

Oxidative degradation or terrigenous sedimentary organic matter (SOM) transforms its chemical and stable carbon isotopic signature to that of marine SOM

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Chemical biomarker and stable isotopic data suggest that there is very little terrestrially derived SOM in the global ocean. Only 30% of the SOM buried in marine sediments is estimated to be of terrestrial origin at continental margins, in muddy deltaic regions with high sedimentation rates. If vascular plant material makes up much of the SOM of riverine OC (along with soil organic matter), why do we not see more terrigenous SOM in coastal and oceanic sediments when one realizes that the net annual flux of this material to the oceans is nearly the same as that of primary production? Recent experiments focused on the dark Fenton oxidation of riverine SOM from Florida streams flowing into the Gulf of Mexico show that both chemical composition, determined by solid-state ¹³C NMR (Figure 1), and stable carbon isotopic signatures (Figure 2) are modified to essentially resemble marine SOM making it difficult to differentiate terrigenous from marine SOM. We report here on analogous studies of SOM from coastal to offshore deposits of SOM from two depocenters, the Santa Barbara Basin, California, USA and from the Angola Basin, Congo, West Africa. SOM from cores collected in the anoxic regions of the basins, where one expects the preservation of chemical and stable carbon isotopic signatures indicative of terrigenous SOM, were subjected to dark Fenton oxidation to simulate the impact of post-depositional oxidation (e.g., resuspension) on modification of the organic matter and its stable carbon isotopic composition. Results of these experiments could explain why organic matter deposited in the more oxic regions of the basins resembles typical aliphatic rich and $\delta^{13}\text{C}$ -enriched marine SOM in contrast to more aromatic and $\delta^{13}\text{C}$ -depleted terrigenous SOM.

Figure 1. Solid-state ¹³C NMR spectra of riverine SOM subjected to dark Fenton oxidation in successive treatments over a 10 day period. Photographs show the location of the sample and the color of the SOM with each treatment.

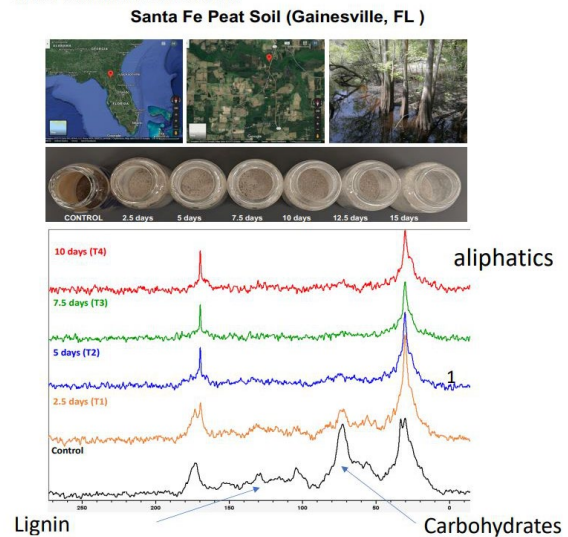


Figure 2. Stable carbon isotope ($\delta^{13}\text{C}$ ‰) and total carbon fractional loss (C_t/C_0) changes in terrigenous SOM during Fenton oxidation of riverine SOM from the Santa Fe River Florida, USA. The trends and regression lines show the results of modeling as a two-component system that includes labile (component 1) and refractory (component 2) carbon sources, each with a kinetic isotope effect, ϵ , of 2.5 ‰.

