[PS]Developing a Paleovegetation Proxy along a Forest to Grassland Transition in Central Texas*

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Abstract

Organic compounds such as Alkanes and others have been used for a wide variety of studies involving developing proxies for past environments, and climates. Alkanes are common in high waxy leafy plants, but are also present in grasses so in previous studies they have been used to simply describe whether past environments were predominantly trees or grasses. To better understand n-alkanes significance as a biomarker we use a Forest to grassland transition area in Central Texas. In order to determine if alkanes will be effective in creating a proxy for the paleovegetation a quantitative description of the diagenetic alteration of alkanes as a function of soil depth will be developed. With each transect the n-alkane fraction will be evaluated to determine whether it represents a valid vegetation record for the area.

Developing a Paleovegetation Proxy along a Forest to Grassland Transition in Central Texas

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Introduction

Organic compounds such as *n-alkanes* and others have been used for a wide variety of studies involving developing proxies for past environments, and climates. *N-alkanes* are common in high waxy leafy plants, but are also present in grasses so in previous studies they have been used to simply describe whether past environments were predominantly trees or grasses. To better understand *n-alkanes* significance as a biomarker we use a Forest to grassland transition area in Central Texas. In order to determine if *n-alkanes* will be effective in creating a proxy for the paleovegetation a quantitative description of the diagenetic alteration of *n-alkanes* as a function of soil depth will be developed. With each transect the *n-alkane* fraction will be compared to a well-established stable carbon isotope method to determine whether it represents a valid vegetation record for the area.

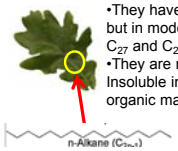
Paleovegetation is a very important component in recreating ancient environments and it can also provide explanations for certain events. For this research in particular we want to use modern soils from a modern environment to create a proxy for use with paleosol research.

Hypotheses

Hypothesis 1:
The Stable Carbon Isotopes ($\delta^{13}C$) for the soils and roots should be directly correlated to the relative abundances of trees and grasses indicated by *n-alkane* distributions.

Hypothesis 2:
Each region along the transect should have an *n-alkane* signature correlating to the dominant vegetation types present.

N-Alkanes

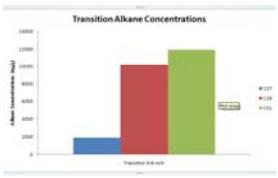


•N-alkanes are long chained alaphatic hydrocarbons found in the waxy coating of leaves.
•They have chain lengths ranging from C_{25} to C_{35}, but in modern vegetations the common alkanes are C_{27} and C_{29} for trees and C_{31} and C_{33}
•They are resistant to biodegradation, transport well, are Insoluble in water and provide accurate information on organic matter input into the soil (T. I. Eglinton, G. Eglinton, 2008)

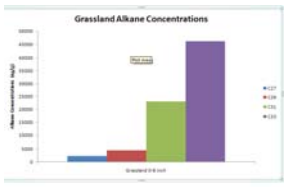
Results

Root Alkane Signatures

The *n-alkanes* for each region pretty well correspond to the specific vegetation types present in the surrounding area. The Forest being dominated by C_{29} mostly with some C_{27} however, there is a significant amount of C_{31} which is very uncharacteristic for Forest regions.

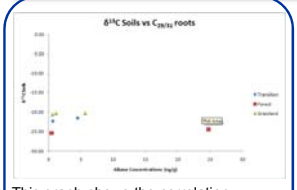


The transition plot yielded a similar distribution as the Forest. The concentration of C_{29} increases slightly, with the C_{31} signature being about the same. This makes more sense for the transition region because it is influenced about equally by both the forest and grassland.

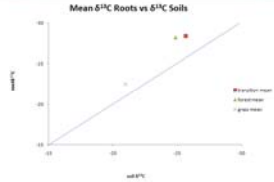


The Grassland region exhibits exactly the array of *n-alkanes* hypothesized with heavy dominance of C_{31} and C_{33}.

Soil Stable Carbon Isotopes versus Root Alkane ratios and Root Stable Carbon Isotopes



This graph shows the correlation between stable Carbon isotopes of soils and the ratio of *n-alkane* concentrations in the roots.



This relationship displays the importance of *n-alkanes* in terms of contribution to the total carbon pool.

Discussion

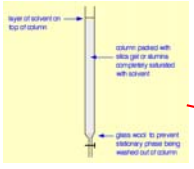
- The *n-alkane* distributions for the Forest, Transition and Grassland were all representative of the vegetation in the area. There were some discrepancies in some plots with the over abundance of even numbered *n-alkanes*. There are many possible explanations for this phenomena. Some of the Forest plots as well showed a significant C_{31} signature which is uncharacteristic but explainable.
- The Stable Carbon Isotopes for the Roots and Soils plotted nicely displaying a trend along the transect. The roots have more of an effect on the Soils as you transition towards the grassland. The values are more negative starting in the Forest then transition to more positive.
- When the Soils Stable Carbon Isotope values are plotted versus the *n-alkane* ratios they don't quite follow the hypothesized trend. The plots with the higher C_{29}/C_{31} ratio should correlate with the more negative Carbon Isotopes.

Future Work

- Future work is needed to better understand the total contribution of organic matter to the bulk soil.
- Also further work with extracting the soils for
- *n-alkanes* will need to be done in order to better understand the paleovegetation in a paleosol.

Analytical Methods

1)Sonication: This process was performed three times each for an hour to partition off the total lipid content the roots contained.



2) Rotary Evaporation: This step is used to concentrate our sample down to about 1 mL for silica gel chromatography. This rotary evaporation evaporates the solvent out of our sample.

3) Silica Gel Chromatography: In order to isolate the non polar lipid fraction containing the n-alkanes.

4) GCMS: The final step in processing the roots for alkanes. Through this method we are able to obtain abundances of each alkane based on their peak area.

References

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