Impacts of sealevel rise on the soil biogeochemistry, and production and destruction of halogenated organic molecules in coastal wetlands

SATISH C. B. MYNENI, DANIELLE SCHLESINGER[1]

[1]Department of Geosciences, Princeton University, Princeton, NJ 08544, USA; smyneni@princeton.edu

Changing climate and associated sea level rise have a major impact on the biogeochemistry of the coastal ecosystems. With rises in sea level, salt water intrudes into coatal aquifers and soils, and results in increases in the salinity of pore waters, and exposes terrestrial organic matter to high concentrations of halides, HCO_3^-, and SO_4^{2-}. These changing chemical conditions modify mineral solubility patters, and redox eauilibria of many major and trace elements in the affected soils. In addition, elevated levels of salt in soil pore waters lead to tree kills, which adds substantial amounts of organic carbon to the soils and further influences the chemistry of coastal wetlands.

In this study we examined how salt water intrusion influences the halide chemistry, and produces halogenated organic compounds along a salinity gradient in South Carolina wetlands. In addition, we conducted laboratory simulations on soils collected from the same site and also from pine lands in New Jersey, USA to evaluate the extent of halogenation of organic carbon. These studies were conducted as a function of different physical and chemical variables (pH, concentrations of HCO_3^-, SO_4^{2-}, halide concentration, and wet and dry versus saturation state of soil). Samples were examined with synchrotron X-ray spectroscopy and microscopy, NMR, GC-MS, and FT-ICR ESI-MS.

Our results show that bromination of organic matter is highly favored and well pronounced in all affected soils, and these reactions are stronger in wet-dry systems, suggesting that aeration and oxidation of soils are important for extensive bromination reactions. Bicarbonate and sulfate abundaces reduced the overall bromination. In addition to the production of these stable brominated and other chlorinated compounds in the affected soils, we also observed rapid release of high concentrations of halomethanes (methyl chloride and methyl bromide). The two types of soils we examined show variability with respect to the intensity of bromination, and these are attributes to the soil texture. A summary of these results will be discussed.