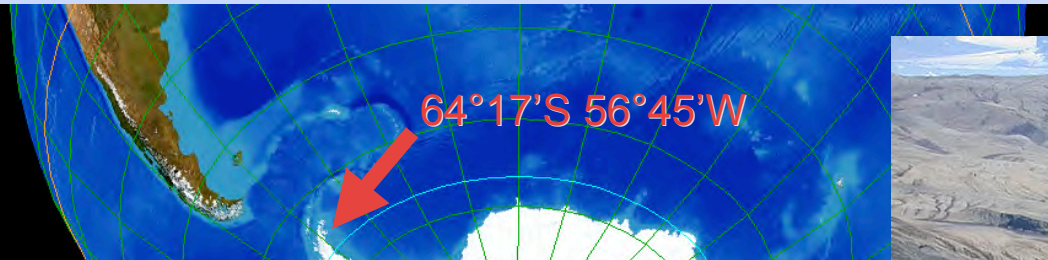


# Seymour Island



**La Meseta Formation**  
(middle to late Eocene)

# La Meseta Formation



## Geological Age

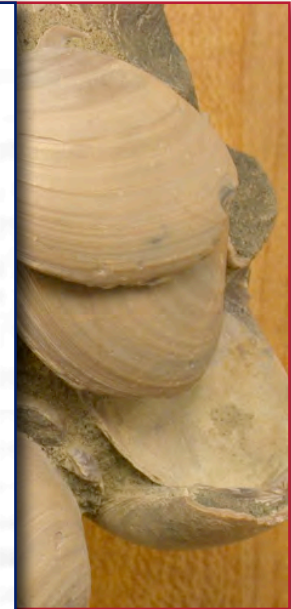
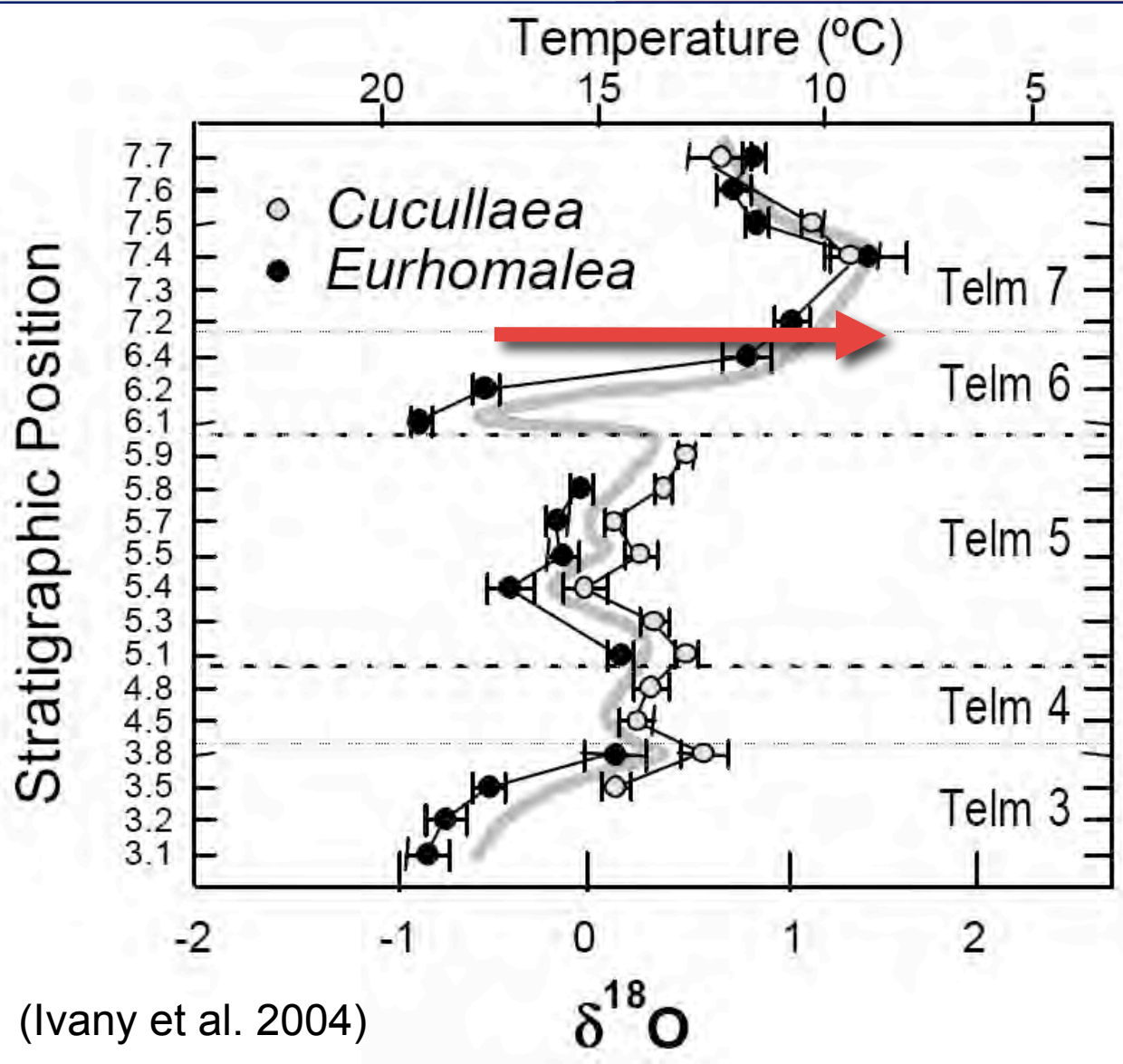
Telm 7: 34 - 40 Ma

Telm 5: ± 50 Ma

Telm 3: 53 - 54 Ma

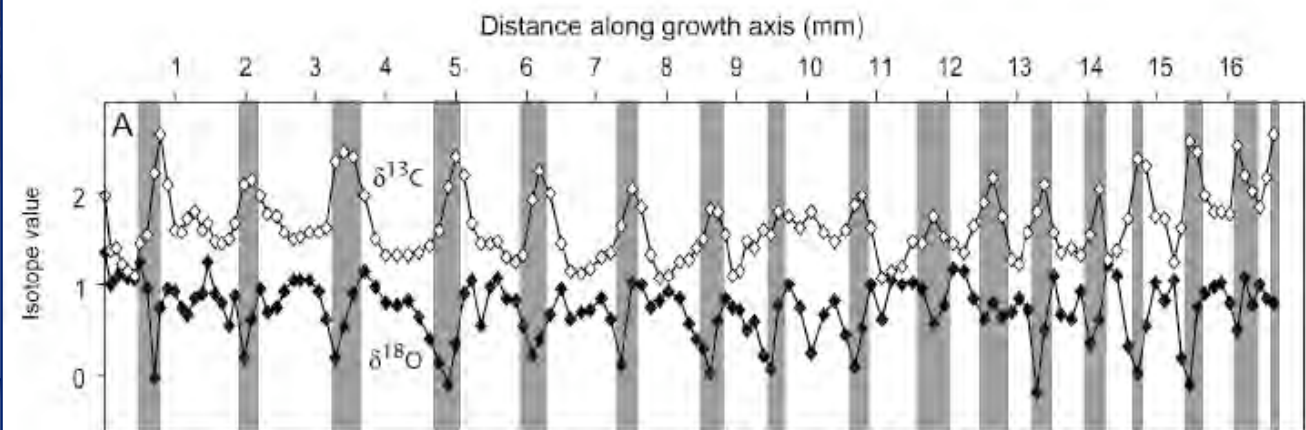
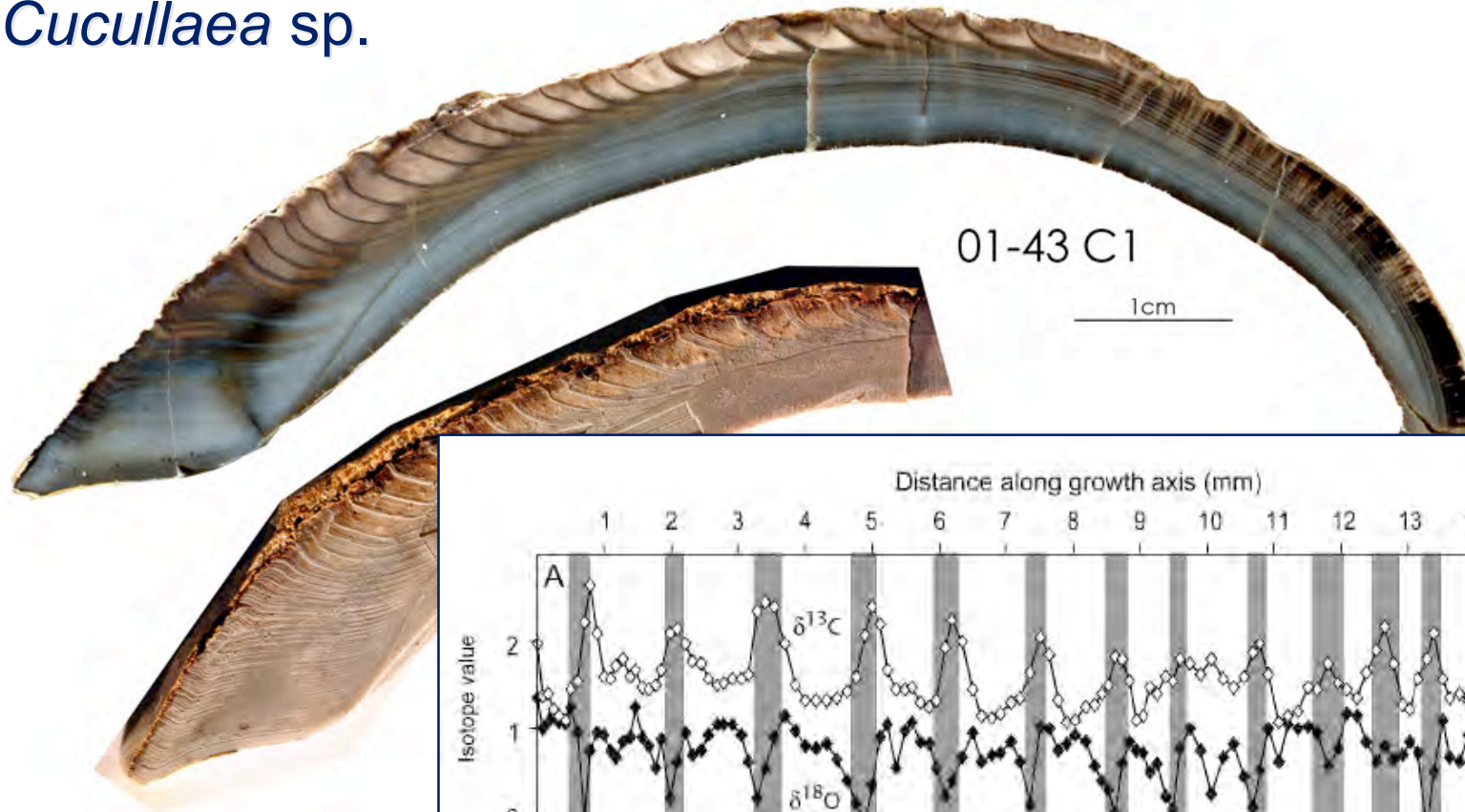
(Ivany et al. in press)

# Eocene Bivalves from La Meseta Formation



# Shell Growth Banding

*Cucullaea* sp.



Buick & Ivany 2004

Stable isotope profiles ( $\delta^{13}\text{C}$ ,  $\delta^{18}\text{O}$ )  
confirm annual formation of growth bands

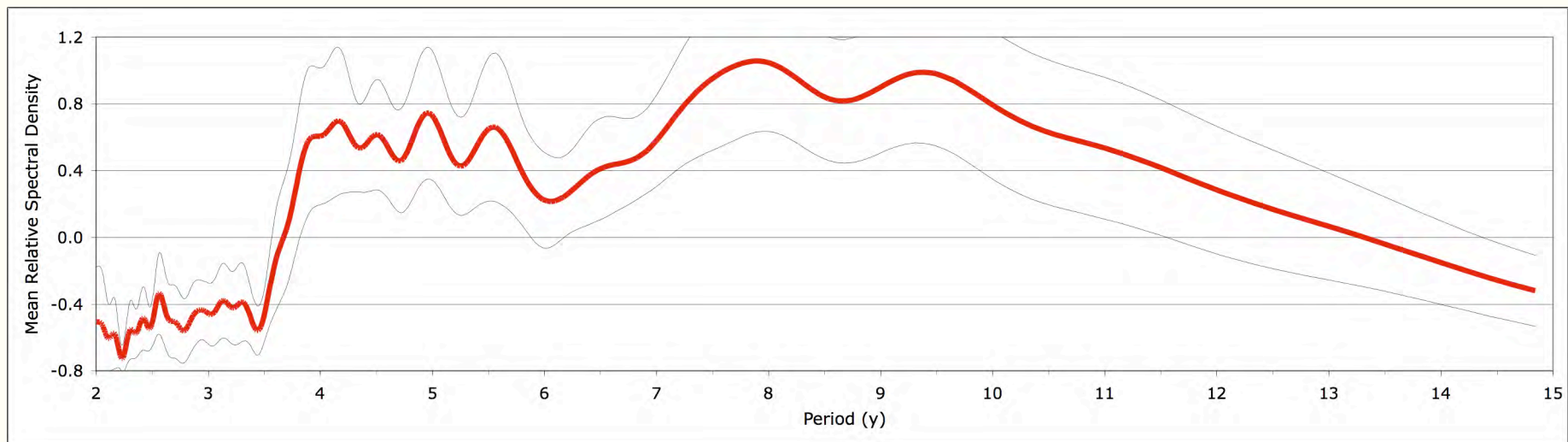
# From Growth Bands to Spectral Density

● Growth Band Mean → Individual SGI Time Series

● Single Spectral Analysis → Noise Reduced Time Series ( $\pm 70\%$ )

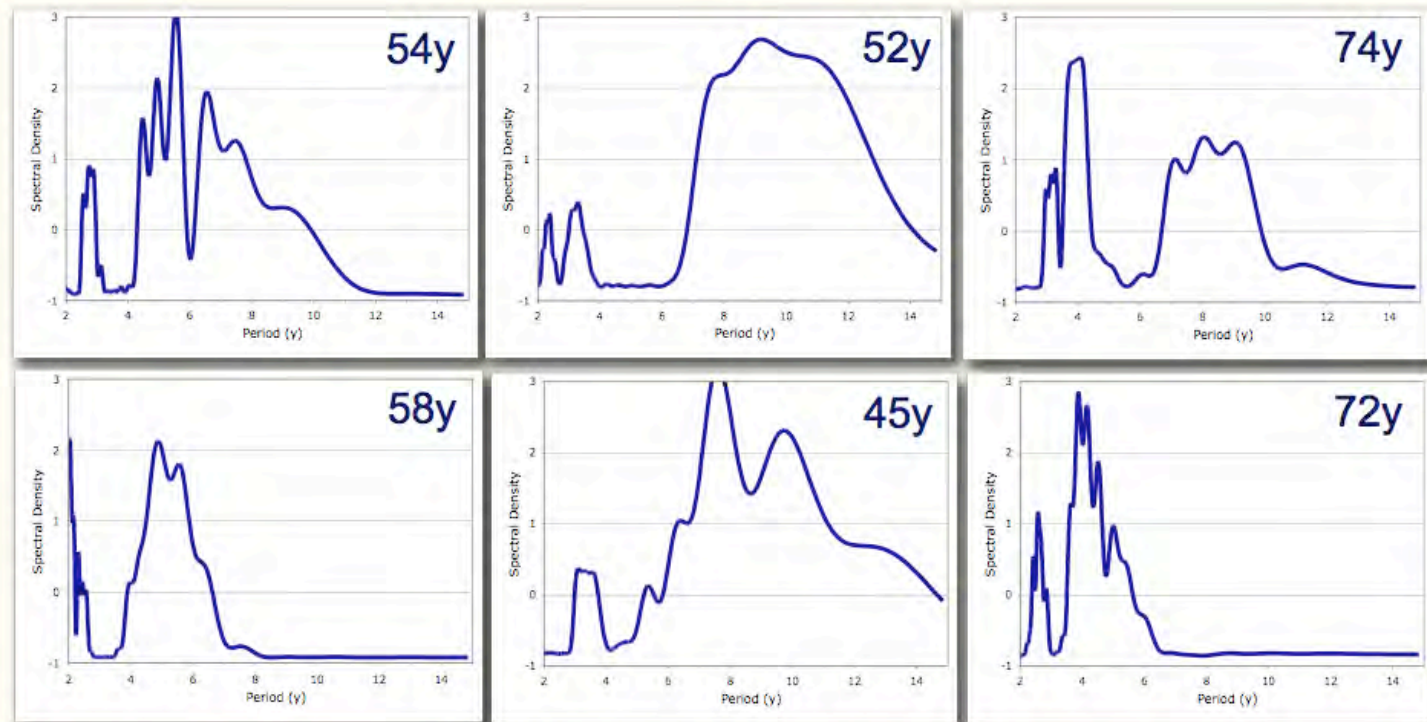
● Multi Taper Method → Individual Spectral Density Pattern

● Stacking (6 + 3) → Common Spectral Density Pattern

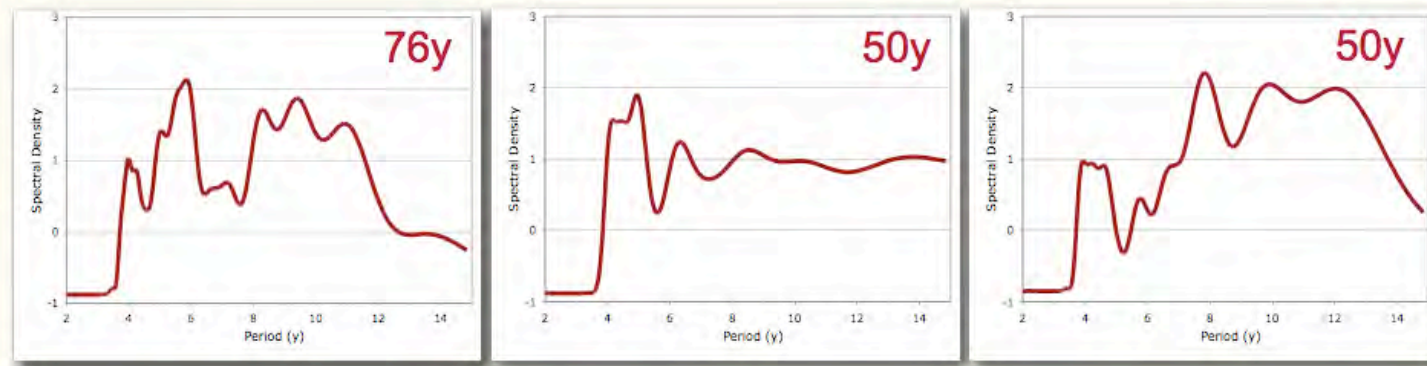


# All Shells - Spectral Density (MTM)

## *Cucullaea*



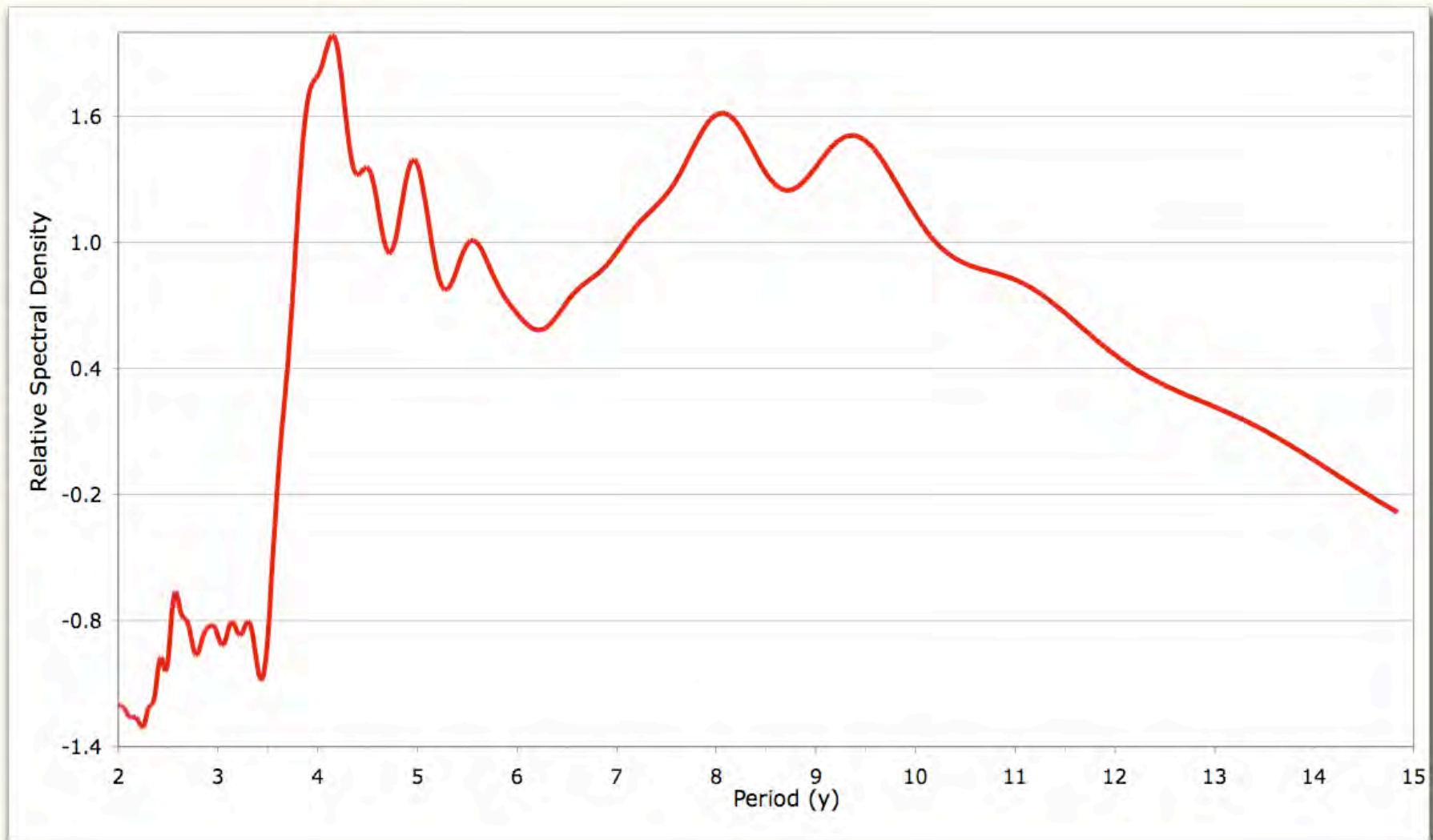
## *Eurhomalea*



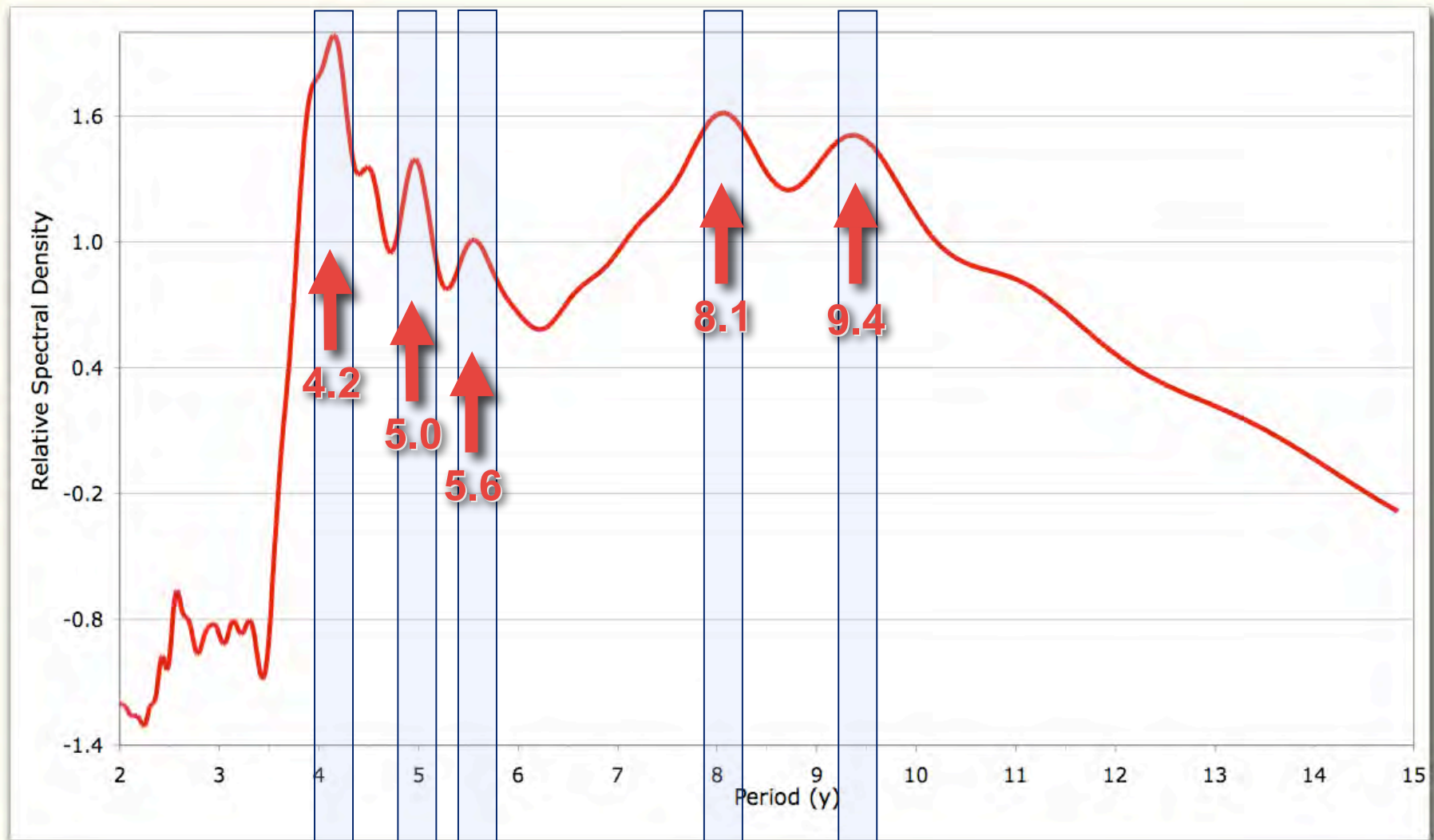


# Stacking by Principal Component Analysis (PCA)

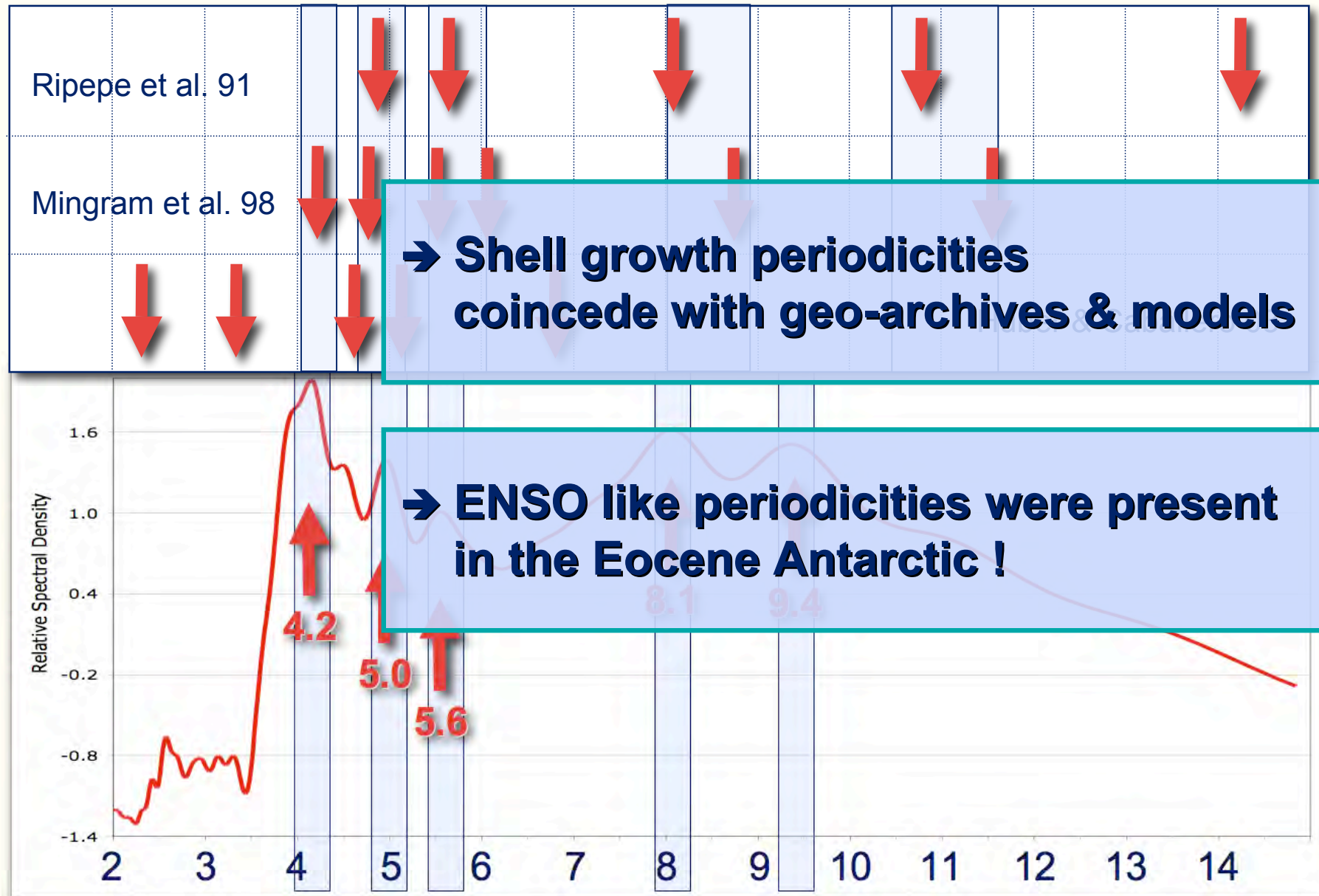
- PCA of 9 Spectra → Weighted Mean of 1st, 2nd and 3rd Axis



# Temporal Patterns



# Does It Fit ?





**Thank You Very Much !**