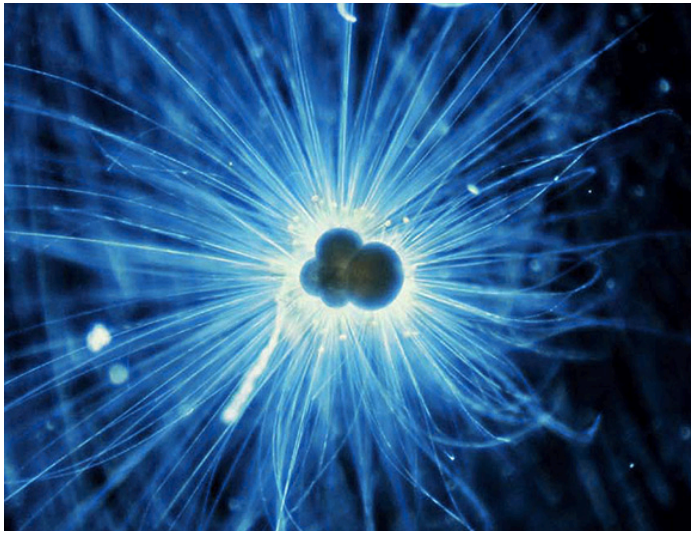
Foraminifera, Isotopes and Paleoclimate Signals

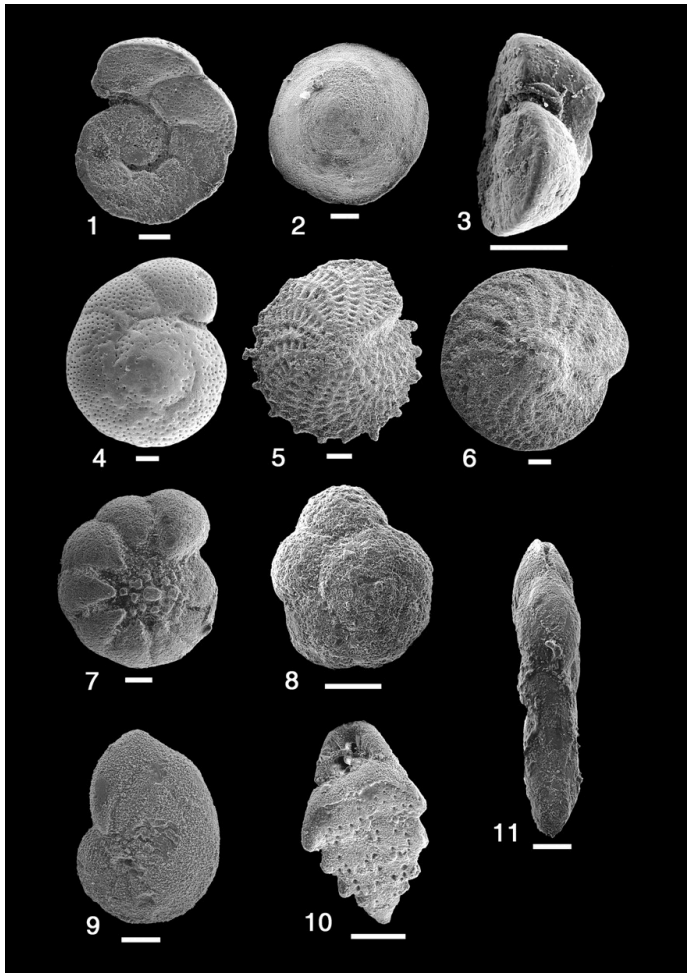
Shannon Valley

EAS 4480

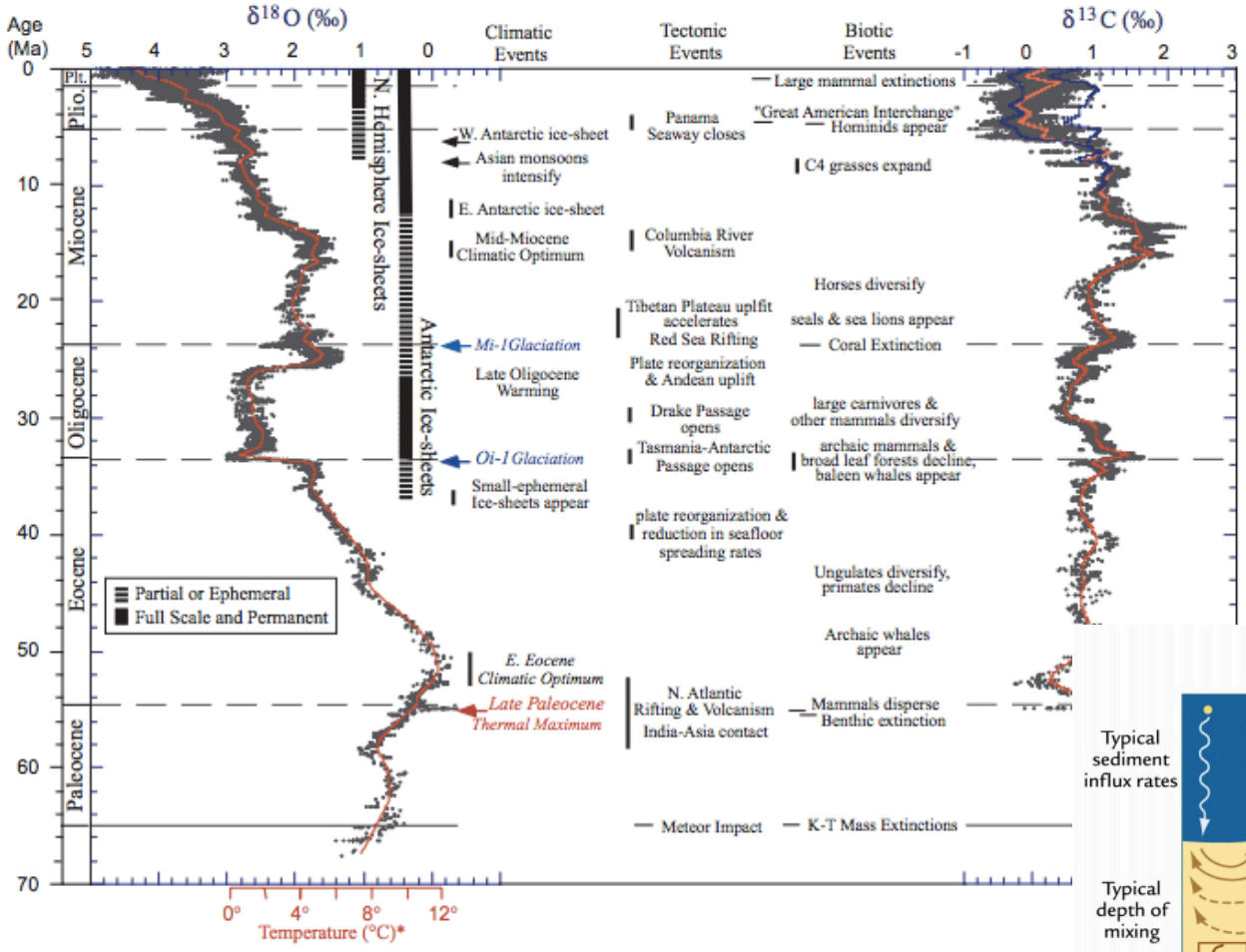
April 23, 2015

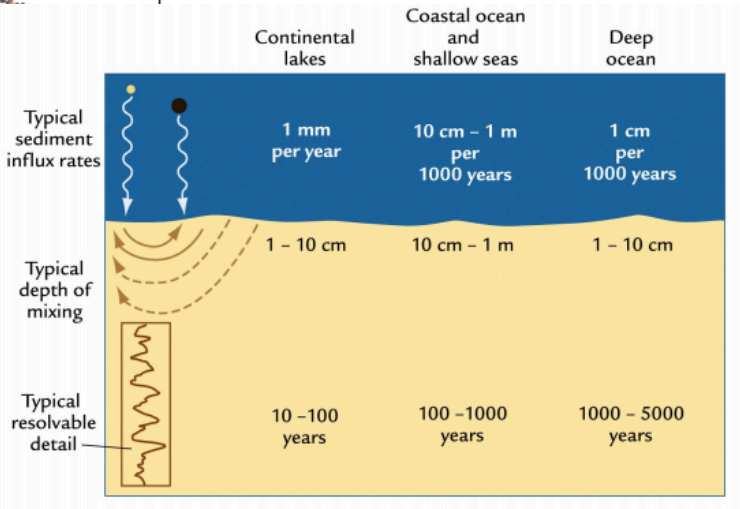
What are foraminifera?



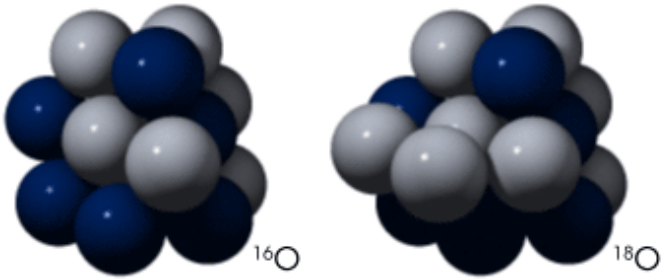


…and what can they tell us?





Isotope Ratios



$$\delta^{18}O = \left(\frac{\left(\frac{^{18}O}{^{16}O}\right)_{sample}}{\left(\frac{^{18}O}{^{16}O}\right)_{standard}} - 1 \right) * 1000\ {}^{o}/_{oo}$$

$$\delta^{13}\mathrm{C} = \left(\frac{\left(\frac{^{13}\mathrm{C}}{^{12}\mathrm{C}}\right)_{\mathrm{sample}}}{\left(\frac{^{13}\mathrm{C}}{^{12}\mathrm{C}}\right)_{\mathrm{standard}}} - 1 \right) * 1000\ {}^{o}/_{oo}$$

$\delta^{18}O$ in forams: ↑T, ↓$\delta^{18}O$

$\delta^{13}C$ in forams: ↑productivity, ↓$\delta^{13}C$

Data and Methods

Core KNR 166-2 JPC 26 from the Florida Straits

3 benthic foram species:

- *Cibicidoides pachyderma*
- *Planulina ariminesis*
- *Cibicides mollis*

Data include depth/age model, $\delta^{18}O$ and $\delta^{13}C$

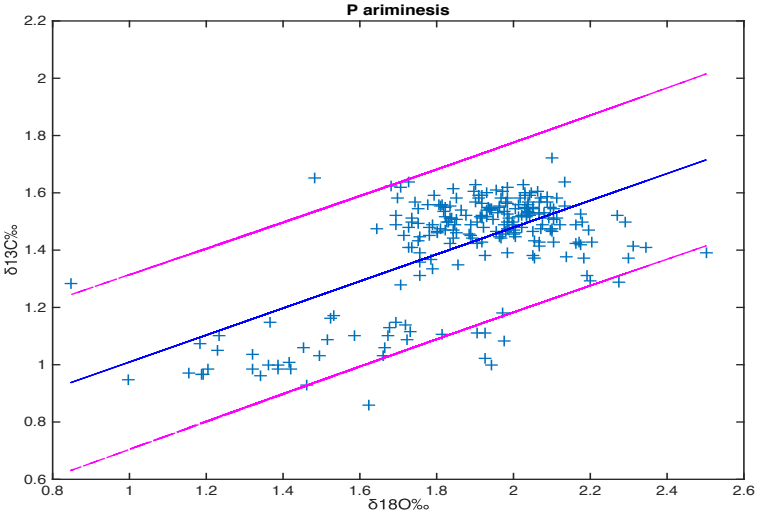
Analyses:

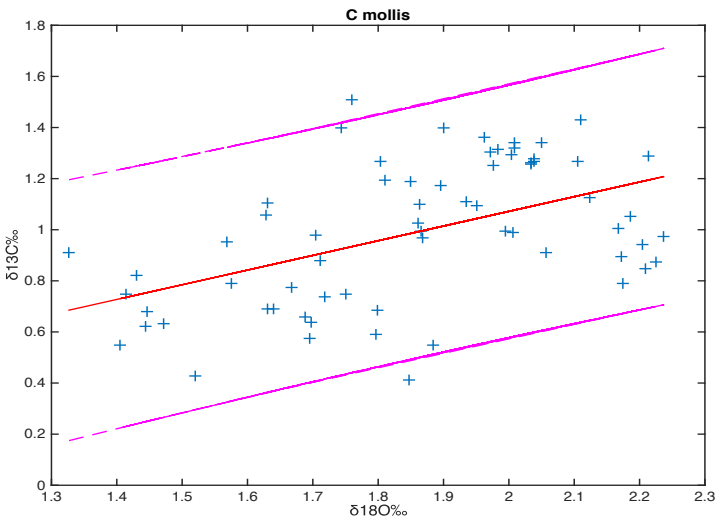
- Linear Regression
- Correlation Coefficient
- Residual Analysis
- Polynomial Fits
- Time Series Analysis

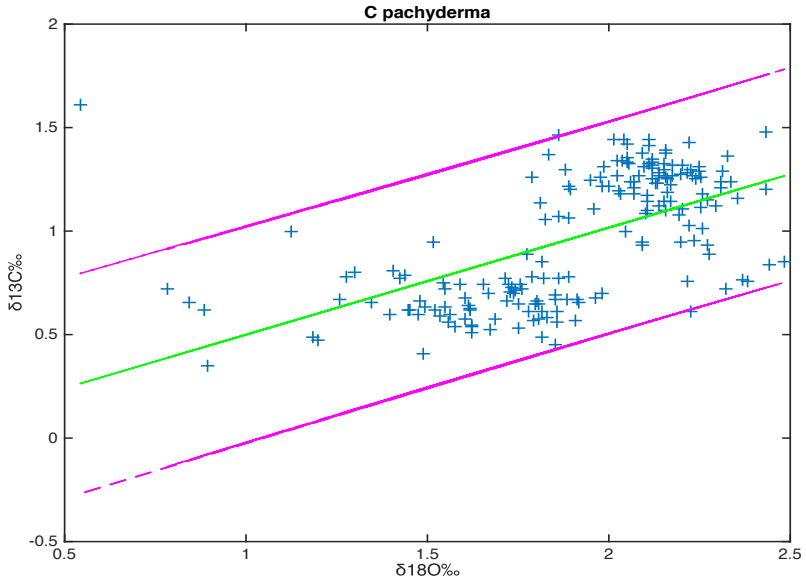
Is there a relationship between temperature and productivity evident in these species?

Can we see evidence of past glaciations?

Linear Regressions with Error Bounds

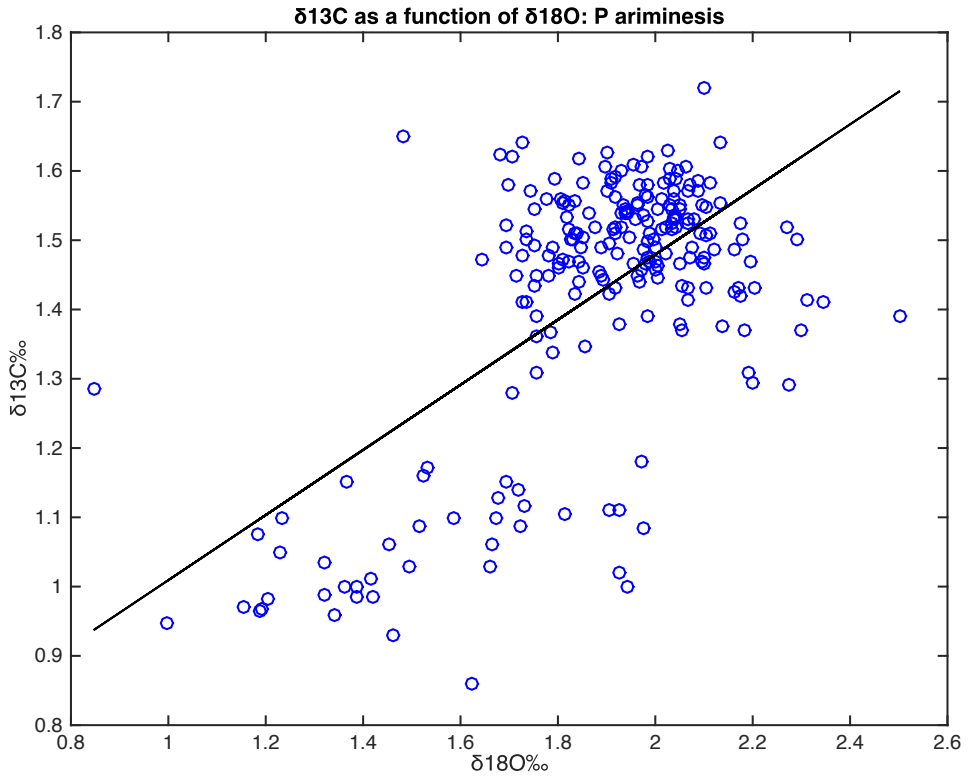






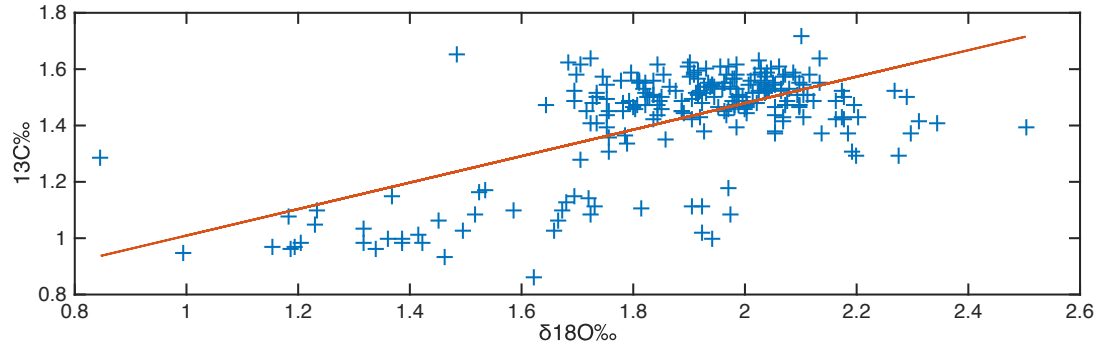
Correlating productivity and temperature

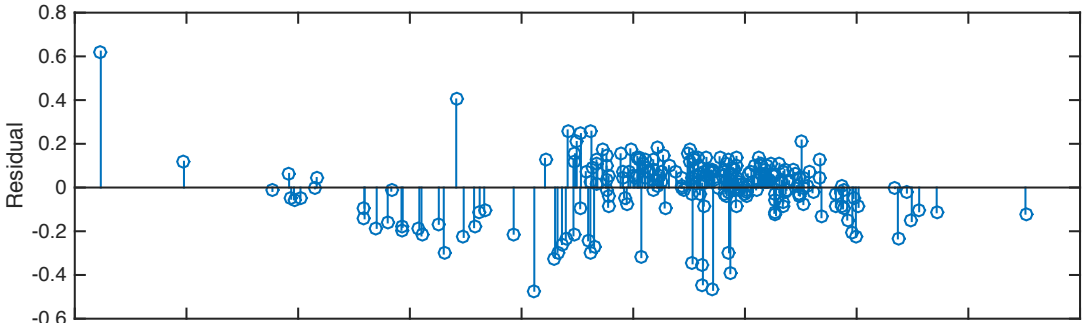
Species	Corr. Coef.
P. ariminesis	0.6272
C. mollis	0.4918
C. pachyderma	0.5742



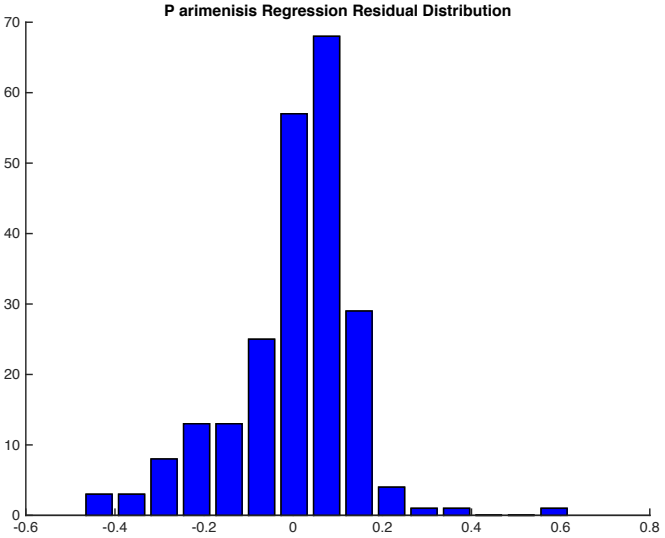
Residual Analysis

1st order– P ariminensis

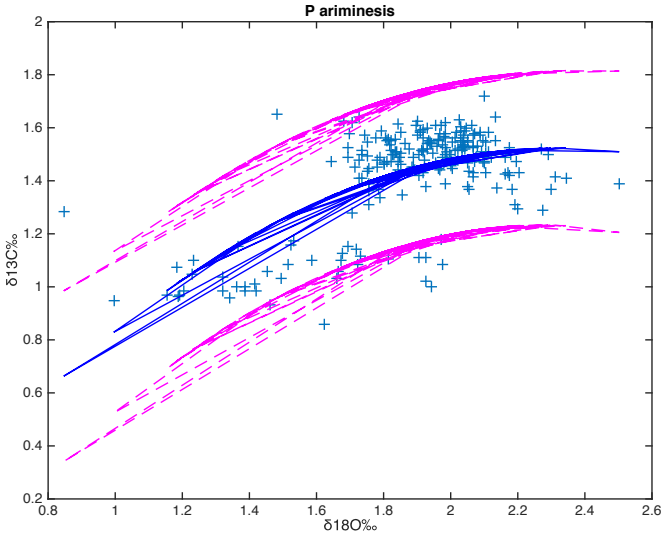


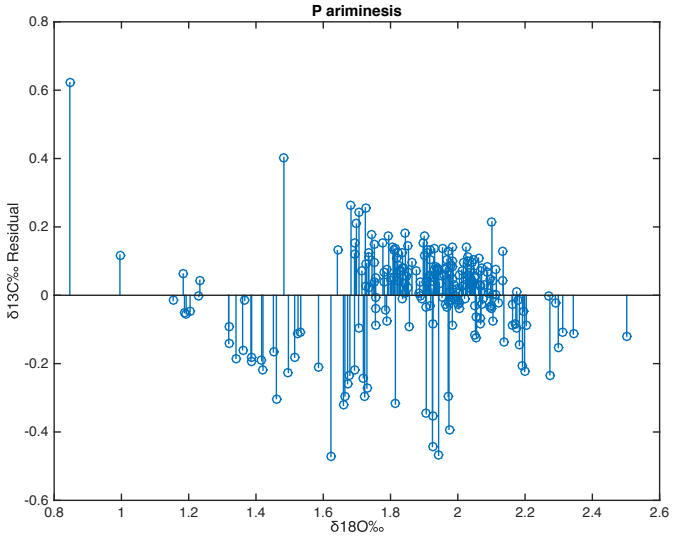


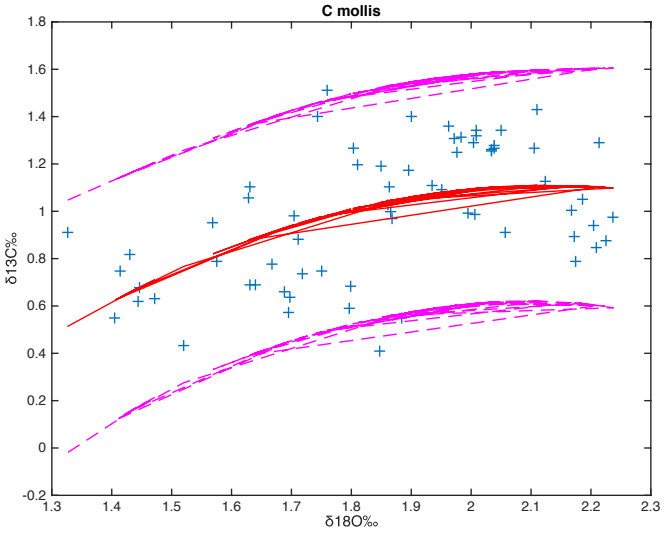
Critical value	X^2 value
21.03	173.2

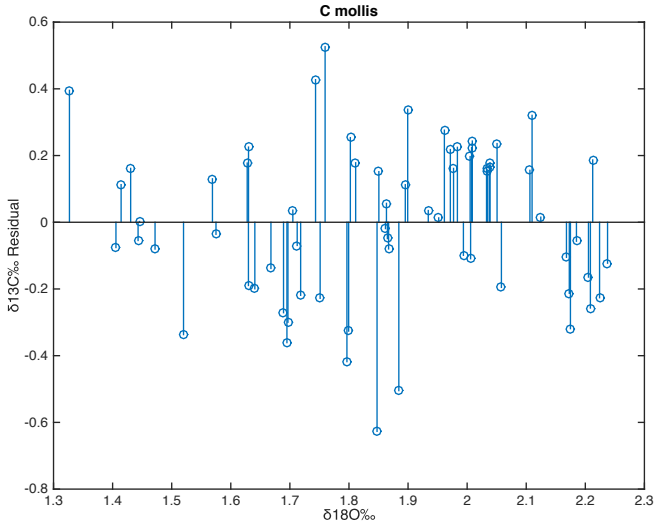


2nd Degree Polynomial Fits









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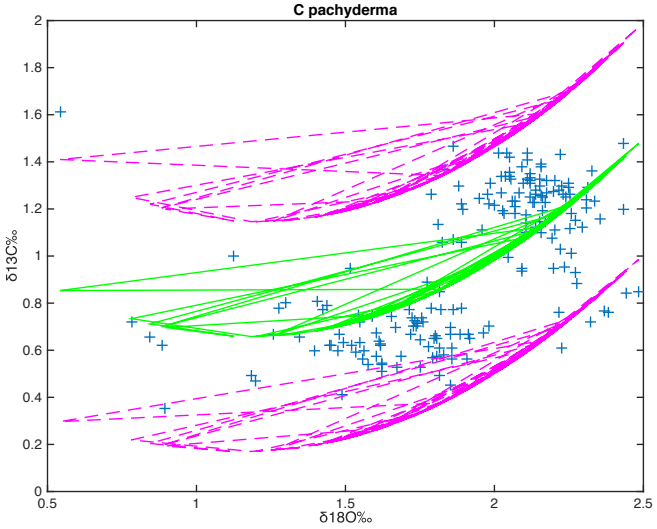
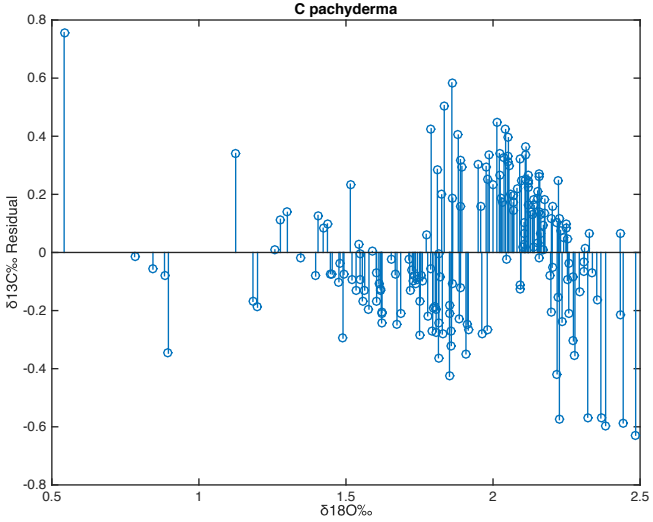
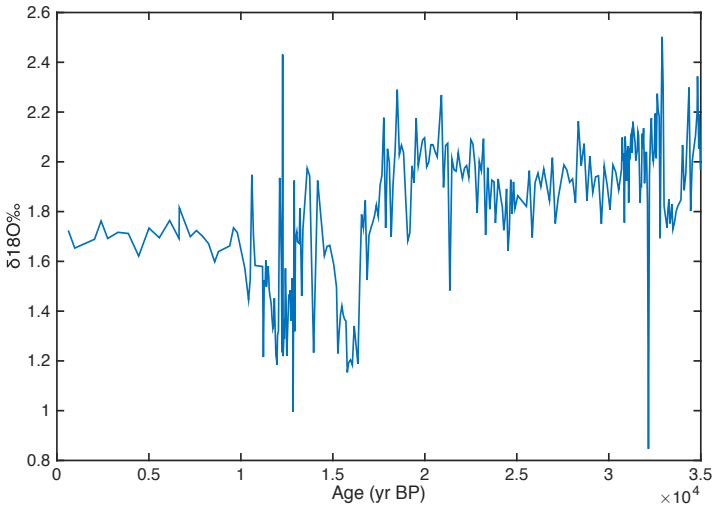
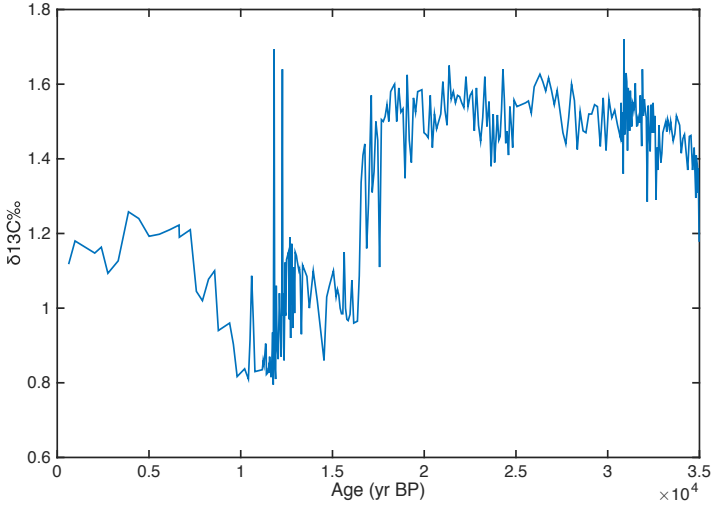
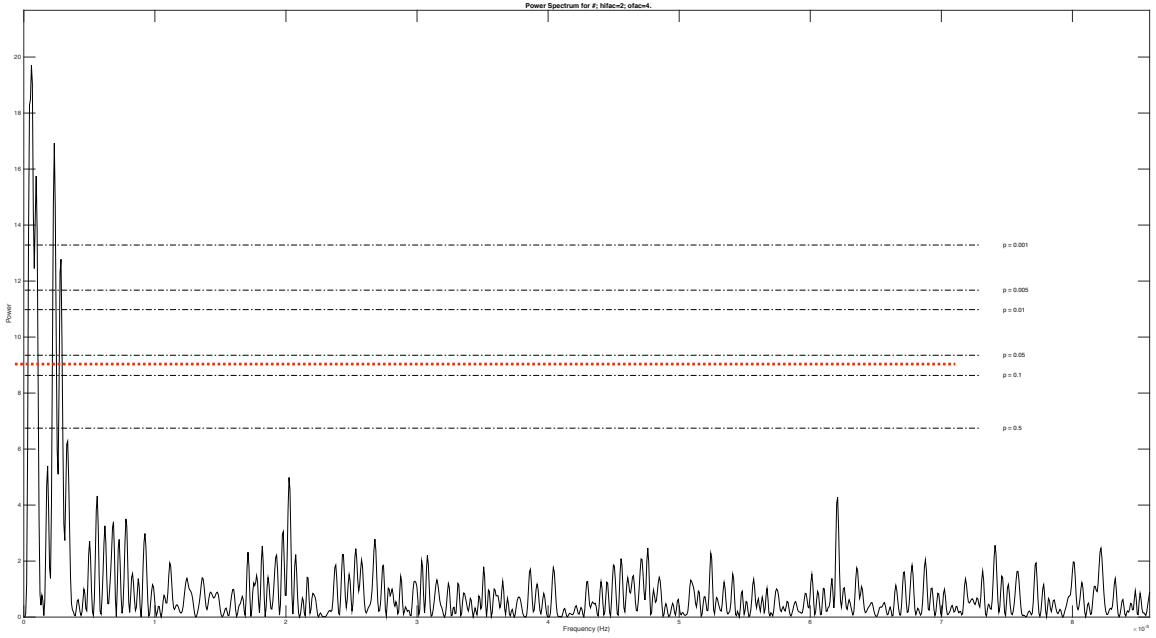




P ariminesis Time Series



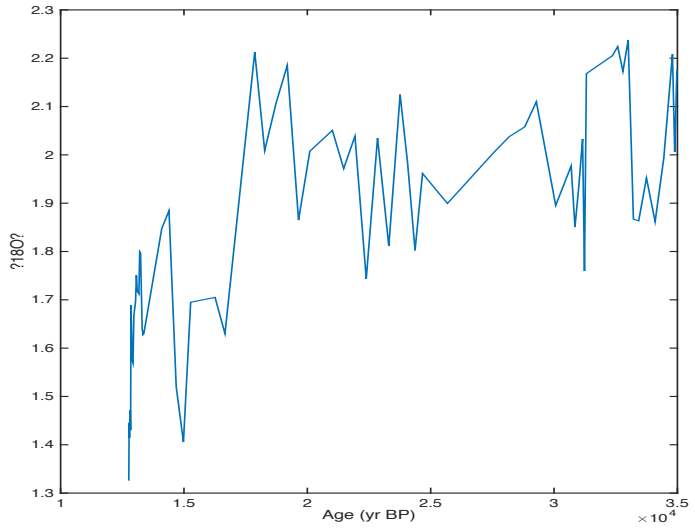


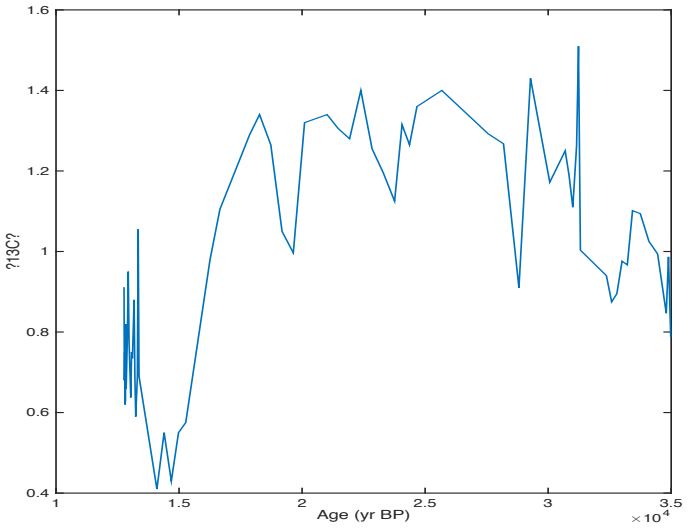


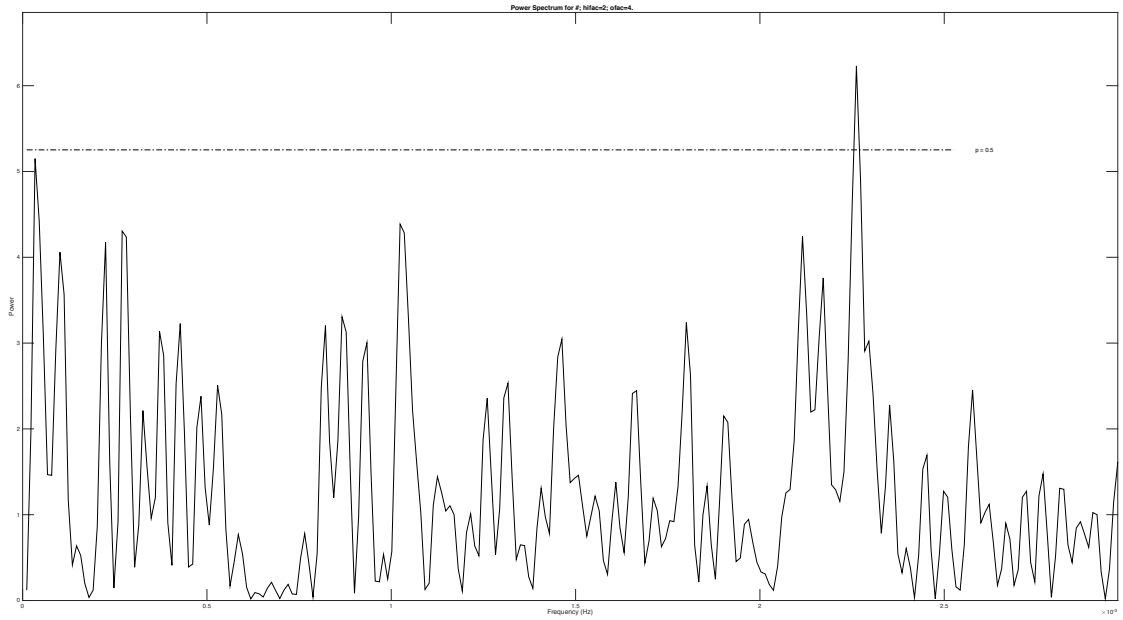
Significant Periodicities (Yrs)

$\delta^{18}O$	17,173	4293	3523
$\delta^{13}C$	22,898	10,568	4432

C mollis Time Series



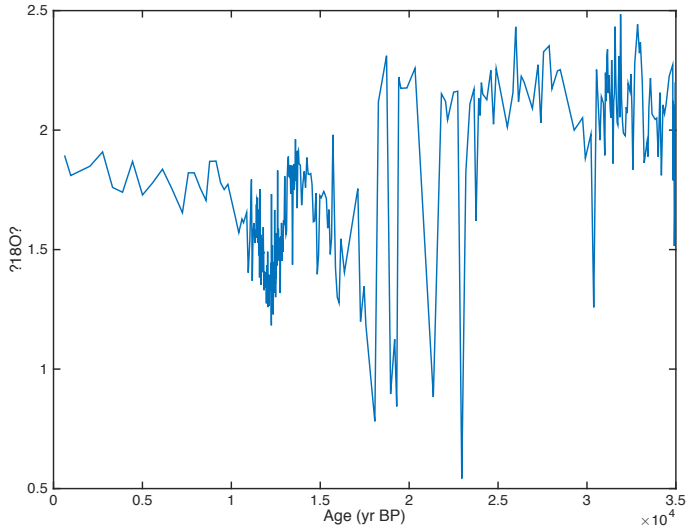


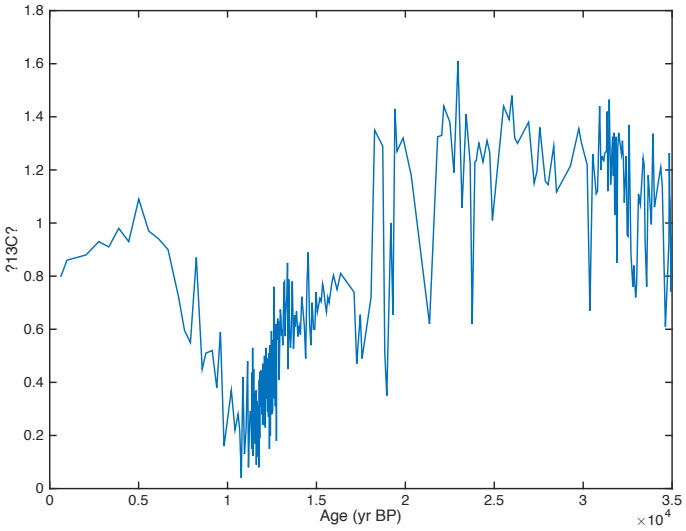


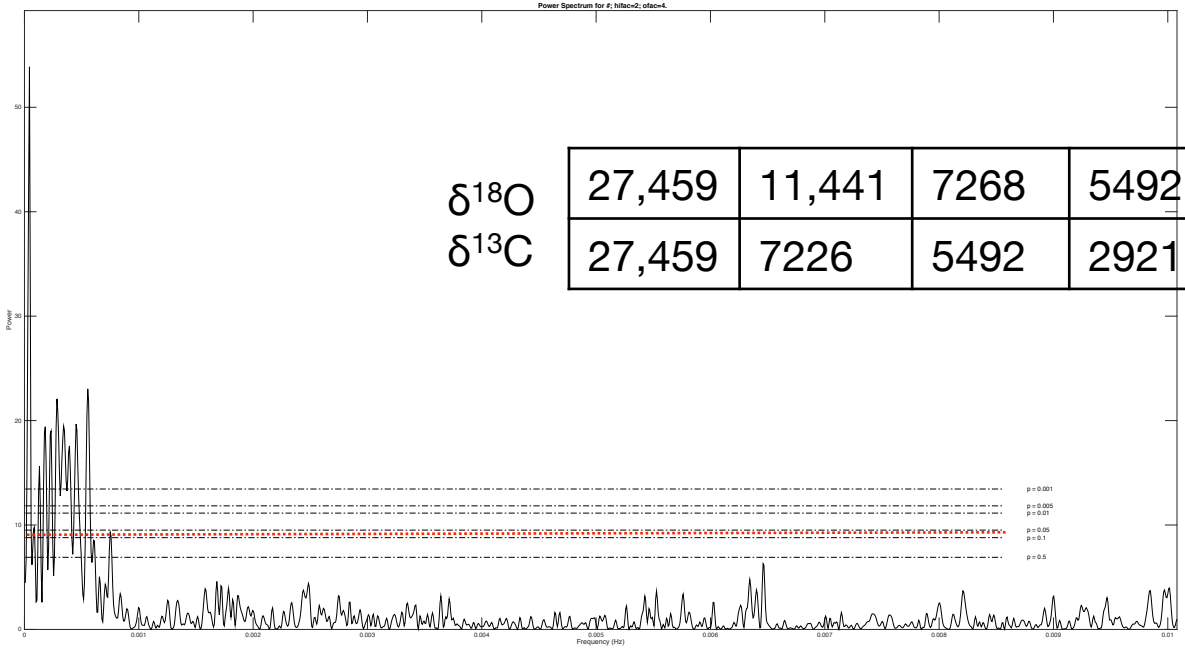
Significant Periodicities (Yrs)

$\delta^{18}O$	-	-	-
$\delta^{13}C$	29,623	9875	6348

C Pachyderma Time Series







Significant Periodicities (Yrs)

$\delta^{18}O$	27,459	11,441	7268	5492	4291	3520	2214	1807
$\delta^{13}C$	27,459	7226	5492	2921	-	-	-	-

Conclusions, Questions

 Temperature is not shown to be an indicator of productivity using these isotopes for these species. Why?

 Time series analyses using these methods are inconclusive. Records are too short for known periodicities.

 Are the three species saying the same thing? Interpolation for cpsd / cross spectral analysis may cause aliasing/ spectral leakage.