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Tidal Pumping, Alkalinity Production and Export: An Overlooked Carbon Sequestration Process in Salt Marshes

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As blue carbon ecosystems, coastal tidal wetlands can capture and sequester carbon in a sustainable manner. Carbon dioxide sequestration by alkalinity production represents durable (>1,000 years) CO_2 removal. Local carbon density, net CO_2 sequestration, CH_4 emission, alkalinity production and its transfer to the ocean are regulated by a variety of factors, including salinity, nutrient loading, tides and seasonality. This study compares carbon sequestration as alkalinity in two contrasting intertidal systems along the French Atlantic coast: a mesotrophic salt marsh in the Arcachon lagoon and a highly eutrophic tidal creek in French Brittany. Concretely, discharge and concentrations of nutrients, carbon (DIC, DOC, CH_4) and d-13DIC of waters draining from salt marshes at low tide were sampled in an Arcachon Bay saltmarsh and in eutrophic tidal creek in French Brittany. These samples were taken in waters along a tidal creek, which is mainly fed by seepage of pore water from the salt marsh sediments. Measurements were taken in different seasons and at different tidal amplitudes. Diffusive and tidal pumping fluxes were compared as well as benthic diagenetic processes in order to understand local carbon and other elements benthic biogeochemistry. Our results show that brackish waters are systematically enriched in alkalinity and depleted in sulfate compared to the mixture between local seawater and freshwater endmembers. Cores suggest that sulfate reduction and sulfide precipitation in sediments are important processes for alkalinity generation and long-term sequestration. Measured fluxes show that the amount of carbon sequestered as alkalinity is greater than the amount of carbon buried. This indicates that coastal wetlands are efficient at sequestering carbon, not only as "blue carbon" but also as alkalinity. Therefore, tidal pumping plays an important and overlooked role in this sequestration process.