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Riverine particles and sequestration of salt marsh carbon

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Coastal wetlands integrate particles and organic matter delivered by freshwater rivers, ocean tides, and local primary producers. High rates of marsh grass production and incorporation of allochthonous particles into anoxic soils result in rapid carbon burial in so-called Blue Carbon ecosystems. However, spatial variability in soil carbon stocks cannot be attributed to differences in plant production, tidal regime, riverine suspended sediments, or climatic factors, among other variables, suggesting that our conceptual model of organic matter preservation needs to be developed further. Here, we evaluated of soil development in coastal wetlands using a chronosequence of marsh progradation from lateral channel migration. We predicted that soil organic carbon (SOC) content and contributions from marsh plants would increase across transects spanning ~150 y but instead found no differences between areas of different ages. Mud-size particles (<53 um) with <5% OC content contributed more to total SOC density than coarse (>1mm) and fine (<1 mm, >53 um) particles because mud made up ~90% of soil mass. Carbon associated with mud-sized particles had nearly equal contributions from terrestrial (C3) and salt marsh (C4) sources across the transects and down to 70 cm depth. In contrast, SOC of coarse particles was nearly 100% salt marsh derived and mainly contributed to SOC density in the rhizosphere. Attenuation of marsh SOC below the rhizosphere suggested rapid turnover in this region. This was consistent with carbon turnover rates modeled based on $F^{14}C$, which peaked in the top 30 cm (i.e., bomb spike). Carbon in larger size fractions had greater $F^{14}C$ values than mud size fractions, with turnover rates of < 10 years. Positive correlations between carbon content in mud-sized fractions and whole soils suggest that particle associations play an important role in preservation in this system. Better understanding the processes by which marsh carbon becomes associated with particles and how the tidal environment affects organic matter – mineral associations could improve predictions of Blue Carbon stocks and support management decisions.