# Staying Grounded: Establishing Baseline Critical Zone Conditions in Mississippi Prior to the Onset of Paleocene-Eocene Hyperthermals





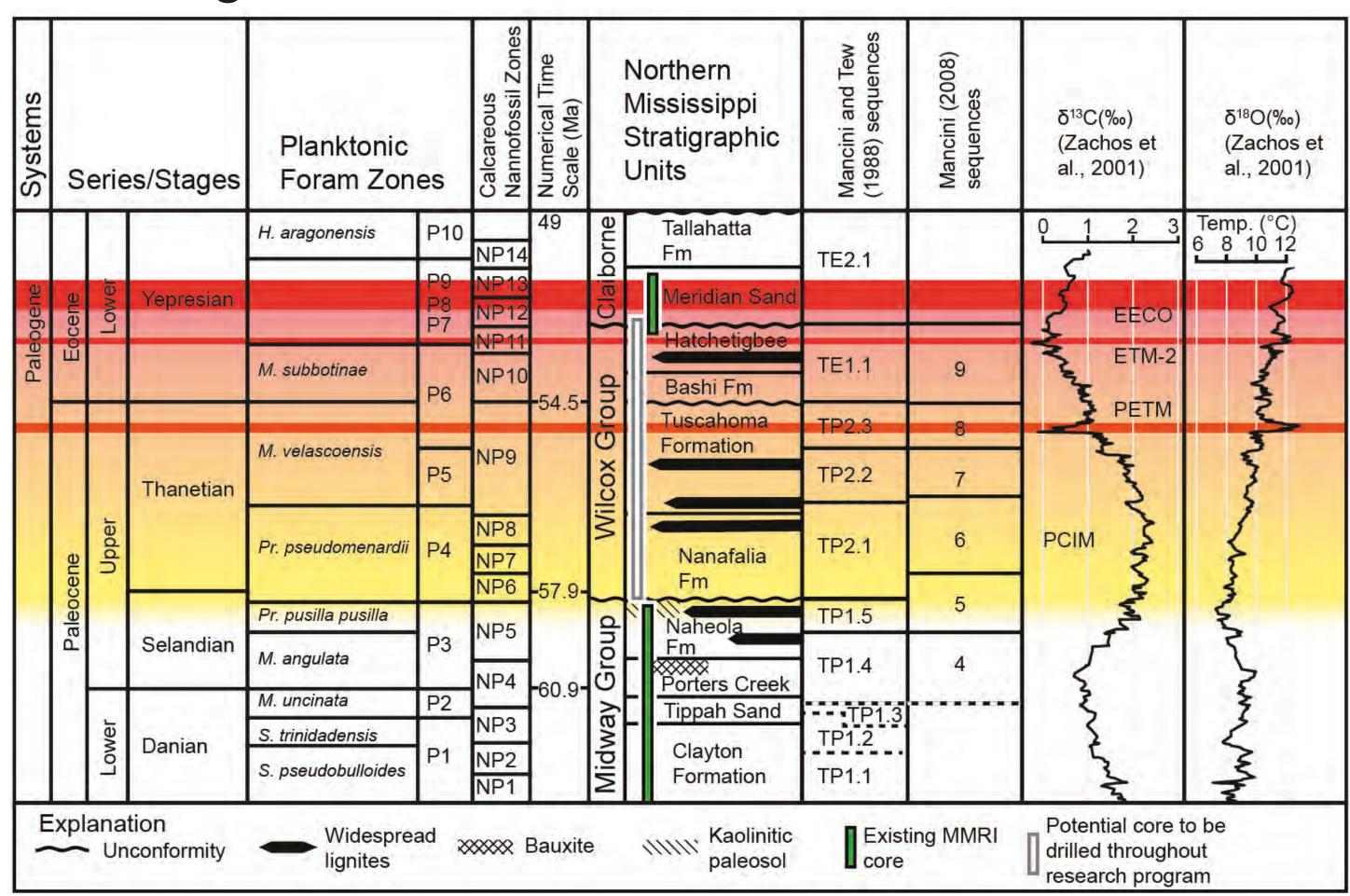
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#### Background

- Paleocene-Eocene hyperthermals are viewed as some of the best ancient analogs for projected future anthropogenic climate change.

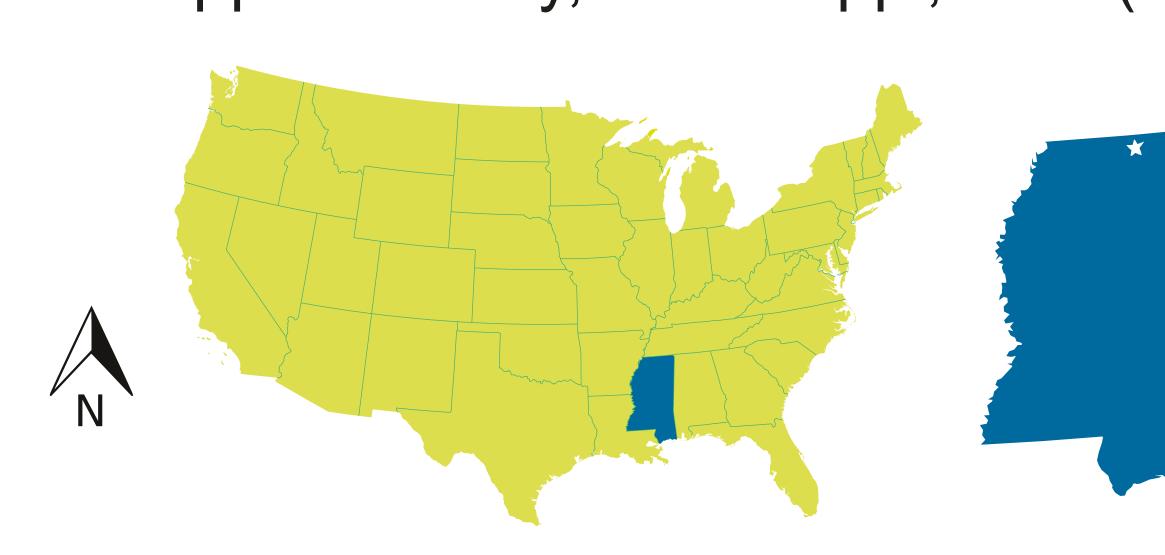


Paleocene Carbon Isotope Maximum (PCIM): large Paleocene warming trend with an overall increase of 5°C. Hyperthermal Events within the PCIM: Paleocene Ecocene Thermal Maximum (PETM) (~55 Ma, average temperature rose 4-6°C), Eocene Thermal Maximum 2 (ETM-2) (hyperthermal ~53.7 Ma), Early Eocene Climatic Optimum (EECO) (warmest sustained temperatures of the Cenozoic)

- In order to fully evaluate the extremity of these hyperthermals, a more complete understanding of preexisting background conditions is necessary.

# Geologic Background

- The Mississippi Embayment (ME) is a major southwest-dipping sedimentary basin in the Gulf of Mexico coastal region of North America
- Focus is on paleosols in the Upper Paleocene Naheola Formation (predates PCIM).
- Core collected by Mississippi Minerals Resources Institute from Tippah County, Mississippi, USA (star).



# Methods

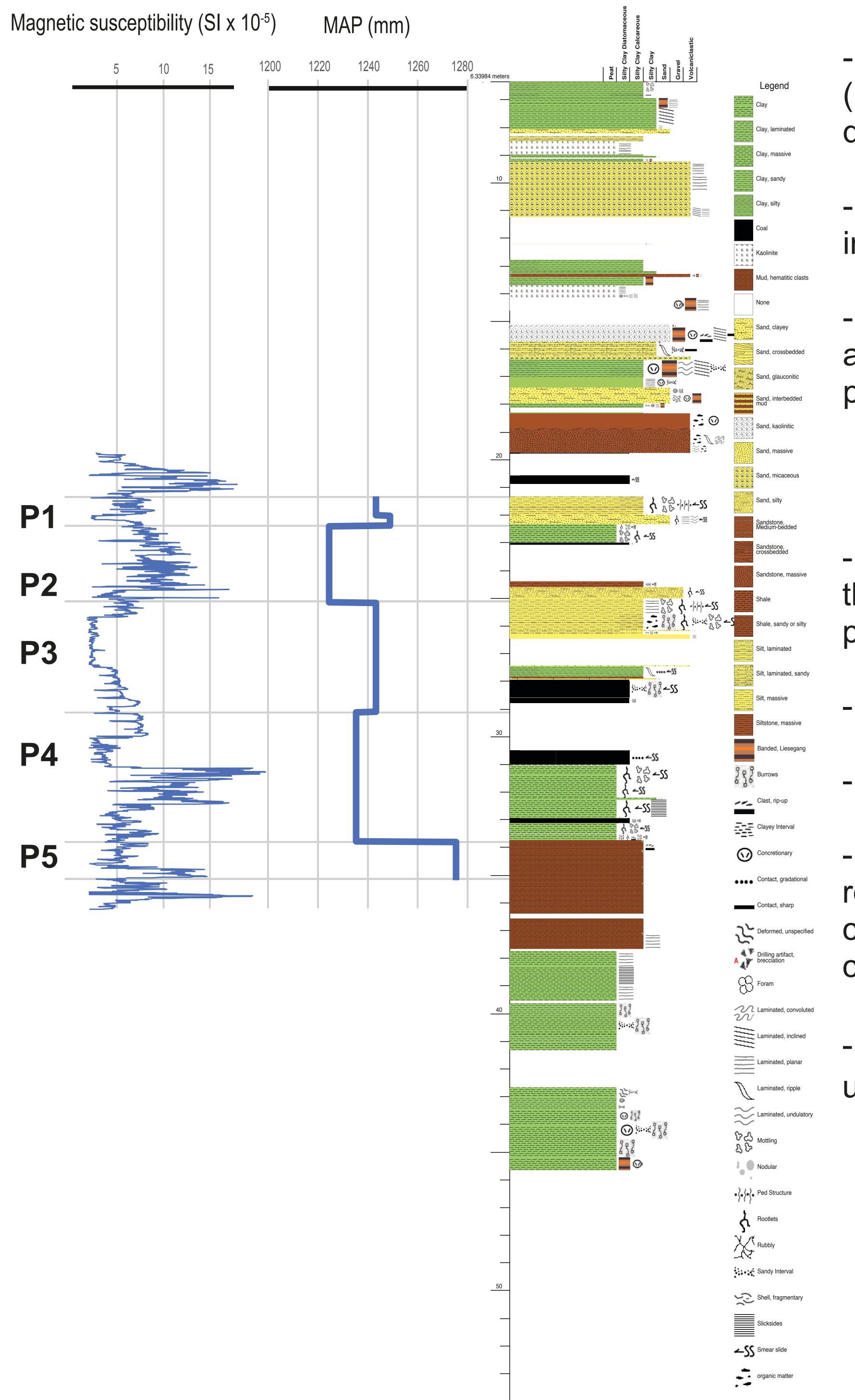
- Initial core description methods performed including:
- visual observations and photos
- magnetic susceptibility
- smear slide analysis
- scanning electron microscopy with energy dispersive x-ray spectroscopy (SEM-EDS)
- Results recorded using PSICAT software
- Paleoprecipitation reconstructed using the chemical index of alteration minus potassium (CIA-K)

 $(CIA - K) = 100 \times [AI / (AI + Ca + Na)]$ 

## **Preliminary Results**

- >8-m-thick interval of 5 stacked paleosols (P1-P5) associated with 4 lignite seams
- Paleosol thicknesses:
- 0.6 m 1.9 m
- Lignite seam thicknesses: 0.3 m - 1.3 m
- Paleosols are characterized by low chroma matrix colors, mottling, and abundant carbonized roots
- P3 and P4 each exhibit an interval that coarsens and fines upward
- P1-4 have roots all the way through, P5 does not
- Preliminary mean annual precipitation (MAP) estimates between 1200 -1300 mm/yr.





Stratigraphic column of studied Hill #2 core.

#### Discussion

- P3 and P4 are likely composite paleosols (paleosols affected by intermittment deposition and erosion/ slow sedimentation)
- Lignite seam thickness could be an indication of climate and vegetation health
- PETM MAP =  $\sim$ 1500 mm/yr (Andrews et al. 2017), roughly 200 mm/yr more than our pre-warming background estimate

### Ongoing Work

- Evaluate the relative influence of each of the five soil-forming factors on Naheola paleosol development.
- Identify and interpret paleosol horizons.
- Calculate sediment accumulation rates.
- Pollen analysis to evaluate paleoecological response to Paleocene- Eocene climate change and improve chronostratigraphic control.
- Stable isotope analysis on kaolinite will be used to reconstruct paleotemperatures.

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