Chemical Characterization of Dissolved Organic Nitrogen in the Florida Coastal Everglades-Preliminary Results

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Introduction

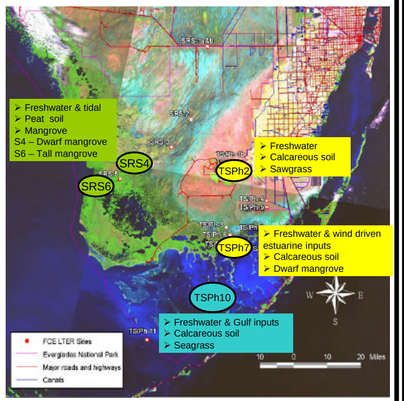
Restoration of a more natural flow to the Everglades ecosystem is currently underway, and will require significant management practices. There is concern that the increased water discharge into Florida Bay may result in increased nutrient loadings. Recent data indicate that 80-90% of the N in the freshwater Everglades is in the organic form. Effective management practices that preserve water quality require identification of sources and processes affecting nutrient concentrations.

Objective

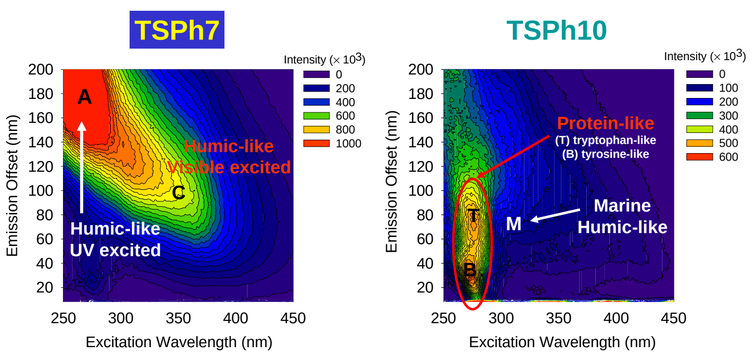
The objective of this work is to characterize dissolved organic nitrogen (DON), gain a better understanding of its dynamics and assess how it may affect ecosystem processes.

Approach

Ultrafiltered dissolved organic matter (UDOM; >1kDa in size) was isolated from 25L water samples using tangential flow ultrafiltration followed by freeze drying. The nitrogen component of the UDOM (UDON) is the focus of this study. A multi-method approach is best to study complex systems with multiple sources and biogeochemical processes. Therefore amino acid analysis, C and N stable isotopes, fluorescence, and ^{15}N NMR were used to characterize UDON at these sites.



3-D Fluorescence

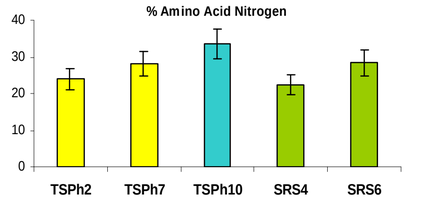


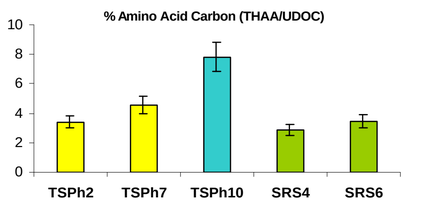
3D fluorescence is a wavelength independent measurement that allows the optical isolation of various compounds. This preliminary data shows variability in fluorescence between freshwater and marine environments. The Florida Bay site (TSPh10) shows a much higher proportion of proteinaceous material consistent with other techniques.

Amino Acid Analysis

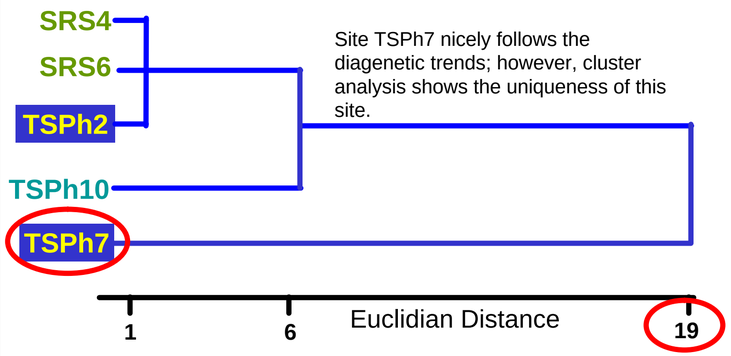
Diagenetic Indicators

The sample sites in this study exhibit relatively high % amino acid C (3-8 %) and N (22-34%), and low yields of non-protein amino acids. Based on these values, it appears that the UDOM is relatively fresh. The amino acid diagenetic indicators below show increased abundances of labile materials along a freshwater to marine transect.



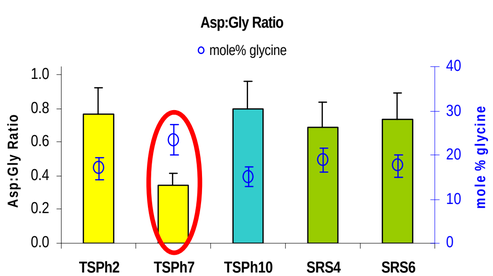


Site Similarity



Site TSPh7 nicely follows the diagenetic trends; however, cluster analysis shows the uniqueness of this site.

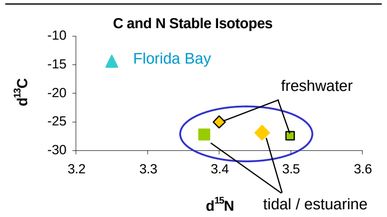
The most notable features of the TSPh7 site are the Asp:Gly ratio and the mole% glycine ratio. High mole% glycine can be an indication of planktonic or bacterial inputs; however, the other amino acid abundances do not point to these sources.



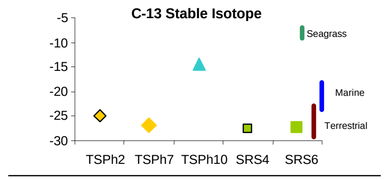
Low Asp:Gly ratios may reflect removal of acidic AAs (Asp) in a calcareous environment. Sites TSPh2 & TSPh7 are calcareous, but only TSPh7 exhibits aberrant values for these parameters.

It is thought that the mangrove influence in a calcareous environment is contributing to this unique behavior. Sites SRS4 & SRS6 are also mangrove sites, but the peat OM input to these sites might result in different dynamics with the mangrove OM.

Stable Isotopes



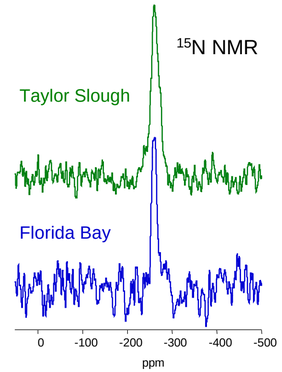
The $\delta^{15}N$ stable isotope signature of the UDON in this study was fairly consistent ($\delta^{15}N$ = 3.4±0.3, 3SD). However, a noticeably lighter $\delta^{15}N$ was observed at the Florida Bay site. The lower $\delta^{15}N$ ratio may be influenced by cyanobacterial N-fixation in the Bay.



The $\delta^{13}C$ stable isotope signature of UDON in Taylor Slough and Shark River Slough indicates more terrestrial inputs in contrast to the Florida Bay site, which falls between marine and seagrass ranges.

NMR

^{15}N NMR spectra of ultrafiltered DOM (UDOM; > 1 kDa) samples collected from Taylor Slough and Florida Bay. ^{15}N NMR spectra show that most of N in UDOM from both sites was in the form of proteinaceous materials (from -220 to -285 ppm).



Conclusions

NMR

- Most N is in the form of proteinaceous material

Amino Acids

- DOM is relatively fresh – i.e. non biodegraded - at all sites.
- DOM is more labile going from freshwater to marine.
- Unique mangrove OM interactions in a calcareous environment (TSPh7)?

Stable Isotopes

- Lighter C in Florida Bay due to seagrass contribution to UDOM pool.
- Lighter N in Florida Bay due to source or process differences – N fixation.

3D Fluorescence

- Variability in fluorophores reflects humic material differences.
- Florida Bay (TSPh10) has a much greater proteinaceous (planktonic/marine derived) contribution relative to the freshwater (terrestrially derived) sites which have greater “humic-like” fluorescence signals.