Using Marker Horizons and Cryogenic Coring to Monitor Sediment Deposition in Salt Marshes of the Bay of Fundy

Marker horizons can be used to monitor deposition of sediment from tidal waters to salt marsh surfaces. Nepheline syenite (a clay-sized feldspar) is shaken onto a 0.5 m^2 sized plot to produce a visible white layer on top of the marsh sediment surface. Subsequent tidal floodings will deposit sediment over this white horizon. Plots are revisted after a period of time and a sample core from the marker plot is retrieved. To determine magnitude of sediment deposition, the thickness of the sediment layer that has accumulated over the marker horizon is measured.

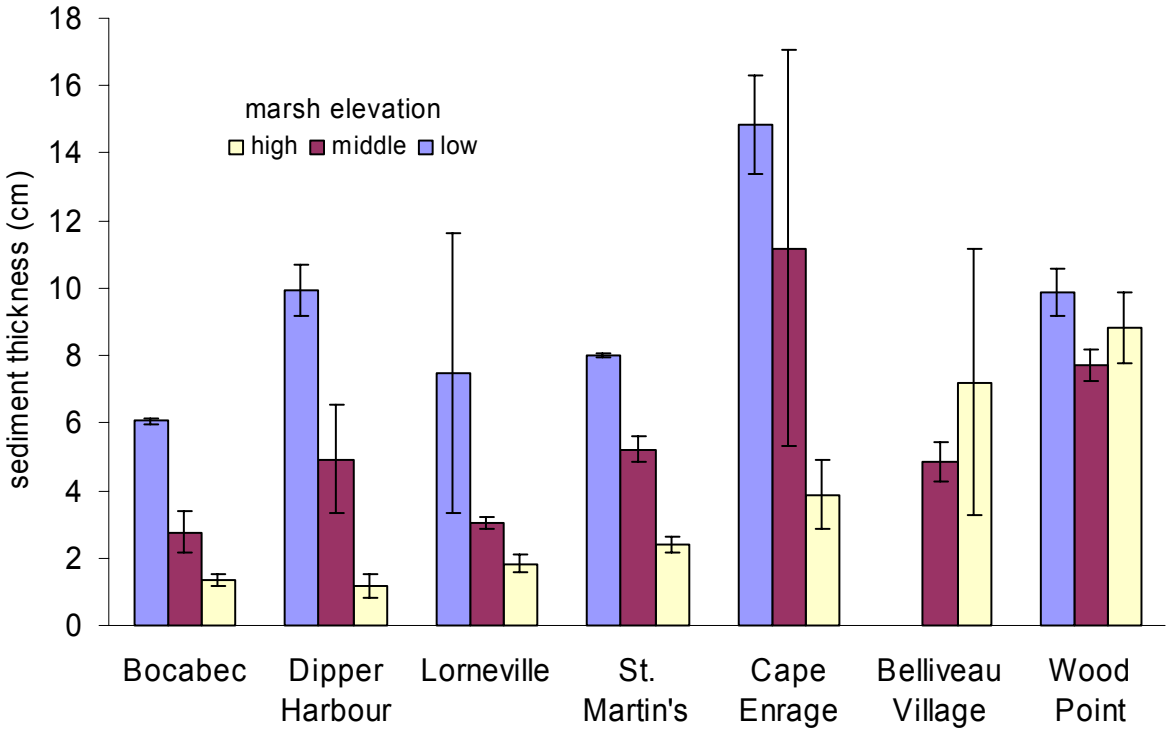
Cryogenic coring is one method of extracting a sample from the salt marsh. A self-pressurizing 15 litre Dewar flask delivers liquid nitrogen, a coolant, via a flexible steel hose to a copper cryoprobe (or bullet) already inserted into the marsh soil. The liquid nitrogen causes sediment surrounding the bullet to freeze to it so that when the bullet is pulled out of the soil, a frozen core of marsh sediment is obtained.

Cryogenic coring in a salt marsh

Using cryogenic coring to obtain salt marsh samples has advantages over other coring methods. By freezing the salt marsh soil in Place before extracting a sample, soil compaction and disruption of the sediment surface is minimised. This is critical for accurate measurements of sediment deposition to the salt marsh surface; soil compaction or a disturbed sediment surface may alter the depth of sediment above the marker horizon and thus affect measurements of sediment deposition.

An example of an extracted cryocore is shown in the picture below. The stratigraphy of the core is (from left to right): accumulated sediment above the marker horizon, the white clay marker horizon, and soil below the marker horizon. Vernier calipers are used to measure the depth of sediment deposited over the clay layer, i.e. the from the core surface down to the upper boundary of the marker horizon, at several places around the core.

In June 1997, marker horizons were established in seven salt marshes located along the New Brunswick coastline of the Bay of Fundy. Cryocore samples were taken from the marker plots after five years of sediment deposition. Results showed a gradient of increasing net deposition from the outer to the inner Bay.



Average net sediment deposition over five years for seven salt marshes in the Bay of Fundy. Error bars represent standard deviations of mean deposition.

Metal Accumulation in Salt Marsh Sediments from the Bay of Fundy

Five year accumulation of a number of heavy metals (e.g., Cu, Cd, Zn, Sn, Ni, Cr, Pb) in salt marsh sediments from the Bay of Fundy has been measured. Cryocore samples were collected in May 2002 and metal concentrations were measured in the deposited sediment layer above the clay marker horizon. Since these marker horizons were established in June 1997, metal concentrations measured in the deposited sediment above the clay layer should reflect the amount that has accumulated over five years.

Analysis of lead (Pb) in these sediments reveal variability among the salt marshes sampled. Calculations of Pb fluxes from two salt marshes are shown in the graph below. Fluxes were calculated using sediment deposition rate (cm yr^{-1}), sediment dry bulk density (g cm^{-3}) and Pb concentration ($\mu g\ g^{-1}$) data.

Lead fluxes of two salt marshes in the Bay of Fundy, presented according to marsh elevation and with standard error bars.