SFP 2006
Sediment-water exchange of dissolved organic phosphorus in Florida Bay

A proposal submitted to the NOAA Coastal Ocean Program
South Florida Ecosystem Research and Monitoring Program

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Proposed Budget: $200,000 for FY 2006 – FY 2007

ABSTRACT

Because phosphorus (P) is a limiting nutrient to seagrasses throughout the entire Florida Bay and to phytoplankton at least in eastern bay, the supply of P is critical to the health of seagrass community and the frequency, intensity and duration of phytoplankton blooms. Our multiyear monitoring has demonstrated that seawater contains a very low concentration of dissolved reactive phosphate (10-100 nM). However, dissolved organic phosphorus (DOP) is usually an order magnitude higher than dissolved reactive phosphate, dominating dissolved phosphorus pool in the water column. On the other hand, carbonate sediments strongly retain P and sediments have been identified as a dominant P reservoir in Florida Bay. Sediments are readily suspended by wind and tidal mixing into surface water in shallow (average water depth 1 m) Florida Bay. The sediment/water exchange of P through adsorption/desorption represents the most important P cycling process and plays a critical role in regulating bioavailable P to the water column. Our previous studies have shown a strong gradient of decreasing sediment exchangeable P concentration from the west to the east across the bay. The spatial pattern of sediment exchangeable P is similar to that of dissolved phosphate concentrations in the water. As carbonate sediments function as a P buffer system, it is reasonable to hypothesize that sedimentary P, to a large extent, regulates the dissolved phosphate concentrations in the shallow water column. Our study on the fractionation of sedimentary P pools by a sequential extraction technique reveals that 60% of exchangeable sediment P is in the organic form, indicating that the dissolved organic P in bay water is reactive in adsorption/desorption processes at sediment/water interface. However, there is little study on organic P sorption on marine sediment surface. To characterize the sediment-water exchange of DOP in Florida Bay, a systematic study is proposed to quantify the sediment characteristics with respect to sediment/water partitioning of DOP. For a given station location, individual sediment parameters for DOP exchange, such as the zero equilibrium DOP concentration, the distribution coefficient, and DOP buffering capacity of sediment will be quantified by isotherm experiments with a model organic compound AMP at ambient temperature and salinity. Such experiments will be conducted at 40 selected sampling locations covering both different sediment characteristics and geographic region of the bay. This systematic study will provide a spatial distribution of sediment parameters relevant to DOP cycling in Florida Bay. These parameters are essential in water quality models for predicting the sediment/water exchange of DOP in Florida Bay.