Stable Carbon and Nitrogen Isotope Composition of Organic Aggregates Produced by Salinity Induced Flocculation of Dissolved Organic Matter from the Suwannee River

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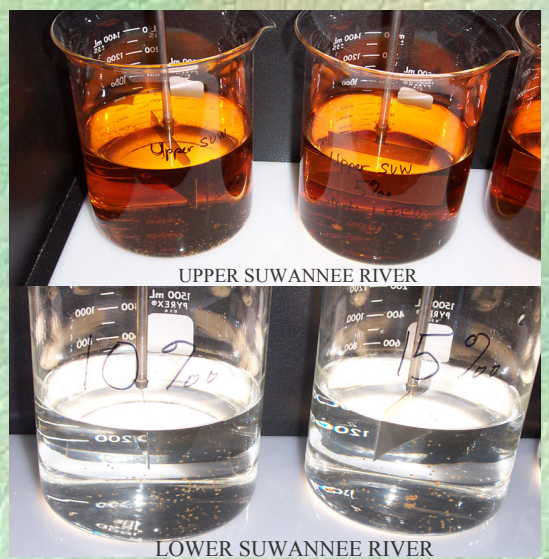
Experimental laboratory set-up employed to produce aggregate particles from dissolved organic matter present in Suwannee River water

BACKGROUND

- Dissolved organic matter (DOM) of terrestrial origin discharged from the Suwannee River to the estuarine and shallow coastal waters along the Gulf coast is a potential important source of energy for consumers
- Flocculation of DOM occurs where fresh water meets salt water
- Flocculated organic aggregates are enriched in both C and N and are suitable food source for many filter and suspension feeding organisms

OBJECTIVE

- Can stable carbon and nitrogen isotope ratios of organic aggregates be used as tracers in food web investigations ?

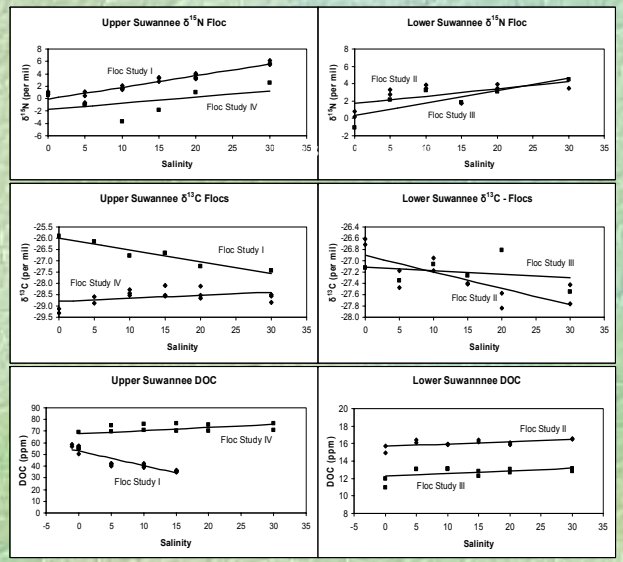


Examples of laboratory produced organic aggregates from the upper and lower Suwannee River water

ABSTRACT

The Suwannee River, which originates in the Okefenokee Swamp (OS) in Georgia, is highly colored as a consequence of elevated concentrations of dissolved organic substances (predominantly humic and fulvic acids). These dissolved substances are derived largely from decaying terrestrial vegetation in the OS and are transported seaward towards the Gulf of Mexico where they are subject to further transformation by a suite of physical, chemical and biological processes. Salinity induced flocculation of dissolved organic matter likely occurs in the upper estuary and results in the formation of organic aggregates of a size suitable for filter- and suspension-feeding organisms such as clams and oysters. Flocculation of dissolved organic matter in several estuarine systems has been documented previously. Organic aggregates were produced in our laboratory by adding salts to fresh surface water collected from the Suwannee River. Based on these findings, experiments were performed to determine if the natural abundance of stable carbon and nitrogen isotopes might be used as markers to characterize organic aggregates and identify their potential role as a food source for fauna in the Suwannee River estuary.

Organic aggregates were produced by adding synthetic sea salts (Instant Ocean®) to unfiltered surface water collected from freshwater portions of the Suwannee River. The aggregates were analyzed for stable nitrogen and carbon isotope composition ($\delta^{15}N$ and $\delta^{13}C$, respectively) as well as elemental composition. As salinity was increased, the $\delta^{15}N$ signature of the aggregates increased by approximately 4 to 6‰ in each of four experiments (two with source water from the upper Suwannee River and two with source water from the lower Suwannee River). In contrast, $\delta^{13}C$ signatures of organic aggregates remained relatively uniform in any given experiment and maintained a signature typical of terrestrial derived organic matter, i.e. -26 to -29‰. The calculated C:N ratios ranged from 6 to 17, indicative of a relatively high quality food source. These findings indicate that the $\delta^{15}N$ signatures might be used as a tracer of organic aggregate development as they are formed as a result of increasing salinity. More importantly, however, our results suggest that $\delta^{13}C$ signatures of organic aggregates might be used to quantify their role as a food source for estuarine fauna.



$\delta^{15}N$ and $\delta^{13}C$ signatures of aggregates and DOC concentrations of residual water as a function of salinity

Examples of organic aggregates from the upper and lower Suwannee River collected on filters

METHODS

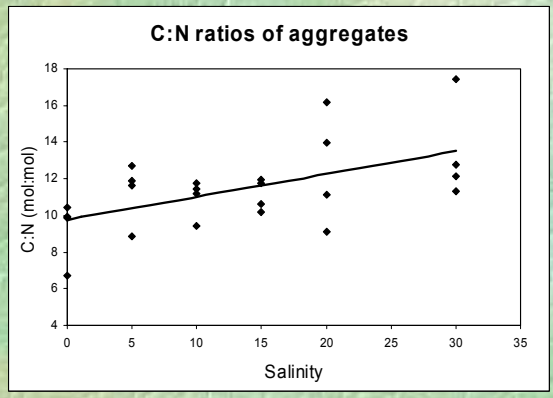
- Whole water samples collected from the freshwater portions of the upper and lower Suwannee River
- Sea salts were added to samples resulting in salinity treatments of 0, 5, 10, 15, 20, and 30 ‰
- Organic aggregates produced after the addition of salts were collected on filters and analyzed for stable C and N isotope ratios
- Residual water analyzed for dissolved organic carbon (DOC)

RESULTS

- Aggregates formed almost immediately after salts were added to the reaction beakers and stirring was initiated.
- Aggregate densities increased with increasing salinities.
- The $\delta^{15}N$ signature of the salinity induced aggregates increased significantly ($P < 0.05$) with increasing salinity in each of the four separate experiments. The range of the $\delta^{15}N$ values for individual samples ranged from -4 ‰ to ca. +6 ‰.
- Although the $\delta^{13}C$ signature of aggregates decreased significantly ($P < 0.05$) in two of the four experiments (Floc I and Floc II), the range of stable isotope values was relatively narrow in each case, generally < 1 ‰, and maintained a signature typical of terrestrial derived material.
- Increasing salinity had undetectable or minor effects on DOC concentrations.
- Elemental C:N ratios of sampled aggregates ranged from 6 to 17 over the broad range of salinities.

CONCLUSIONS

- Organic aggregates, i.e. flocs, can be induced by mixing salts with Suwannee River water rich in dissolved organic material.
- $\delta^{15}N$ signatures of aggregates increase with salinity, and exhibited pronounced variability.
- $\delta^{13}C$ signatures did not change significantly with increasing salinity indicating that stable carbon isotope ratios might be used as a tracer of terrestrial derived dissolved organic matter in estuarine and coastal food webs.
- The C:N ratios increased significantly with increasing salinity, but did not exceed values of 17 indicating that salinity induced aggregates are a potentially high quality food source for suspension feeding organisms in the Suwannee River estuary and associated nearshore coastal waters.



C:N ratios of organic aggregates as a function of salinity