Organic matter flux and reactivity on a South Carolina sandflat: The impacts of porewater advection and macrobiological structures

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Limnol. Oceanogr., 47(4), 2002, 1056-1070 | DOI: 10.4319/lo.2002.47.4.1056

ABSTRACT: Study of the flux and fate of reactive organic material (OM) within Debidue Flat, an intertidal sandflat in the North Inlet estuary, South Carolina, demonstrated that this coarse-grained deposit is a dynamic, open system that experiences rapid OM decomposition and exchange of solutes in the top 30 cm of the sediment column. The fluxes of reactive OM through Debidue Flat were high during all seasons (27-170 mmol C m^2 d^{-1}) and were comparable to fluxes in muddy portions of the North Inlet estuary. Porewater decomposition products were N- and P-rich, the modeled reactivity of organic carbon undergoing decomposition was high (first-order rate constant, k = 0.02 d^{-1}), and abundant extractable chlorophyll a was measured year-round; all properties were consistent with marine algal derived substrates. Porewater solute profiles were controlled by advective flow that rapidly exchanged porewater with overlying waters to ~25 cm depth on timescales of hours. Thus, these sandflats act like an unsteady "trickling bed filter," capturing or generating reactive organic particles, rapidly remineralizing OM, and recycling nutrients. Macrobiological structures within the flat altered the amounts and reaction rates of OM on various spatial and temporal scales. Relatively elevated OM decay rates were associated with the burrows of *Callichirus major*, a deepburrowing thalassinid shrimp. Large stingray feeding pits accumulated fine grained OM, locally clogging the "trickling bed filter," and inhibiting porewater advection. As illustrated by Debidue Flat, intertidal sands can be sites of high OM flux and turnover and play an important role in biogeochemical cycling in estuarine systems.