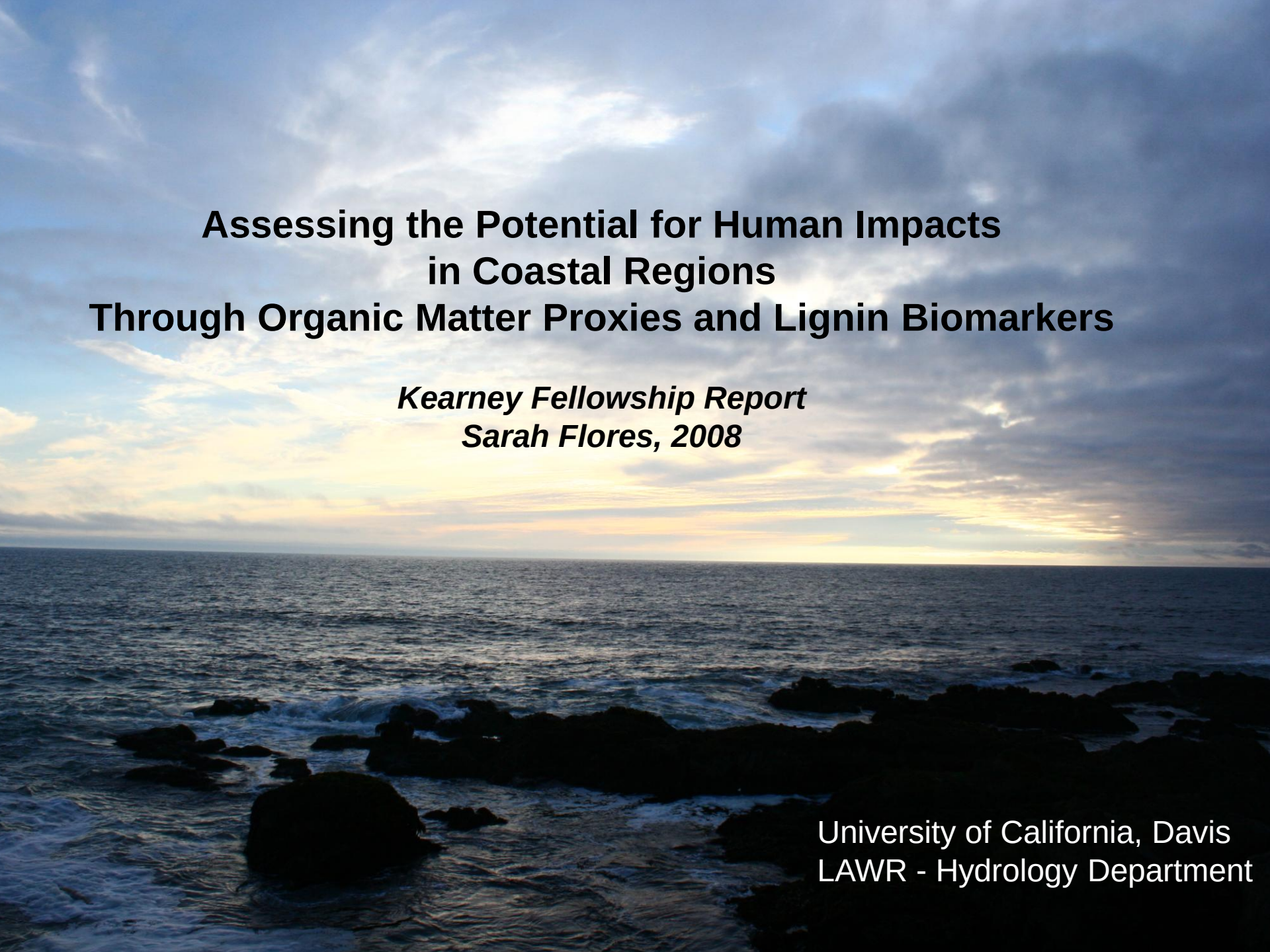

# Assessing the Potential for Human Impacts in Coastal Regions Through Organic Matter Proxies and Lignin Biomarkers


***Kearney Fellowship Report***
***Sarah Flores, 2008***

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# Background

- Coastal regions are unique natural habitats:
  → merge of terrestrial and marine environment

- 50% to 70% of the world's population dwells within coastal areas

- Sensitive to anthropogenic activities

# Background

- Sediments deposited record temporal changes geochemistry.
- Used to establish time-series of:

  (1) An estuary's geochemistry

  (2) Understand the processes associated with such changes

# Background

• Understanding the extent to which human activities impact a coastal region is important to address:

(1) Estuarine problems changing water geochemistry

(2) Potential ecological responses to such changes

# Background

For example:

(1) Increases in land run-off may decrease a bay's salinity which is related to a decrease water pH
→ create a negative environment for calcifying organisms

(2) Increases in nutrient inputs from an export of farming and agricultural waste through run-off, can change the nutrient budget within a bay
→ alter organism populations
→ further impact food-web interactions

# Proposed Research

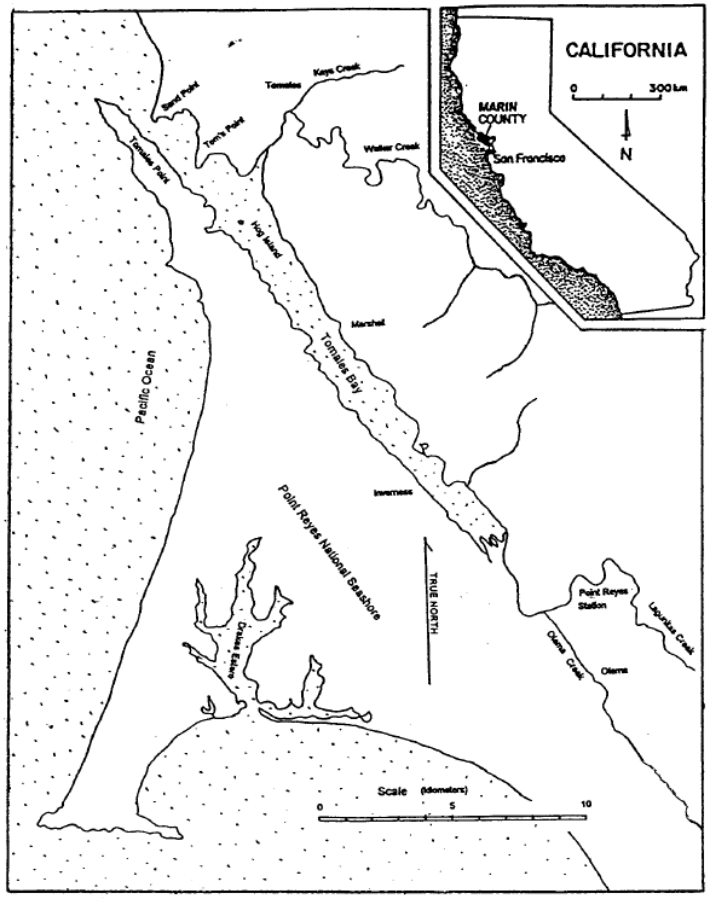
Sample for short sediment cores (17-19 cm) that reveal recent changes in estuarine geochemistry to:

(1) Develop a temporal record of recent (approx. 50 yr) marine vs. terrestrial dominated deposition

(2) Discern the degree to which human activities within a watershed can change estuarine geochemistry

# Methods

- Obtain push-cores at low tide in Tomales Bay, CA
- Analyze organic matter (OM) C-isotopes and C:N ratios
- Quantify lignin polymer phenols



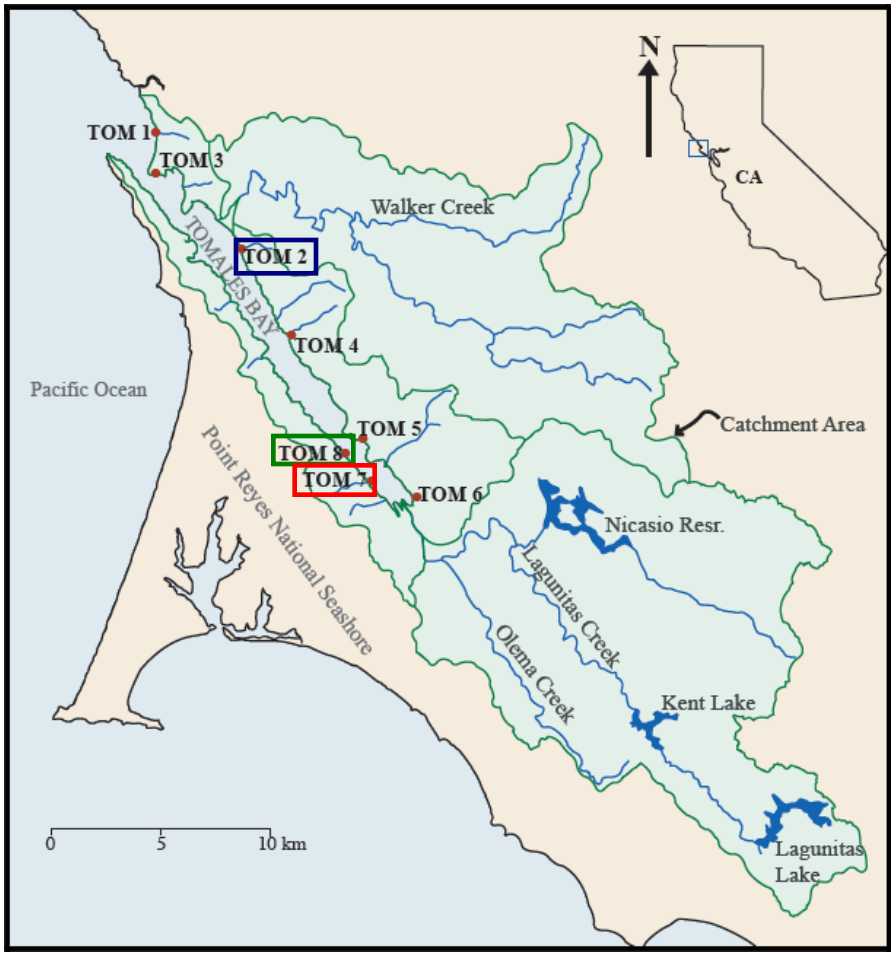

Tomales Bay, CA

# Sampling Sites

- Eight (8) cores were taken along the bay

- Only three (3) were used

  TOM 2: outer bay
  TOM 7: inner bay
  TOM 8: inner bay



# Methods Background

C/N Ratios

• Useful for distinguishing between marine and terrestrial dominated deposition:

• Marine plankton and algal production → low C:N ratios (6 to 7)

• Terrestrial leaves → higher ratios (30 to 50)

•Terrestrial plants → higher ratios (100)

*Therefore:*

• Lower C/N values suggest a marine signature
• Higher ratios suggest a more terrestrial-influenced deposition

# Methods Background

δ 13C Analyses

- Useful to determine system's influence of marine vs. vascular deposits.
- In systems where fractionation of C is minimal and C-diagenesis is not dominant,
- Vascular plant tissue deposition
  → 13C depleted values (δ 13C = -27 to -28 ‰)
- Marine plankton deposition
  →13C enriched values (δ 13C = -18 to -22 ‰)

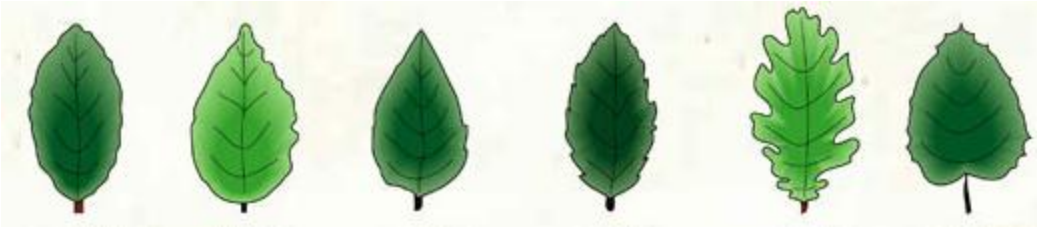
# Methods Background

Lignin Biomarker Phenols:

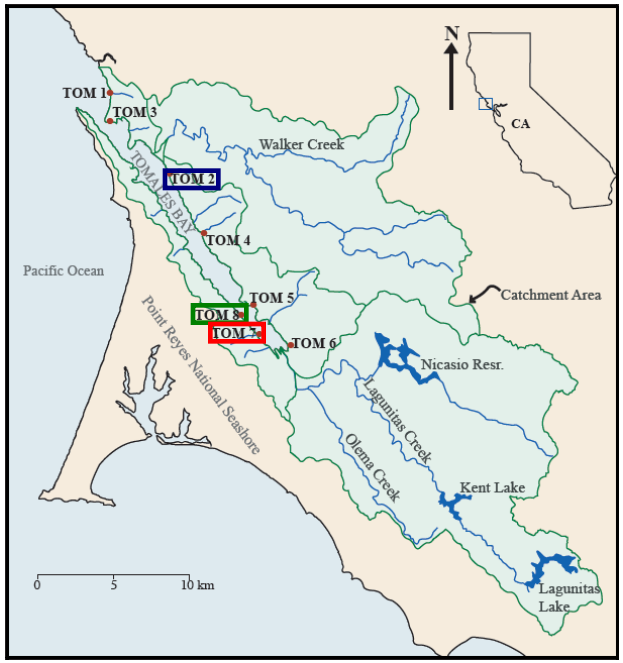
• Useful for ID of terrestrial-derived deposits within marine sediments

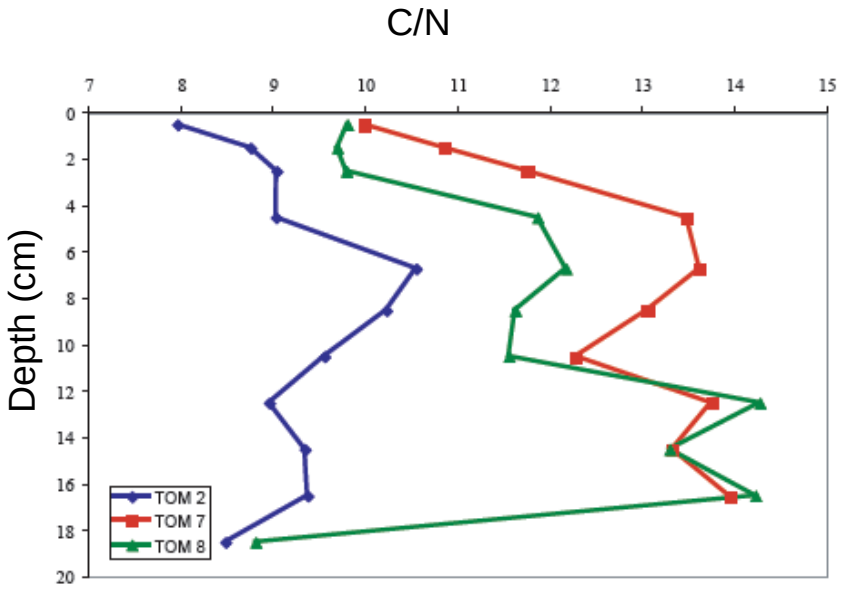
• Only vascular terrestrial plants are composed of lignin

• Characterization of lignin phenols
→ used to distinguish between
angiosperm and gymnosperm vascular plants



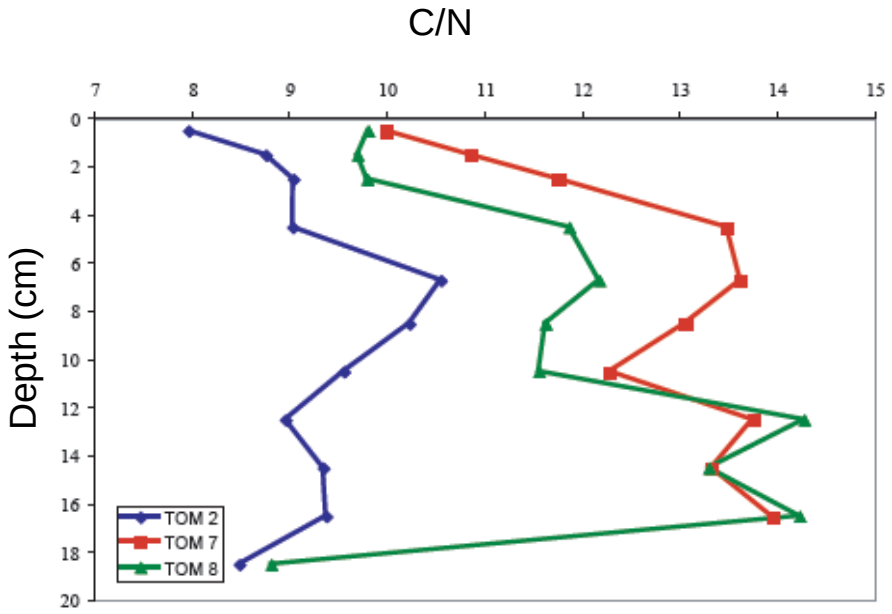
# Results




- TOM 2 shows more marine-dominated deposits while
- TOM 7 and TOM 8 are more terrestrial
  → indicative of relative placement

# Results




TOM 2, TOM 7, TOM 8

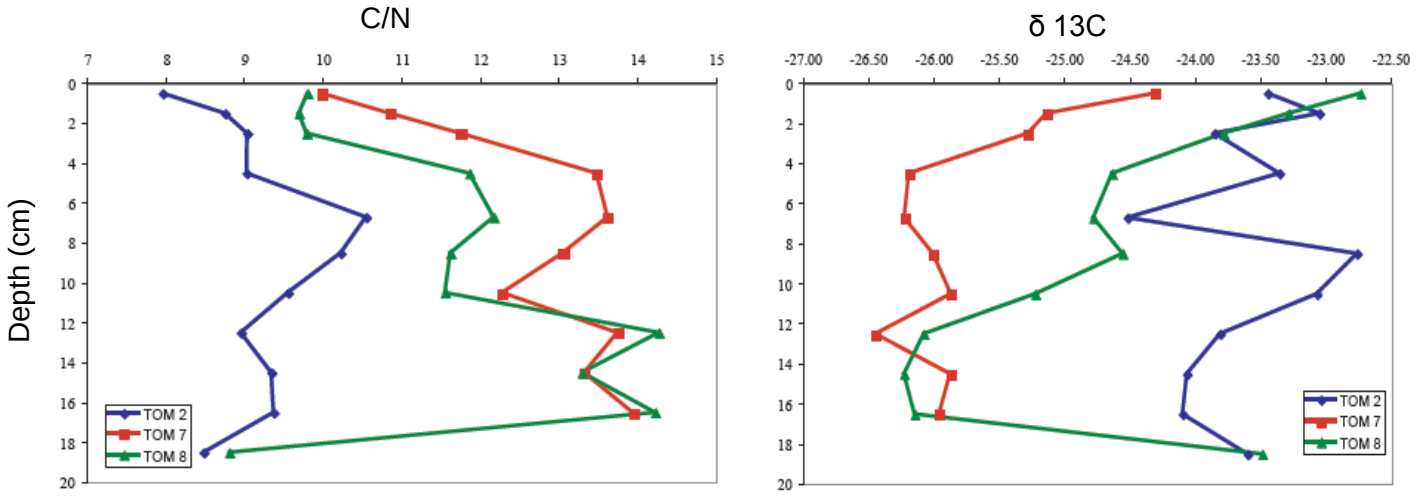
→ recent marine influence within the last 5-7 years

→ Mid-core, observed shift toward terrestrial-dominated inputs

→ Return to more marine-dominated deposits 20-30 years ago

→Trend unclear at base of sediment cores (older deposits)

# Results

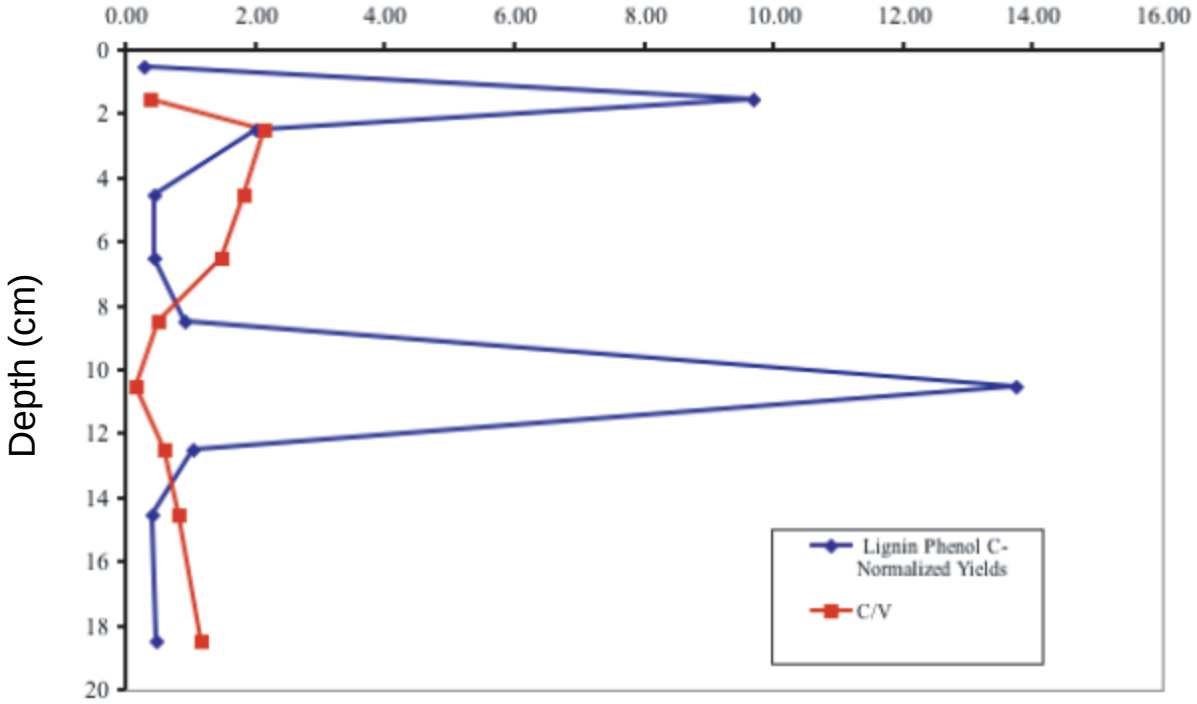



- Since δ $^{13}C$ agree with C/N results:

  → plankton C-fractionation and C-diagenesis have not been substantial in the environment

# Results

Lignin Phenol C-Normalized Yields (mg/100 mg OC) and C/V* Ratios for TOM 2



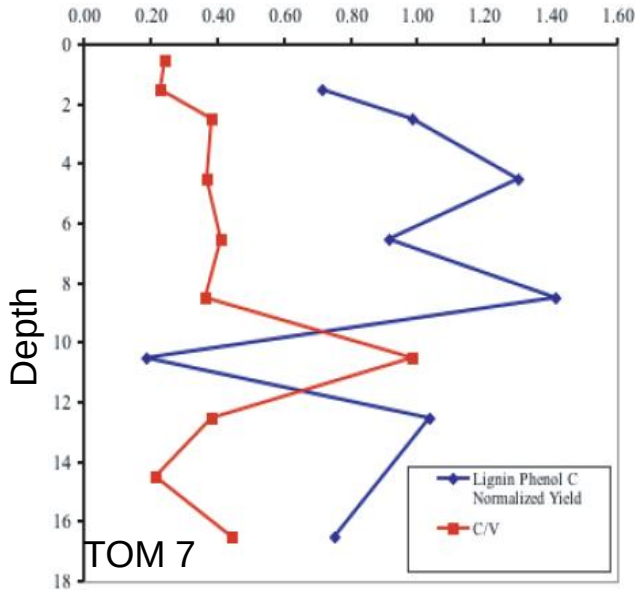

- Two observed increases in terrestrial inputs possibly due to:

(1) Two warming episodes (?)
(2) Two periods of sharp increases in land run-off (?)

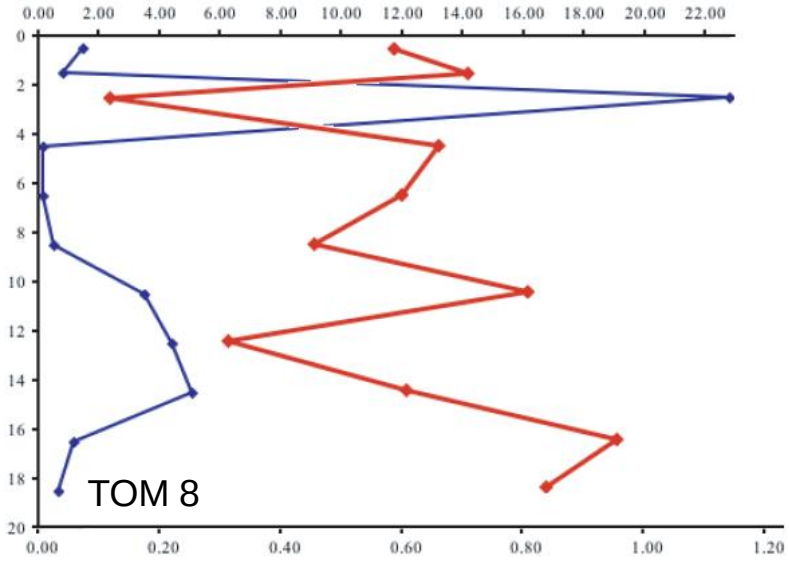
**cinnamyl:vanillyl lignin-derived phenols = C:V*

# Results

Lignin Phenol C-Normalized Yields and C/V Ratios




Lignin Phenol C-Normalized Yields




- Lack of correlation throughout the cores despite sediment proximity
  → spatial heterogeneity cannot be assumed

# Conclusions

• C/N shows two marine influenced deposition periods bracketing a single terrestrial-dominated period

• δ $^{13}C$ records agree with C/N data

• δ $^{13}C$ records suggest low C-fractionation and low diagenetic alteration

• Records of total lignin amounts and C:V phenols suggest two episodes of increased terrestrial deposits

• Spatial heterogeneity in a system cannot be assumed

• **Terrestrial-influenced deposition in Tomales Bay is common and long-lived**

→ human activities have a large potential for altering the estuary's water chemistry and in turn, affecting it's ecology

# Future Work

- Obtain a record of precipitation and land run-off to better understand two episodes of terrestrial deposits in records

- More core samples in the inner bay to understand inner-bay variability

- Establish a record of syringyl:vanillyl phenol data to reconstruct changes in terrestrial sources