Temporal and Spatial Variability in Inorganic Sediment Contribution to The Great Marsh, Massachusetts

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Abstract:
- In New England, the marsh platform is predominantly "high marsh," characterized by Spartina patens and Distichlis spicata with vertical accretion rates of ~2.5 mm/year (Wilson et al. 2014).
- Addition of inorganic sediment to the marsh surface is aided by deposition of suspended sediment during spring high tides and storms. Coarser sediment is deposited by ice rafting.
- Twenty ~180 cm-long sediment cores along five transects provide a means for studying inorganic sediment contribution at the Great Marsh in northern Massachusetts during the past ~2.5 ka.
- Transects were aligned perpendicular to bays and major channels at different compass quadrants to capture possible influences of wind and tidal flow during storms.
- Data show a strong correlation between grain size and distance from the nearest channel or bay throughout history of the marsh.
- Data show no consistent vertical trend in grain size, neither within individual sampling sites nor among all coring transects.

Study Area:

The Great Marsh is located along the North Shore of Massachusetts. The marsh platform consists primarily of high marsh (Spartina patens & Distichlis spicata). Major estuaries include (north to south) Parker, Rowley, Ipswich, and Essex Rivers, which contribute freshwater and minor suspended sediment.

Methods:
- Four cores taken along five transects with a 125 meter spacing.
- Transects perpendicular to channels & bays with different orientations.
- Cores were 180 cm long using a Half-Derel Avenger.
- Samples were taken every 20 cm.
- Grain sizes determined using a Micromaster 3000 laser particle analyzer.
- Percent organic matter determined by Loss On Ignition (LOI).

Role of Organic Matter:

Comparison of grain sizes before and after LOI. After LOI, the data show a notable overall decrease in the sand fraction and slight increases in percent silt and clay. This trend may indicate that organic matter is attached to mineral grains producing apparent sand-sized grains. These grains become silt and clay sizes when organic material is removed.

Conclusions:
- Deceleration in tidal current velocity across the marsh surface due to obstructing vegetation leads to a decrease in mineral grain size deposition toward the marsh interior. This is a well-known trend (Leonard and Croft 1995, Moskalik and Sommersfield 2011).
- Our data set suggests that this trend exists through the ~2000 year history of the marsh, although variability in the trend may be due to ice rafting, creek evolution, bioturbation, and other processes.
- Transect #5 did not exhibit this trend, which may be related to its isolated location and being very distant from a major water body compared to the other transects.
- The data do not show any obvious vertical trends, which might be suspected if channel deepening affected suspended sediment distribution vertically through the water column.

References:


Conceptual models of sediment transport onto the marsh platform based on grain size trends. We envision channel deepening due to marsh-verge ecretion.