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Dissolved Organic Matter from Coastal Vegetated Ecosystems Through the Lens of Carbon Sequestration

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Coastal vegetated ecosystems (CVEs) are highly productive habitats whose role in coastal biogeochemical cycles cannot be understated. The high productivity of salt marshes, seagrass meadows, and mangrove forests is channeled into the sediments and into the sea in form of particulate and dissolved organic matter (DOM). While labile DOM is degraded within a short time frame, recalcitrant DOM compounds can remain in the oceanic water column for hundreds to thousands of years. However, so far, DOM has received little consideration in carbon sequestration approaches. In sulfidic porewater of CVEs, DOM can undergo abiotic sulfurization, producing dissolved organic sulfur (DOS), which may render it resistant to biodegradation. Thus, the formation of DOS in CVEs can act as a link between labile and recalcitrant pools of DOM and provide the means of carbon transport across and beyond ecosystem boundaries. We analyzed DOM as well as inorganic nutrients in samples from temperate (German) and tropical (Malaysian) mesotidal CVEs. Unprecedentedly high porewater DOC concentrations were found in both temperate salt marshes as well as in tropical mangroves. High proportions of DOS in the DOM pool demonstrated accumulation of sulfurized compounds in the porewater. Molecular DOM patterns deduced from ultrahigh-resolution mass spectrometry (FT-ICR-MS) analysis indicated that up to 50% of the several thousand molecular formulas identified were characteristic of the analyzed CVEs. Adjacent habitats shared a substantial proportion of DOM molecular formulas indicating lateral transfer of organic material. This emphasizes that the potential for carbon dioxide removal of CVEs extends beyond the areas with above-ground biomass.