Spatial and temporal variations in trace metal contents in salt marshes sediments in Wallops Island, Virginia

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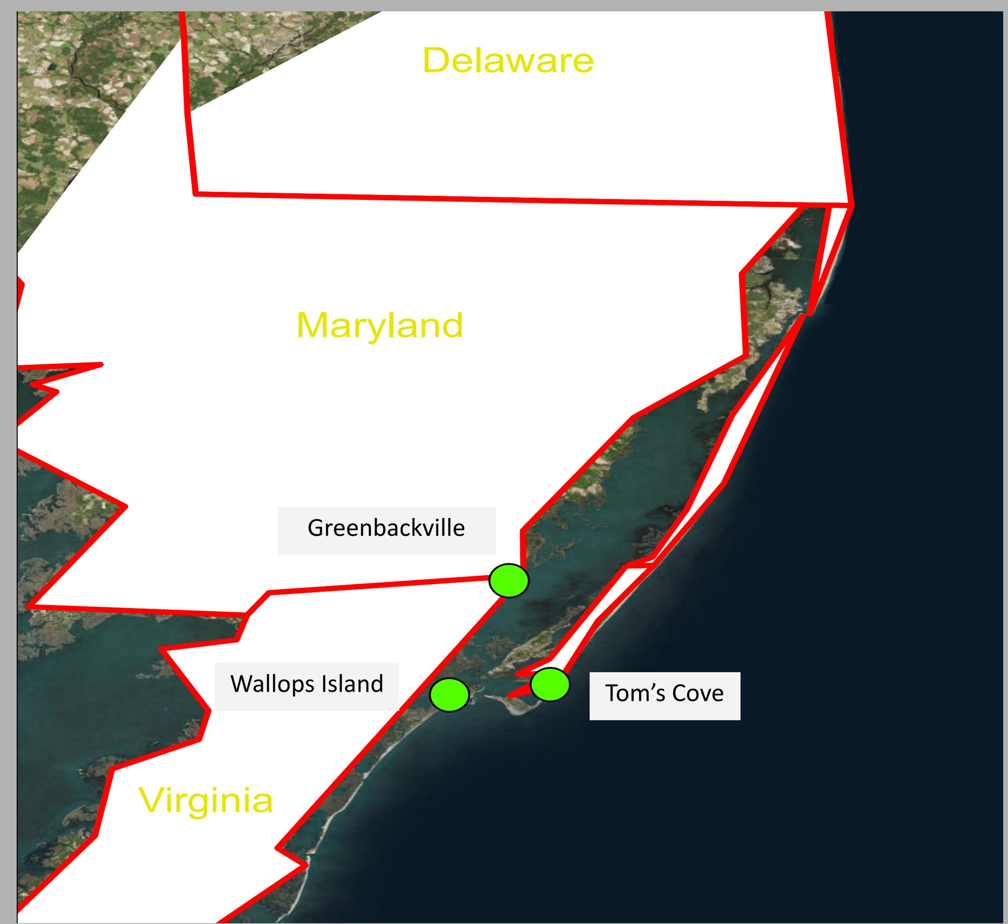
Delmarva Peninsula Study Area



Abstract:

Salt marshes accumulate sediments and trace metals from sources that are present around them. The continuous sedimentation of salt marshes facilitates analysis of historical changes of the trace metals accumulation. The primary objective of this study was to evaluate the changes in trace metal content of salt marsh sediment in Wallops Island and surrounding areas along eastern shores of Virginia. Several one-foot core samples were collected from salt marshes on Wallops Island, Toms Cove, and Greenbackville. Based on assumed sedimentation rate of 2-3mm per year, this study allowed us to see changes in various metal content in the sediments approximately for the last 120 years. After acquiring our 7 hand augured samples we sliced them into one-inch interval, which represented an 11-year of sedimentation. One inch samples were then visually analyzed by hand looking at the decrease of plant material and, then were analyzed using the XRF (X-Ray Fluorescence) machine for determination of the metal contents. While testing with the XRF the main trace metals of interest we found in the sediments were Lead (Pb), Arsenic (As), and Titanium (Ti). As hypothesized data showed a decreasing trend of metal content towards the surface of the cores. We concluded that this decrease in metal content is due to stricter regulations put on by the government, such as the use of unleaded fuel in motor vehicles and, restrictions of arsenic in certain pesticides.

Methods:

Hand Auger was used to collect samples (Figure 1). XRF was used to analyze and detect Trace Metals in the cores (Figure 2) (Figure 3). Research was then done to see if we can conclude our sedimentation rate was the same as other studies in the area. Trace metals also analyzed to see trends within Core samples

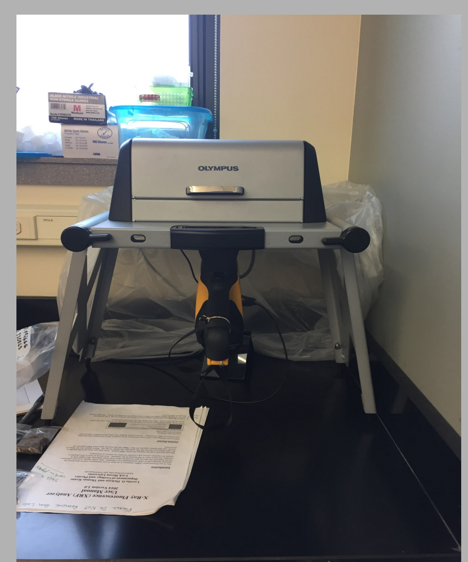


Figure 2: Photo of XRF used to analyze sediment samples

Figure 1: Picture of hand Auger used to collect Sediment samples

Conclusions:

Assuming that the Sedimentation rate of salt marshes in the study area approximates 2-3mm/year, we can state that the one foot long cores analyzed represent geologic record of 100-150 years (Table 1). Titanium and Zirconium are abundant in beach and dune sands which are transported over marsh surfaces during high energy storm events. Cores collected from low and high marshes in Greenbackville indicates a high concentration of Titanium and Zirconium at a depth of 4.5 inches, which are indicative of high energy storm over wash deposits that took place in the early 1970s. Historic records that indicate several high energy storm events took place during 1969-1972 (http://weather.gov/akq). The Upland marsh has a corresponding spike at a depth of 3.5 inches, which corresponds to the 4.5 inch event in low and high marshes indicated above. Similar spikes observed in various cores at different depths can be attributed to the variations in sedimentation rates. This method of identifying Titanium and Zirconium spikes created by past high energy storm events can be applied to identify pre-historic high energy storm events.

There exist a relatively high concentrations of Pb, Zn, Ti, Zr, Fe, and Cr in the top two inches of the high marsh core collected from Greenbackville, which are likely to be associated with human impacts during the past two decades.

Two cores collected from Wallops Island show a high spike of Pb, Zn, Ti, Zr, Fe, and Cr at a depth between 8-10 inches, which corresponds to the years between 1930s and 1940s. This increase can be attributed to high energy storm events prior to the construction of the sea walls and other engineering costal protection measures.

The core collected from the back barrier marsh at Tom's Cove (TC1) exhibits relatively higher concentration of Fe, Ti, and Zr as compared to the core collected further inland (TC2). The variation can be attributed to their difference in geographical location in relation to the proximity of the Beach.

Future Research Directions:

- Collecting deeper cores and analyzing at shorter increments (1cm).
- Determining absolute ages of core increments using Carbon-14 or other appropriate dating methods
- Adjusting for varied compaction rates as a function of depth
- Expanding the study area to include a wider variety of geographic settings

Figure 4: Photo of collection of core sample in Tom's Cove

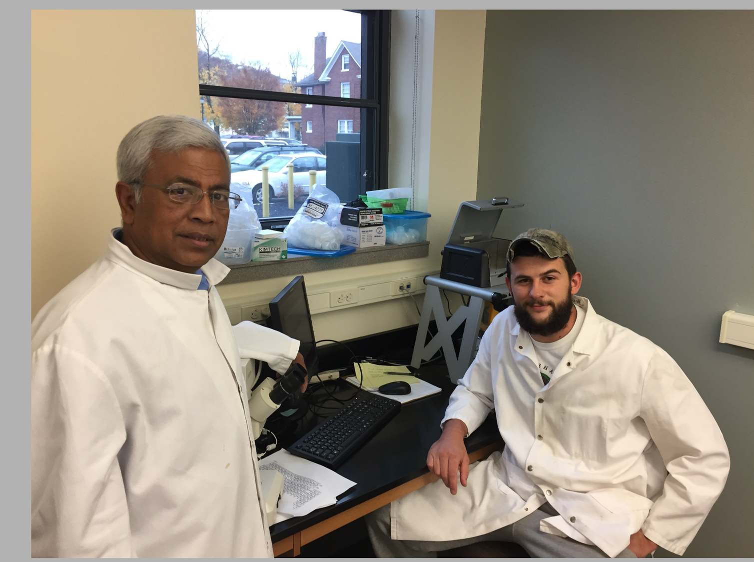


Figure 3: Photo of analysis of sediments under XRF (left to right) Dr. Khalequzzaman, Nathan Dick

Table 1: Relationship between depth of salt marsh cores and relative ages based on assumed sedimentation rates

Depth (in)	Depth (mm)	Age (in years) @2mm/year *	Age (in years) @3mm/year *	Calendar Year @2mm/year (+ -) 6.5 years	Calendar Year @3mm/year (+ -) 4 years
0.5	12.7	6.4	4.2	2010	2012
1.5	38.1	19.1	12.7	1997	2003
2.5	63.5	31.8	21.2	1984	1995
3.5	88.9	44.5	29.6	1972	1986
4.5	114.3	57.2	38.1	1959	1978
5.5	139.7	69.9	46.6	1946	1969
6.5	165.1	82.6	55.0	1933	1961
7.5	190.5	95.3	63.5	1921	1953
8.5	215.9	108.0	72.0	1908	1944
9.5	241.3	120.7	80.4	1895	1936
10.5	266.7	133.4	88.9	1883	1927
11.5	292.1	146.1	97.4	1870	1919

*Guebuem Kim, L.Y. Alleman, T.M. Church, Accumulation records of radionuclides and trace metals in two contrasting Delaware salt marshes, Marine Chemistry 87 (2004) 87-96