

Quantifying Hydrologic Exchange Between Surface and Ground Water in the Florida Everglades, WCA-2A

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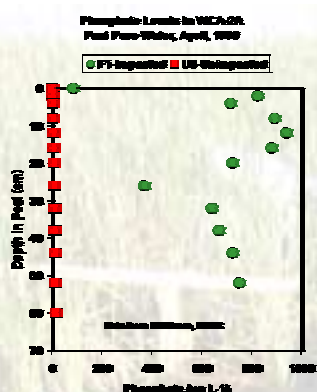
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Recent interest in the Everglades is focusing on restoring the hydrologic flow and nutrient concentrations to historical levels. However, high nutrients in agricultural runoff, particularly phosphorous, have effected a change in plant types and soil nutrient concentrations, especially near release structures.



Cattails



- A large fraction of these nutrients are sequestered in the ground, dissolved in pore water and adsorbed to sediment particles.
- As restoration efforts begin, it is important to realize that cleaning up surface water from agricultural runoff is only the first step in reducing nutrient concentrations in the Everglades' surface waters.
- After years of accumulating nutrients in the subsurface, decreasing surface water concentrations will eventually cause a shift from trapping of nutrients to a net release from the peat and possibly from the carbonate aquifer.

In order to anticipate the magnitude of this release, we must increase our understanding of the exchange of water and chemicals between the surface water, ground water and sediments.

Goals:

- Determine the exchange between surface water, peat pore-water, and ground water in WCA-2a using radium and radon.
- Use this exchange rate to quantify nutrient fluxes.

Radiochemical Background

- There are four naturally occurring isotopes of radium, and all are produced in the sediments from their thorium parents.
- Thorium is extremely particle-reactive ($K_D \approx 10^5$), and is almost exclusively found on or in particles.
- Radium is less particle-reactive ($K_D \approx 10^3$), and has a measurable dissolved fraction in pore water and g-w.
- ^{222}Rn is produced from ^{226}Ra , and has no affinity for sediment particles.

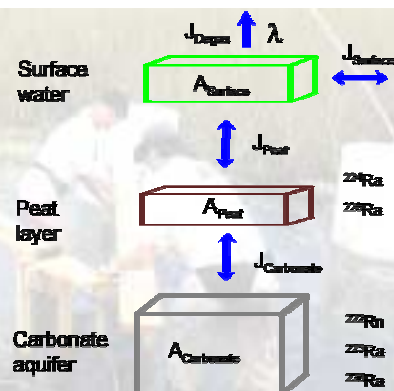


Sediment Geochemistry of Radium at WCA-2A

Any radium measured in the surface water must have been generated by thorium in the sediments.

^{228}Ra and ^{224}Ra have highest production rates in peat layer.

^{226}Ra and ^{223}Ra have highest production rates in carbonate aquifer.

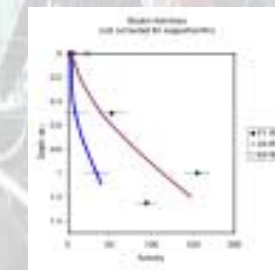


Our Approach:

- Water and soil samples will be collected and analyzed for the concentrations, production rates and distribution coefficients of radium and radon.
- The range of half-lives (4 d to 1600 y) and the different production rates will allow us to quantify fluxes and exchange rates between surface water and the sediment layers.
- Since radon is not geochemically active, it is an excellent tracer for ground water exchange.
- Since radium exhibits a geochemistry similar to phosphate, when these data are combined with nutrient data we will begin to understand the quantity and quality of nutrients released to the surface waters from Everglade sediment in this region.

Preliminary Data

- The $^{224}\text{Ra}/^{223}\text{Ra}$ activity ratios of samples collected in Sept, 2000 confirm our assumption that ^{224}Ra activities will be low in the carbonate aquifer, and high in the peat layer, relative to ^{223}Ra .
- The surface water (depth = 0) reflects radium signals from the peat layer, not from the carbonate aquifer.
- The different ground water signatures allow us to put constraints on discharge estimates from the peat and carbonate layers.



Radon activities indicate that exchange rates are greatest near the surface of the peat.

Surface water Rn activities are very low, most likely from rapid exchange between the water and the atmosphere.

Current research focus:

- Our current research effort is to obtain higher resolution of the distribution and production of radium and radon in the peat. This information is needed as we begin to quantify the diffusive, dispersive and advective mixing.
- To address this, cores were collected on Monday (weather permitting) and will be analyzed at a 10 cm resolution for Ra and Rn production rates.

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