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Benthic metabolism and sulfur cycling along an inundation gradient in a tidal Spartina anglica salt marsh

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ABSTRACT: Central aspects of carbon and sulfur biogeochemistry were studied along a transect extending from an unvegetated mudflat into a Spartina anglica salt marsh. Conditions along the transect differed with respect to tidal elevation, sediment characteristics, vegetation coverage, and benthic macrofauna abundance. Dark sediment O, uptake and CO, emission at the highly bioturbated mudflat were low and relatively unaffected by tidal coverage. Sulfate reduction accounted for 30-60% of the daily CO, emission from the open mudflat sediment. Sediment O, uptake within the nonbioturbated and vegetated marsh was up to seven times higher during air exposure than during inundation, whereas the difference in CO, emissions always was less than a factor of 2. The contribution of sulfate reduction to CO, production was low (<21%) and decreased progressively with tidal elevation as a result of the oxidizing capacity of 5. anglica roots in the vegetated marsh. The boundary between the mudflat and the retreating marsh is a unique environment. High near-surface pore-water concentrations of dissolved organic carbon (DOC) above the marsh cliff and highly elevated total carbon dioxide (TCO,) pore-water concentrations at both sides of the cliff during air exposure coincided with extremely high TCO, emissions and apparent respiratory quotients (up to 14) only below the marsh cliff during inundation. We propose that substantial seepage of DOC-poor and HCO, -rich pore water may have occurred from the elevated marsh to the unvegetated sediment below during low tide followed by massive release of HCO, during high tide. Accordingly, sulfate reduction accounted for more than the TCO, release above the marsh cliff, but only for about 40% below the cliff. Mineralization rates and pathways in salt-marsh sediments vary considerably on small spatial and temporal scales and are dependent on inundation frequency as well as the composition and distribution of flora and fauna.

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