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Is carbonate sediment dissolution a significant source of dissolved organic matter to Florida Bay?

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Florida Bay is subtropical embayment characterized by dense Thalassia testudinum seagrass meadows, the prevalence of carbonate-rich sediments, and relatively long residence times (~1 yr). Florida Bay seagrass meadows store appreciable quantities of allochthonous and autochthonous organic matter (OM) as so-called 'blue carbon', the fate of which is therefore tied to that of the carbonate minerals it is bound to. Dissolved organic carbon (DOC) concentrations are also relatively high (~7-12 mg/L), despite potential photo-oxidative loss in this shallow and long residence time system, as well as low internal DOC production due to the ecosystem's documented oligotrophy. These carbonate sediments can dissolve through net acid production via sediment heterotrophic processes as well as sulfide oxidation, processes which may be enhanced via O_2 pumping through seagrass roots.

This study investigated the impact of carbonate dissolution on the release of sediment-associated OM to surface waters, and the relative contribution of this process to surface water DOC quantity and quality. We undertook a three-part experimental approach, with analyses including EEMs, δ13C-DOC, and FT-ICR-MS, to better understand the sources and fate of DOC in Florida Bay. 1) We conducted a spatial survey of surface waters, pore waters, and acid-leachable (representing the 'carbonate-bound' OM fraction) sedimentary OM. 2) We conducted a DOM photodegradation study using two potential source surface waters, from a main tributary (Taylor Slough) and a central mangrove island. 3) We conducted benthic flux experiments using intact sediment cores facilitating direct measurements of the quality and quantity of DOC release from sediments. The flux information was placed into the context of sediment dissolution rates, estimated from coinciding determinations of alkalinity and inorganic carbon.

While analyses are ongoing, our initial results indicate a high degree of similarity between the fluorescence signature (PARAFAC components and fluorescence indices) of acid-leachable sedimentary OM, and that of DOC in pore water and surface water throughout Florida Bay. Taken together, our study points to sediment dissolution as an important, yet understudied, process affecting organic carbon cycling in carbonate-dominated systems like Florida Bay.