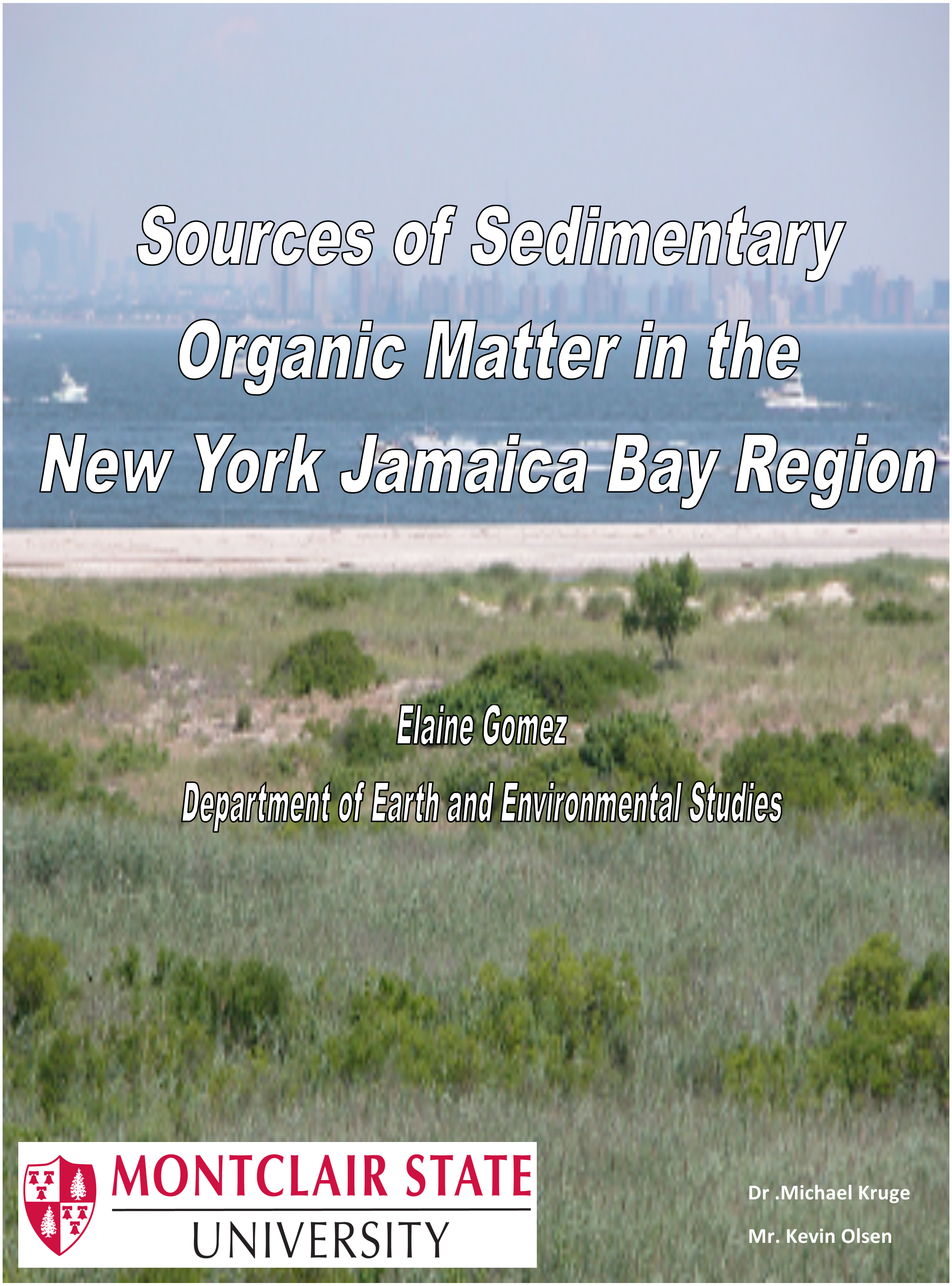

Sources of Sedimentary Organic Matter in the New York Jamaica Bay Region

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Jamaica Bay became a national wildlife refuge in 1972 and is managed by the National Parks Service as part of the Gateway National Recreation Area. Located on the southern shore of Long Island, Jamaica Bay, a 9,155 acre district, is a shallow estuary full of diverse habitats, salt marshes, upland fields, woods, and an extensive area of open space. The bay is home to hundreds of birds, fish, and native plant species. However, before it became the recreational area that it is today, the people of New York had used it for several purposes. It served as a source of food, a place to live, a transportation hub, a manufacturing center, and a place to dispose of waste from the 1860's to the 1930's. The area's history marks Jamaica Bay as an active area- both socially and ecologically.

The National Parks Service studies Jamaica Bay with great curiosity, being that such a rich history has left the area in very poor conditions. The sediment of the bay has a lot to say for the dynamics of the area, and what is learned from the sediments can be applied to answer questions regarding marsh loss and future site remediation. To better understand the bay, the source of organic sedimentation should be determined. This can be done by mapping the ratios of a terrestrial plant biomarker versus an aquatic organism biomarker on a Gas Chromatograph-Mass Spectrometer. Determining where the sediment comes from is essential for any future work to be done in the site, and being that these ratios have never been calculated before the time was just right to map the source of organic content of Jamaica Bay for the National Parks Service.

The focus of this research is to determine the source that is responsible for the organic content of the sediment in New York's Jamaica Bay. The sediments of the Bay may be coming in from two direct sources: terrestrial plant and aquatic organic matter. The terrestrial plant organic matter may be traced through the Mass Spectrometer as vinylguaiacol, a lignin biomarker that is significant to woody vascular plants. The input of aquatic organic matter may be traced in the Mass Spectrometer as indole, a protein biomarker. This experiment will focus on the vinylguaiacol-indole ratio (VGI) for each individual sample location of the Bay. The values obtained will then be used to establish a VGI mapping for the National Parks Service and the Environmental Protection Agency. The data gathered will also provide vital information regarding the sediment dynamics of the bay.

The Jamaica Bay region is an estuary and wetland area, therefore it is expected that vinylguaiacol be the dominant source of organic content in the Bay. Vinylguaiacol in this particular study is a trace of wetland plant species. Jamaica Bay is an extensive marsh area, and therefore will have a high population of plants holding the wetland in place. The organic sediments of the Bay will reflect the presence of these marsh plants with a high VGI ratio. Aquatic input will be traced with indole, a protein biomarker that is significant to aquatic organisms such as algae and bacteria, but being that the area is dominated by plants; the ratios will depict low aquatic input in the sediments of the Bay. The ratios, although particular to the sample's location, are expected to have high values overall, signifying a terrestrial plant dominance.

The main focus of this study lies in its procedure and methodology. A brief explanation of the procedure can be outlined as follows:

- Tool Preparation
- Instrument Preparation
- Sample Preparation with Deuterated anthracene
- Full Scan of Sample
- Method Creation
- VGI Calculations

The research conducted revolves around its procedure, therefore an introduction to the materials needed for this projected are listed for reference as they are mentioned in the methodology.

The materials in this study are used to prepare the samples and load the instrument. The Gas Chromatograph-Mass Spectrometer allows for simple preparation and accurate results without a lot of manual labor. The materials used in this study are:

- Gas Chromatograph Mass- Spectrometer
- Internal Standard, Deuterated Anthracene
- Sterilized Quartz Wool
- Crucible
- Sterilized Quartz Tubes
- Calibrated Scale
- Syringe
- Sterilized Tweezers

The methods used in this study are composed of protocol standards for running a Gas Chromatograph Mass Spectrometer along with the unique calculation of the VGI ratio.

A. Tool Preparation

1. Take a Quartz Tube, about an inch in length, and place a small piece of quartz wool in the middle of the tube. The piece of quartz wool should be small and placed adequately so it can create a holding space for the sample.
2. Bake the tubes for about 600◦ centigrade.
3. Samples should be hand grinded into fine powder and stored at room temperature.

B. GC/MS Preparation

1. A blank must run on the GS/MS, and the instrument must be monitored and properly calibrated.
2. The software used for the instrument must be on and running being that it holds control over the start key and shows the instrument's progress.

C. Sample Preparation

1. Pick up a clean prepared 'sample tool' with tweezers.
2. Fill the tube with about 5mg of desired sample.
3. Weigh on calibrated scale and record.
4. Fill syringe with 5microliters of deuterated anthracene
5. From the bottom of the tube, gently insert the syringe until it touches the quartz wool, and inject internal standard into tube.
6. Allow sample to dry for 15 minutes.

D. Run Sample

1. Once the sample is dried, load the sample in the probe, and insert the probe into the instrument.
2. Allow for the temperature to adjust (50), and remove probe after two minutes.
3. Close valve tightly and allow machine to run for about 50 minutes.

E. Create Method

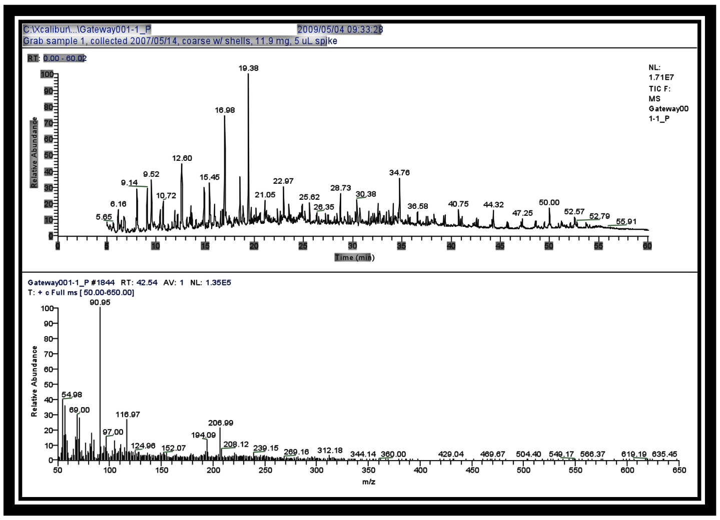
1. The computer software of the instrument allows for manual method creation. A method used to detect the peaks, area, and response ratio of vinylguaiacol and indole should be established.
2. Vinylguaiacol should be programmed to have a retention time of 19.36 minutes if using a 30m capillary tube. The distinctive mass should be 150m/z, accompanied with masses of 135m/z, 107m/z, 77m/z.
3. Indole should be programmed to have a retention time of 18:47 minutes with a distinctive mass of 117m/z, accompanied with a mass of 90m/z.

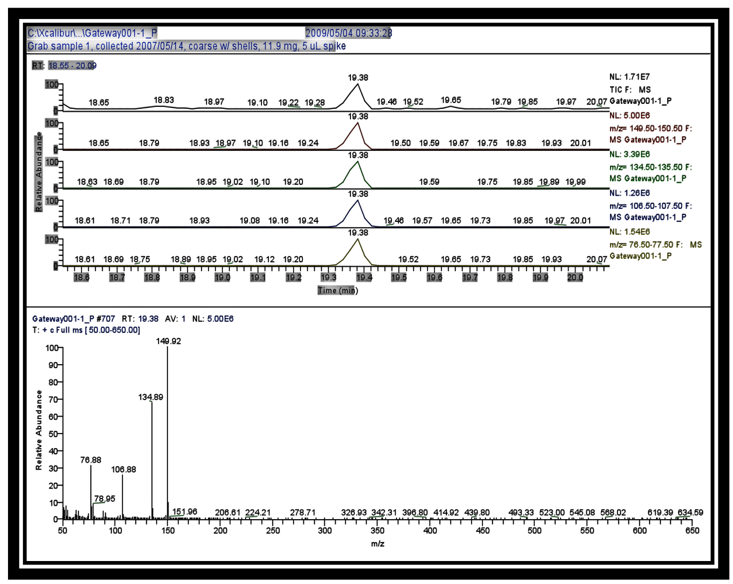
F. Calculating

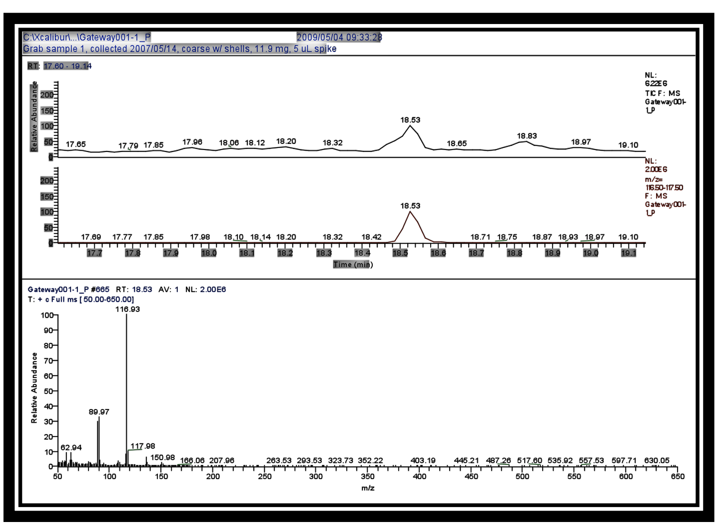
1. Exporting the data from the software to excel allows one to view the performance of the instrument.
2. Taking the area of vinylguaiacol over a sum of the area of indole and vinylguaiacol allows for a ratio restricted between 0-1.
3. Calculate each ratio for each sample location.
4. Finally, using the coordinates of the sample locations and the VGI ratios, mapping is possible.

DATA

Mass Spectrometer Peaks of VA and I.







Results

Sample Location	Indole	Vinylguaiacol	VGI	Sample Description	Latitude	Longitude
	m/z 117	**m/z 150**	VG/(I +VG)			
	18.47 min	**19.36 min**				
Gateway001_P	59736222	139500732	0.70	mud	40.56736	73.93529
Gateway002_P	58895790	153345856	0.72	mud		
Gateway003_P	29774551	174724367	0.85	mud	40.582333	73.933445
Gateway004_P	12433185	2518303	0.17	grainy sand	40.584471	73.902597
Gateway005_P	1927972	0	0.00	all sand	40.577706	73.870286
Gateway006_P	31730580	6032912	0.16	fine sand, shells	40.58201	73.856054
Gateway008_P	4109547	25977723	0.86	mud	40.597972	73.924756
Gateway009_P	16186139	4938185	0.23	mud with shells	40.604798	73.900527
Gateway010M_P	29446309	9897812	0.25	mud	40.597852	73.870668
Gateway010S_P	9382686	5427501	0.37	sand		
Gateway011_P	12228713	4611252	0.27	fine sand	40.595603	73.825911
Gateway012_P	275091328	275091328	0.50	mud, plant fibers		
Gateway013A_P	13097637	12453895	0.49	mud	40.59879	73.78885
Gateway016_P	29084923	6689411	0.19	sand	40.62384	73.825911
Gateway018_P	9859634	5414476	0.35	fine sandy mud	40.611389	73.801417
Gateway022_P	4694539	7914803	0.63	mud	40.634734	73.849788
Gateway023M_P	5875729	1003210	0.15	mud, fine sand, shells	40.643734	73.834962
Gateway023S_P	10921105	563174	0.05	sand		
Gateway024_P	40555244	18229665	0.31	mud	40.637497	73.810692
Gateway026_P	38557264	21966909	0.36	mud	40.628833	73.725667
Gateway027_P	83429735	68022330	0.45	mud	40.64854	73.87505
Gateway028_P	57300474	293579661	0.84	mud, plant fibers		
Gateway029_P	34117525	21052552	0.38	mud	40.652448	73.7728
Gateway100_P	29618079	11474867	0.28	sand	40.5462	74.13607
Gateway101_P	26492421	22023305	0.45	mud	40.54882	74.11399
Gateway102_P	12697007	20436965	0.62	mud	40.60828	74.188896
GatewayNB_P	27941712	21219177	0.43	mud	40.60828	74.188896
SandyHook_W1_P	16597026	119526442	0.88	mud	40.4048	73.9793
SandyHook_W3_P	4927788	920737	0.16	sand	40.44884	73.9993

Results


G29: VGI 0.38
Queens
G27: VGI 0.45
G23: VGI 0.15
G24: VGI 0.31
G22: VGI 0.63
Kings
G26: VGI 0.36
G16: VGI 0.19
Canarsie Pol
Inwood
Grass Hassock
G18: VGI 0.35
NB: VGI 0.43
G9: VGI 0.23
G4: VGI 0.17
Yellow Bar Hassock
Winhole Hassock
G8: VGI 0.86
G10: VGI 0.25
Ruffle Bar
Barren Island
G13A: VGI 0.49
G3: VGI 0.85
G6: VGI 0.16
G5: VGI 0.00
G1: VGI 0.70
Linden Blvd
Caton Ave
Nassau Expy
S Conduit Ave
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2009 Tele Atlas
Image © 2009 Bluesky
© 2009 Europa Technologies
Imagery Dates: 2004 - Jul 5, 2007
lat 40.603468° lon -73.847751° elev -1 ft
Eye alt 11.60 mi
Google

Having successfully calculated and mapped the vinylguaiacol-indole ratio, it is clear to see that the dominate input of the Jamaica Bay region is aquatic organic matter. Terrestrial traces are only seen along the Brooklyn Borough shoreline, closest to residential areas. The insides of the bay, where most of the marsh islands reside have very low VGI ratios, where they were expected to be high. The roots of the marsh plants hold the soils of wetland areas together, and prevent erosion during the submergence of water due to tides. Clearly there is a lack of terrestrial plants in the sections where they would be expected the most, contributing to the idea that current marsh loss is occurring. The mean VGI ratio is 0.42 suggesting not even nearly half of the input is terrestrial, which is a truly disturbing fact. New York has lost more than half of its native wetland areas and the benefits they provide, and now the state is faced with the challenge to preserve the 14 million acres of wetlands that remain. Wetland conservation is essential in order to maintain the ecological balance of nature, a clean water environment, and preserve biodiversity.

Mapping ratios provides insight to Jamaica Bay in a more geological level, and can help understand the sediment dynamics in the area. It is important to understand the composition of the sediment and where the sediment originated from before any sort of influencing action is taken upon the Bay. Mapping the vinylguaiacol-indole ratios is critical information for the goals at hand: to become closer in achieving an answer as to why wetland loss occurs and to submit information that will allow the National Parks Service to manage the area in response to habitat loss.