

Sediment microbial community dynamics and geochemistry during oxic and hypoxic periods in the Gulf of Mexico

Anthony V. Palumbo¹, Jennifer J. Mosher¹, Tatiana A. Vishnivetskaya¹, Steven D. Brown¹, Dawn Klingeman¹, Courtney Johnson¹ and Richard Devereux²

ORNL, Oak Ridge, TN

USEPA, Gulf Breeze, FL

Background: Seasonal hypoxia in the benthic waters of the Louisiana Coastal Shelf contributes to the Gulf of Mexico “dead zone” phenomena. Limited information is available on sedimentary biogeochemical interactions during periods of hypoxia.

Methods: Sediment samples were collected south of Terrebone Bay in April (oxic) and September (hypoxic) 2006. A suite of geochemical parameters, including Fe, Mn, and nutrients were measured. Pyrosequencing analysis of the 16S rRNA V4 hypervariable region was performed on DNA extracted from the sediments to determine microbial community structure.

Results: Of the measured geochemical parameters, dissolved inorganic carbon ($p < 0.001$), NH_4 ($p < 0.001$), porewater Fe^{2+} ($p = 0.033$), NO_2 ($p = 0.03$), NO_x ($p = 0.003$), PO_4 ($p < 0.001$) and sediment Fe II ($p = 0.001$) were found in significantly greater concentrations in the hypoxic sampling period. Mn ($p = 0.011$) and sediment Fe III ($p = 0.001$) concentrations were significantly greater from the oxic samples. Redundancy analysis of the bacterial community indicated significant differences in the community composition in samples from oxic vs. hypoxic periods. The surface sediments (1-3 cm) from the oxic sample had higher abundances of *Verrucomicrobia* and *Firmicutes* and were correlated with Mn concentrations. The deeper sediments (5-9 cm) during the oxic period were characterized by higher abundances of *Acidobacteria*, *Proteobacteria* and *OD1*. The surface samples taken during the period of hypoxia exhibited greater abundances of *Fusobacter*, *Bacteroides*, *Planctomycetes*, *WS3* and *Actinobacter*. These organisms were correlated with porewater Fe^{3+} concentrations. Deeper sediments from the hypoxic period were associated with higher abundances of *Deferribacter*, *Chloroflexi* and *Spirochaetes* and correlated with concentrations of sediment Fe II.

Conclusion: These results suggest a shift in both the microbial community structure and geochemical composition during periods of hypoxic vs. oxic bottom waters in the Gulf of Mexico sediments.