



**MONTCLAIR STATE**  
UNIVERSITY

Montclair State University  
**Montclair State University Digital  
Commons**

---

Department of Earth and Environmental Studies Faculty Scholarship and Creative Works Department of Earth and Environmental Studies

---

12-15-2010

## The Vinylguaiacol/Indole or VGI ("Veggie") Ratio: A Novel Molecular Parameter to Evaluate the Relative Contributions of Terrestrial and Aquatic Organic Matter to Sediments.


Michael A. Kruge  
*Montclair State University*, [krugem@mail.montclair.edu](mailto:krugem@mail.montclair.edu)

Kevin K. Olsen  
*Montclair State University*

Jaroslaw W. Slusarczyk

Elaine Gomez

Follow this and additional works at: <https://digitalcommons.montclair.edu/earth-environ-studies-facpubs>

 Part of the [Analytical Chemistry Commons](#), [Environmental Chemistry Commons](#), [Environmental Sciences Commons](#), [Geochemistry Commons](#), and the [Sedimentology Commons](#)

---

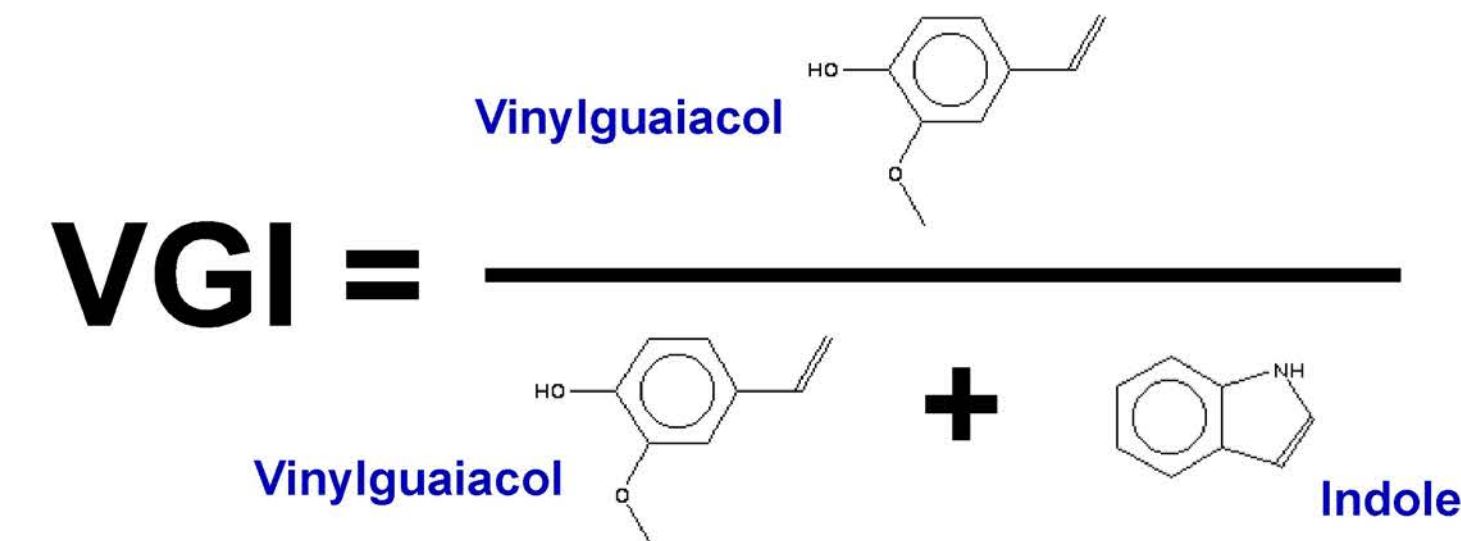
### MSU Digital Commons Citation

Kruge, Michael A.; Olsen, Kevin K.; Slusarczyk, Jaroslaw W.; and Gomez, Elaine, "The Vinylguaiacol/Indole or VGI ("Veggie") Ratio: A Novel Molecular Parameter to Evaluate the Relative Contributions of Terrestrial and Aquatic Organic Matter to Sediments." (2010). *Department of Earth and Environmental Studies Faculty Scholarship and Creative Works*. 78.  
<https://digitalcommons.montclair.edu/earth-environ-studies-facpubs/78>

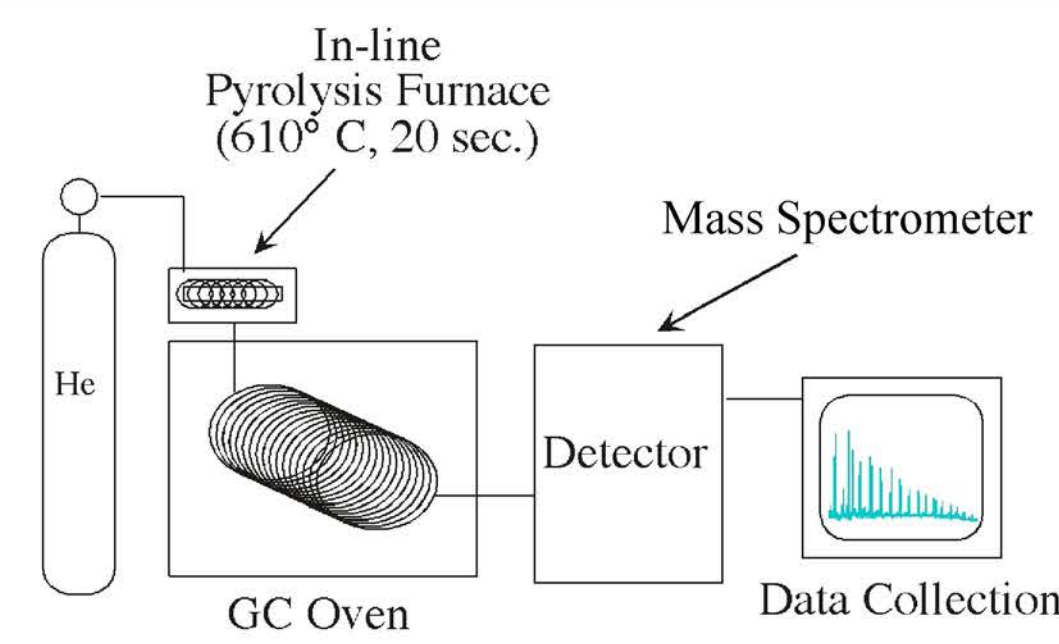
This Poster is brought to you for free and open access by the Department of Earth and Environmental Studies at Montclair State University Digital Commons. It has been accepted for inclusion in Department of Earth and Environmental Studies Faculty Scholarship and Creative Works by an authorized administrator of Montclair State University Digital Commons. For more information, please contact [digitalcommons@montclair.edu](mailto:digitalcommons@montclair.edu).

Michael A. Kruge, Kevin K. Olsen, Jaroslaw Slusarczyk, and Elaine Gomez

Department of Earth & Environmental Studies, Montclair State University, Montclair (NJ) 07043 USA (krugem@mail.montclair.edu)

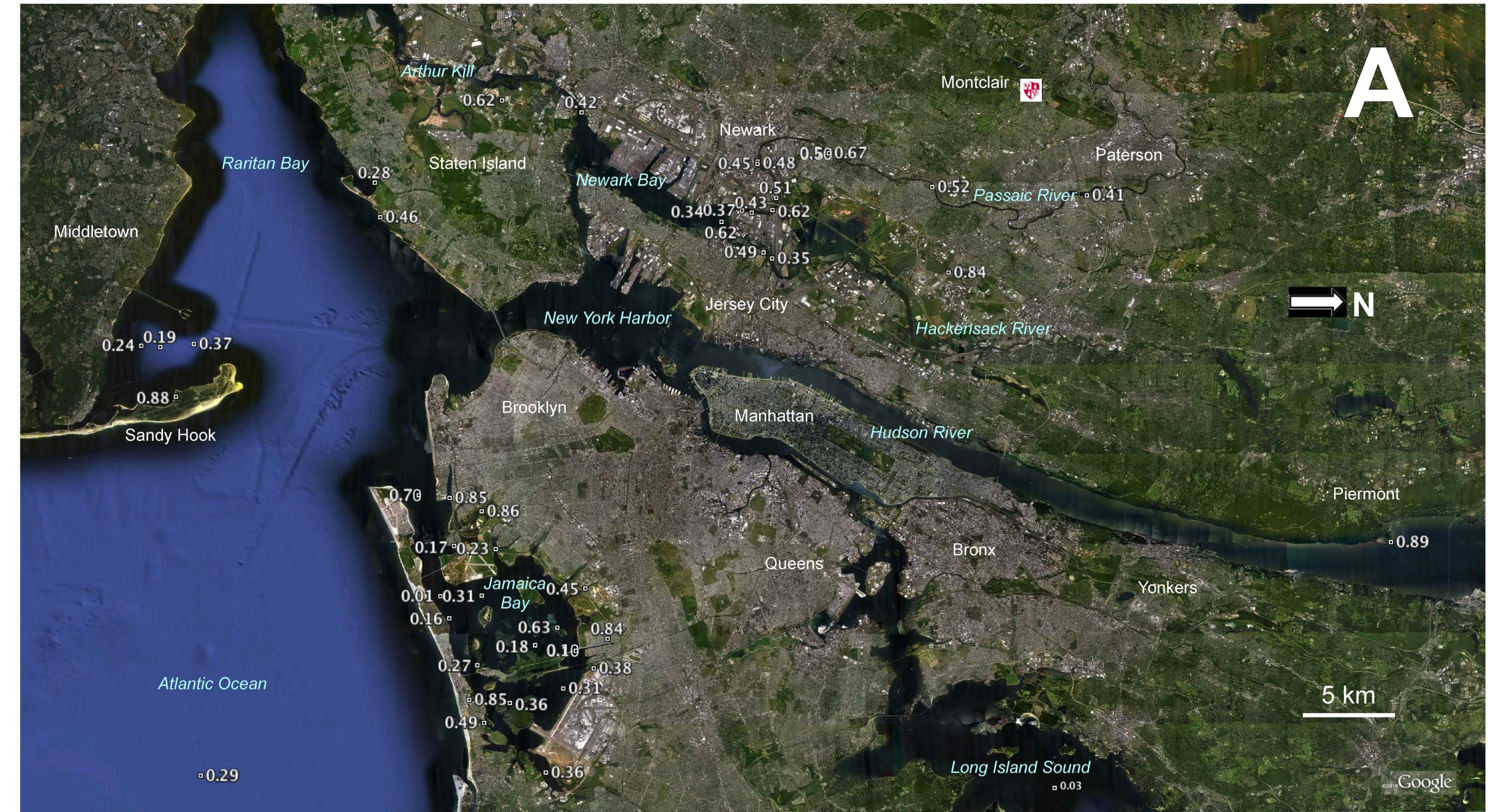
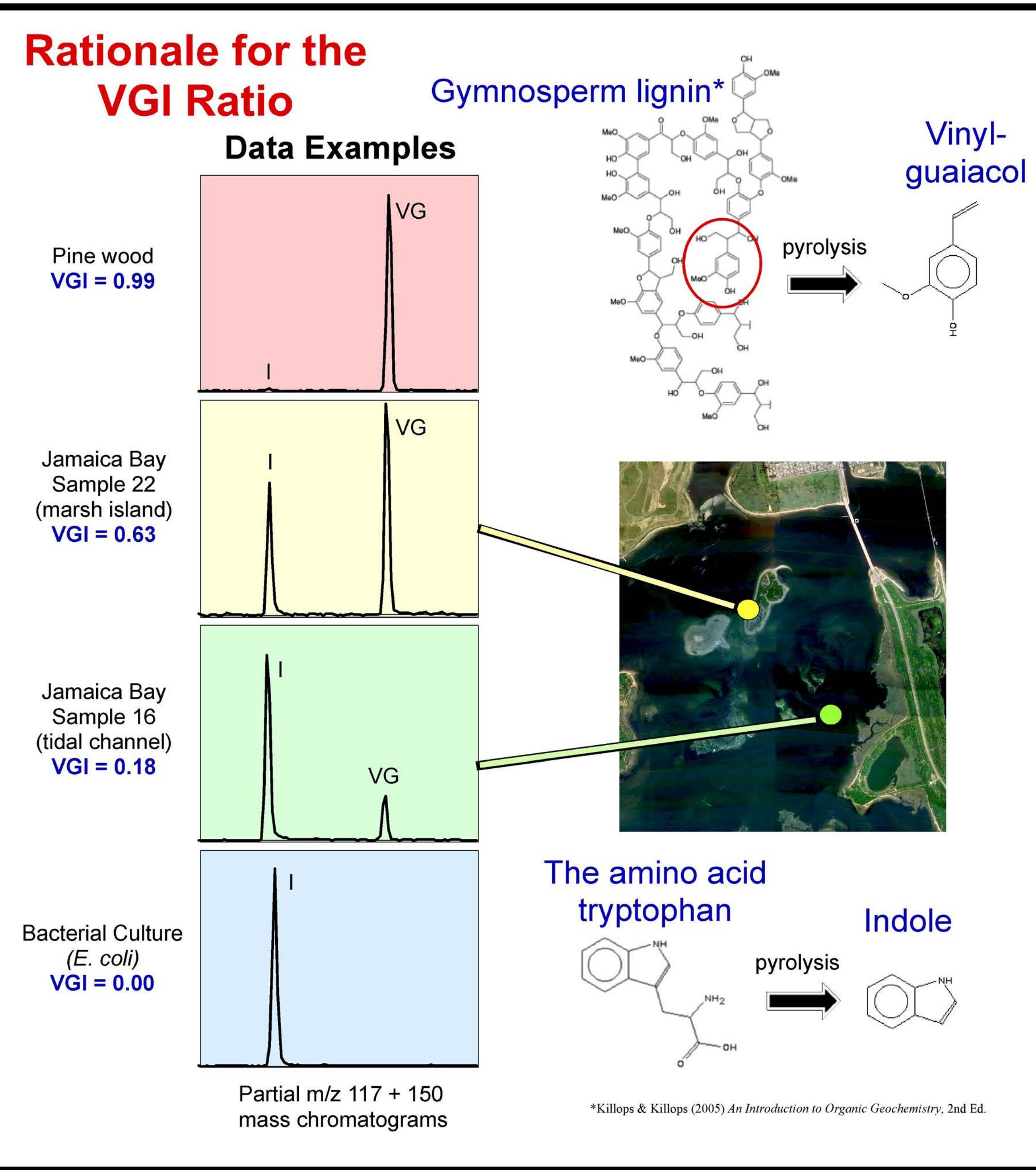


(1) The organic matter (OM) fraction of estuarine sediments is often distinctive and thus diagnostically useful in determinations of sedimentary provenance. Among the most fundamental distinctions to be made is that between **terrestrial and aquatic OM**. To supplement the parameters commonly used for this purpose (e.g., C/N and stable isotope ratios), we proposed the **Vinylguaiacol/Indole or VGI ("Veggie") ratio**, defined as [vinylguaiacol / (indole + vinylguaiacol)] using data produced by analytical pyrolysis-gas chromatography/mass spectrometry of dried, homogenized sediment samples. The ratio employs the peak areas of these two compounds on the mass chromatograms of their molecular ions (m/z 150 and 117).



Analytical Pyrolysis - Gas Chromatography System

(2) Major pyrolysis products of **terrestrial plant lignin** include a variety of methoxyphenols, notably **4-vinylguaiacol**. In contrast, **aquatic algae and bacteria** characteristically produce distinctive organonitrogen compounds upon pyrolysis, particularly **indole**, derived from the amino acid tryptophan. The end member VGI ratio value of about 1.00 is obtained for reference land plant matter, including the marsh plants *Phragmites* and *Spartina*, as well as maple and pine wood. The end member value of 0.00 is obtained for cultured microbes, including *Escherichia coli* and the cyanobacterium *Anacystis*.

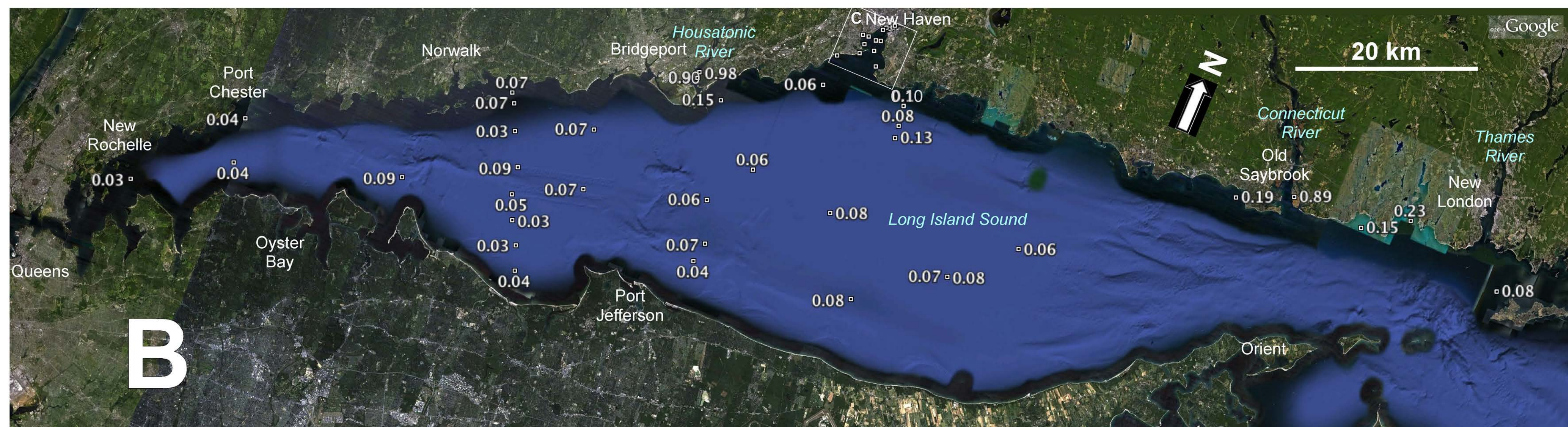


VGI Ratio Values for Sediments of the Hudson Estuary System, Jamaica Bay, and Sandy Hook Bay (New York & New Jersey)

(3) Vinylguaiacol and indole are commonly detected in recent sediment pyrolyzates. We hypothesized that their relative quantities therein should be proportional to the relative contributions of land plant and microbial OM, respectively.

(4) Jamaica Bay (NY), behind an Atlantic barrier island and with marsh islands and multiple urbanized tidal creeks, displays a very wide VGI range, affected by proximity to stands of marsh vegetation, bathymetry, and sediment grain size (Rationale & Map A).

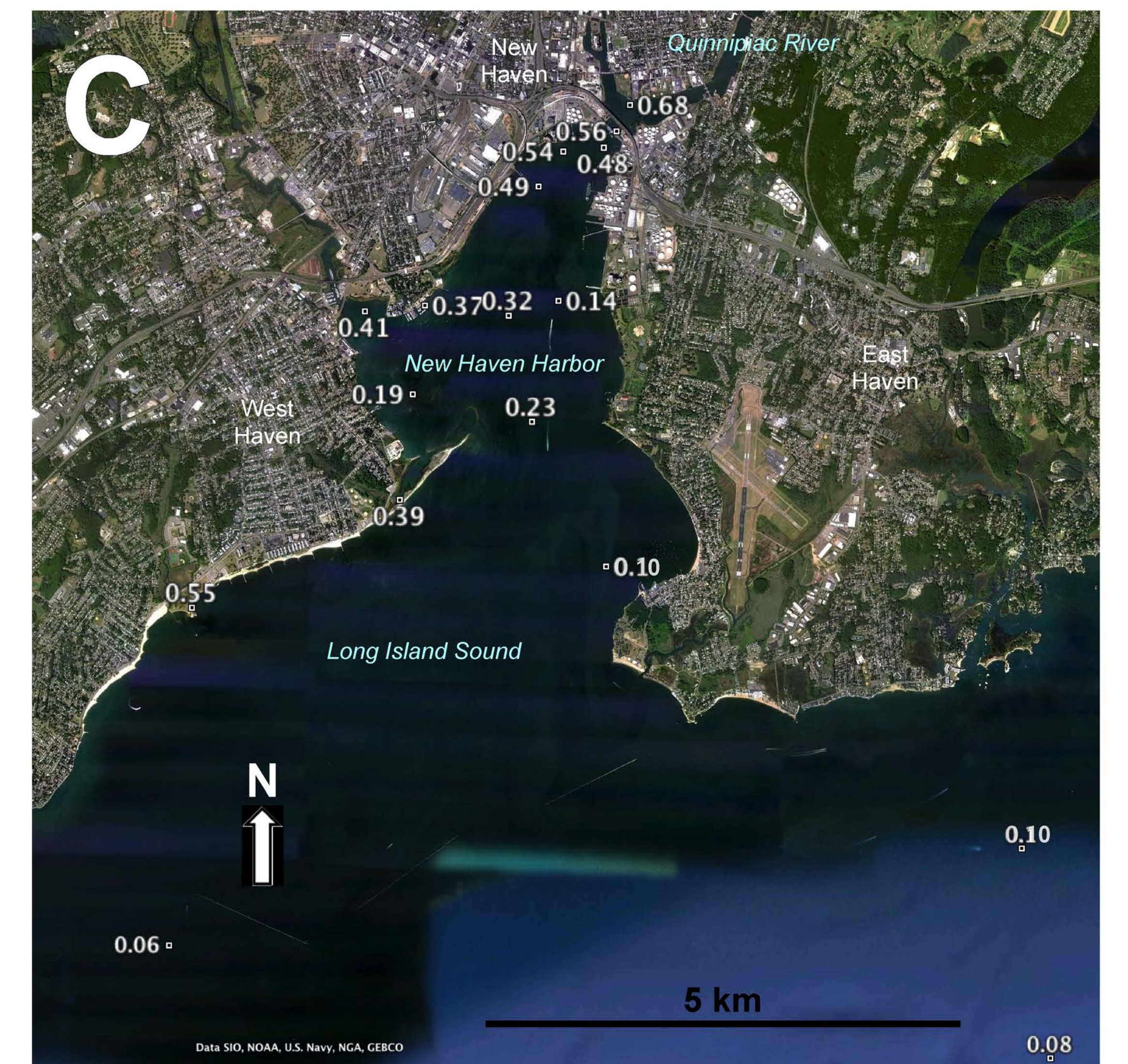
(5) Sediments collected within the Newark Bay (NJ) estuary from the lower Passaic and Hackensack Rivers and the Arthur Kill show mixed terrestrial and aquatic OM signatures (VGI from 0.3 to 0.7, generally increasing upstream) (Map A).



VGI Ratio Values for Long Island Sound Sediments



Index Map - New York metropolitan area and southern New England, USA



VGI Ratio Values in the Vicinity of New Haven Harbor (Connecticut)

(6) Samples taken from *Spartina* peat marshes at the mouths of major rivers (Housatonic and Connecticut) entering Long Island Sound and a *Phragmites*-dominated tidal marsh along the Hackensack River (NJ) have high (> 0.8) VGI ratio values (Maps A & B).

(7) Deep water Long Island Sound sediments show a strong predominance of aquatic OM (VGI about 0.05), while nearshore sediments collected 2 km from the mouth of the Housatonic River and in embayments near the Connecticut and Thames River mouths have a greater terrestrial OM component (VGI of 0.15 to 0.23). The results demonstrate a precipitous decrease in the relative amounts of unaltered land plant OM in the offshore direction, but also that a minor fraction persists in deeper water environments (Map B).

(8) Sediments from New Haven (CT) harbor show a diminution in VGI values from 0.66 at the mouth of the Quinnipiac River to 0.08 at the entrance to the harbor over a distance of only 4 km, as terrestrial influences wane moving towards open water (Map C).

**Conclusion - The VGI ratio provides a simple and effective molecular parameter useful in determining the relative contributions of terrestrial and aquatic organic matter to estuarine and near-shore marine sediments, supplementing traditional bulk chemical and isotopic indicators.**

Thanks to:  
Joop Varekamp, Marilyn Buchholtz, ten Brink, Gabe Benoit, Carl Harvey, Eric Stern, Nicole Bujalski, Vesna Mircic