Comparison of Soil Phosphorus, Iron and Sulfur Pools in the Everglades/Florida Bay Ecosystem

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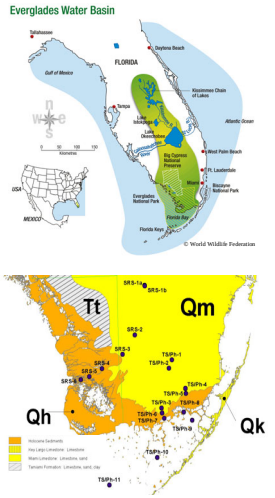
INTRODUCTION: The south Florida landscape has changed dramatically over the last 100 years. Development of sub-tropical lands in Florida has accelerated as humans have changed water flows, drained wetlands, and opened up a world of agriculture, retirement villas and vacation getaways. Alteration of the native landscape has occurred in dramatic fashion, with loss of greater than 50% of the natural wetland area and profound disturbance of adjoining upland environments. Coupled with these human impacts are chronic, long-term impacts associated with sea level rise and acute, short-term impacts associated with hurricanes. The outcome is that the freshwater Everglades marsh—the largest remaining freshwater marsh in the contiguous United States—is lost to human development on the landward side, and to drowning on the seaward side. Given these different forcing functions, we are characterizing soils from different portions of the Everglades/Florida Bay ecosystem to: 1) track long-term changes in nutrient and mineral pools; and 2) determine the soil response to proposed restoration of freshwater discharge through the eastern portion of the Everglades.

Freshwater Sawgrass Marsh, Everglades

Seagrass Meadow, Florida Bay



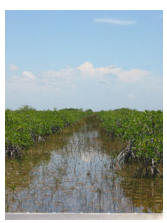
South Florida geology and sampling sampling stations along Shark River Slough (SRS) and Taylor Slough/Panhandle (TS/Ph) transects.

METHOD: During summer 2003, soil samples were collected in triplicate to depths of 10 cm from 17 Long-Term Ecological Research (LTER) stations throughout the Florida Coastal Everglades system. The LTER sampling stations are situated: along the western, Shark River Slough transect (SRS 1-6), characterized by large freshwater inflows and estuarine circulation, and; along the eastern, Taylor Slough/Panhandle transect (TS/Ph 1-11), characterized by much smaller freshwater inflows and limited tidal exchange. Both transects traverse freshwater marsh and brackish/salty mangrove forests. Additionally, TS/Ph 9-11 sampling stations are located in seagrass meadows of Florida Bay.

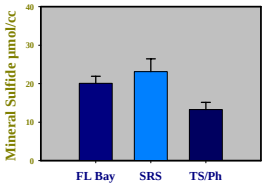
Each soil core was sectioned into three depths and chemical extractions for mineral sulfides (S), available iron (Fe), and total phosphorus (P) were completed. A two-step extraction for mineral sulfides was completed (1N HCl extraction followed by boiling chromium/conc. HCl extraction). Iron was determined following soil ashing and 1N HCl extraction. Total P was determined using the same ashing/acid extraction for Fe. On separate samples, a four-step sequential extraction for different forms of phosphorus was completed using 1) 1N $MgCl_2$ (labile P), 2) buffered dithionite (sorbed P), 3) 1N HCl ($CaCO_3$ P), and 4) ashing/acid extraction (detrital, organic P).

Because differences by depth were not significant, soil measurements were averaged among cores and depths at each location (N=9). Graphical comparisons of sediment concentrations of S, Fe, and P were completed among locations (FL Bay vs. SRS and TS/Ph transects) and among wetland habitat types (seagrass meadow vs. mangrove forest vs. freshwater marsh).

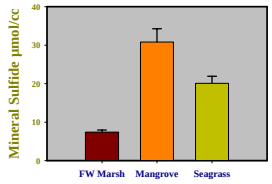
Dense Mangrove Forest
SRS 5

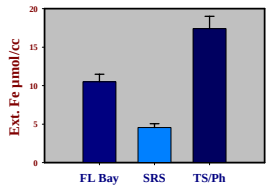


Stunted Mangrove Forest
TS/Ph 6

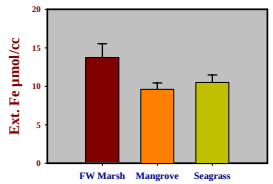


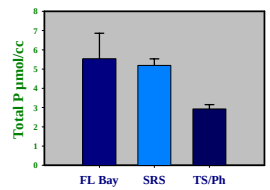
RESULTS: Mineral sulfide in soils occurred mostly as pyrite, averaged 10-24 µmol S/cc across all transect locations, and were highest along the SRS transect. The highest concentration of S was measured in mangrove soils; the lowest in freshwater marsh soils.



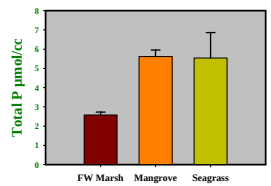


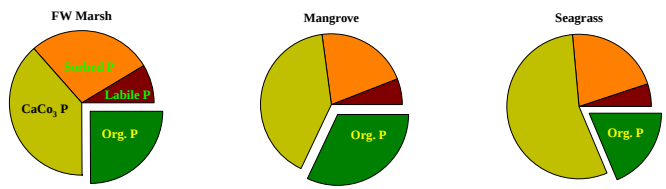
Extractable iron concentrations in the carbonate soils of south Florida are 1-2 orders of magnitude lower than those found in terrigenous soils. The highest concentration of Fe was measured in the freshwater marshes along the eastern TS/Ph transect, lowest along the freshwater SRS transect.





Total phosphorus concentration was lowest on the TS/Ph transect and comparably higher from SRS and Florida Bay locations. Total P in soils from seagrass meadows and mangrove forests was higher than in soils from upstream, freshwater marshes.





Results of sequential P extraction demonstrate the largest fraction of total phosphorus is retained in the inorganic calcium carbonate pool. Although extractable Fe concentration was low from all locations, the sorbed P fraction (that includes P sorbed to iron oxide minerals) was fairly large. The organic phosphorus fraction was largest in mangrove soils and smallest in seagrass sediments.

CONCLUSIONS: These "snapshots" of nutrient and mineral pools in soils establish a baseline across the south Florida landscape and serve to describe the antecedent conditions prior to increases in freshwater flows proposed for Everglades restoration. They also highlight the differences between SRS and TS/Ph transects and help to identify the connections among water flows, nutrient availability, and primary production in this coastal, oligohaline ecosystem.

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