Project Summary Form

Louisiana Sea Grant

RFP Title

Coastal Science Assistanship Program 2018

Project Number

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Determining Pre-project Wetland Soil and Estuarine Sediment Physical Properties and Phosphorus Cycling in the area of Influence of the Mid-Barataria Sediment Diversion

Initiation Date

06/01/2018

Completion Date

05/31/2021

Award Number

Sub Program

Principal Investigator

Total Months effort

Other Investigators

Total Months effort

Keywords

phosphorus, eutrophication, baseline conditions, flux

Sea Grant Classification(s)

Focus Areas

Proposal Title: Determining Pre-project Wetland Soil and Estuarine Sediment Physical Properties and Phosphorus Cycling in the area of Influence of the Mid-Barataria Sediment Diversion

Understanding Phosphorus dynamics related to planned, large sediment diversions is important because of the potential for algal blooms and, in particular, harmful algal blooms. There is a tremendous focus in coastal Louisiana on the study of nitrogen dynamics, primarily due to the fact that N is in high concentrations in the Mississippi River water and in general, in coastal waters within the plume of the Mississippi River. To underscore this fact, recent studies have found that N limitation switches to P limitation when pulses of Mississippi River water are diverted to Lake Pontchartrain through the Bonnet Carré Spillway (White et al, 2009; Roy et al, 2013). After the diversion is closed, it has been found that water column P begins to increase steadily over a period of up to 6-8 weeks. It has been hypothesized this increase is due to redox-driven P release of the Mississippi river sediment since the bioavailable, water column pool has been consumed. Briefly, the Fe-bound P is in particulate form under aerobic conditions, similar to the water columns of the river and Lake P. However, once that sediment is deposited, much of the Fe-bound P becomes mobile as Fe^{3+} is reduced to Fe^{2+}. This leads to a condition of ample bioavailable P with very low bioavailable N. This nutrient condition is favorable to the formation of harmful algal blooms, since many species can fix N from the atmosphere, giving them a competitive advantage over other phytoplankton species (e.g. diatoms).

Phosphorus differs from N in that there are organic and inorganic particulate forms which vary in mobility related to pH, DO and complexity of the organic pool. There is little information in the coastal basins as to the forms of phosphorus in the sediment and what changes will occur with diversions. Only one published study, we are aware of, characterized the release of the sediment P pool in a diversion site in Big Mar, Caernarvon using stirred reactors, rates which can be difficult to use in spatial models since they are unrealistic. (Zhang et al, 2012).

Therefore, this proposal seeks to examine the forms of sediment phosphorus in Barataria Bay in close proximity to the planned Mid Barataria sediment diversion as well as in coastal vegetated wetlands and sediments in the open water bay. Samples will be analyzed for bulk density, total C, N and P, and samples will undergo a phosphorus fractionation scheme that will partition the P into several organic and inorganic pools based on reactions with salts, acid and bases (Figure 1). The remaining or recalcitrant P pool will be determined by ashing followed by hot acid digestion (Reddy et al, 2011; Adhikari et al, 2016).

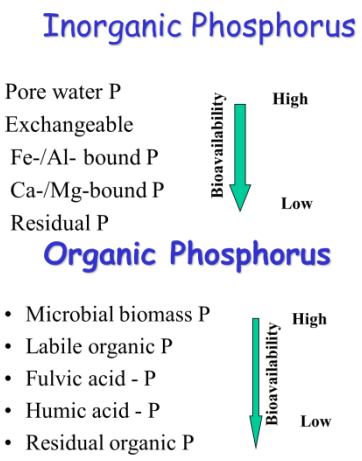

Figure 1. Phosphorus forms in sediments and wetland soils

The goal of this project is two-fold. The first is to create a map of organic and inorganic pools of soil and sediment P in eastern Barataria Bay which will be influenced from the Mid-Barataria Basin Sediment Diversion to include at least 60 stations (We will seek

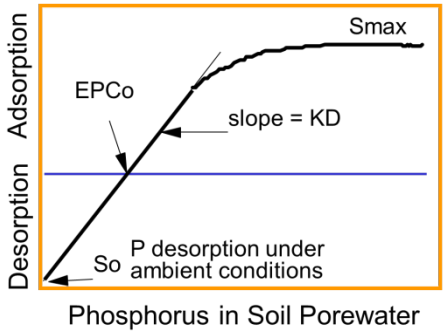

Figure 2 Equilibrium P Concentration diagram

guidance from Water Institute and CPRA personnel to delineate the area of influence to include sites near the diversion and more distant). It is important, in terms of successful modeling, to understand and document the starting point related to sediment properties. Total phosphorus is not a good measure of P availability or reactivity. Secondly, at select stations (~5-10 %), representative of the sediment types, the Equilibrium Phosphorus Concentration (EPC) will be determined (Figure 2). This concept is vital in determining whether the sediments will serve as a sink or a source of P under a range of concentrations. In short, replicate cores will be collected by piston core and subjected to a range of surface water concentrations. Depending on the change in concentration (increase or decrease) the direction and magnitude of flux can be determined. Plotting this data will allow the determination of the EPC for various sediment types. This information can then be used to determine the spatial dynamics of P uptake and release during and post diversion event and will be invaluable for modeling the receiving basin response to the Mississippi River sediment diversions. To determine how P behavior will change over time, we will also perform P flux measurements on newly deposited sediment in the Wax Lake Delta, which receives similar sediment. This data will then allow the prediction of how P dynamics will change with diversion operation and provide critical information to predict the potential for N-fixing harmful algal blooms to occur post diversion.

Relevance to the Louisiana Master Plan – Large sediment diversions are being planned for coastal Louisiana and modeling efforts have been completed as a first pass. There is still some uncertainty related to P dynamics, both the dissolved water column P and the sediment bound P associated with Mississippi River sediment. There is much more known about N in this area. This study will help set the baseline condition and reduce the uncertainty related to both the P dynamics and eutrophication potential for conditions favoring algal blooms (including HABs) and other expressions of eutrophication. In addition, this dataset will be vital in helping design monitoring plans, track changes over time, including the relationship of P release (EPC) and P fractionation which is sorely missing from this area.

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