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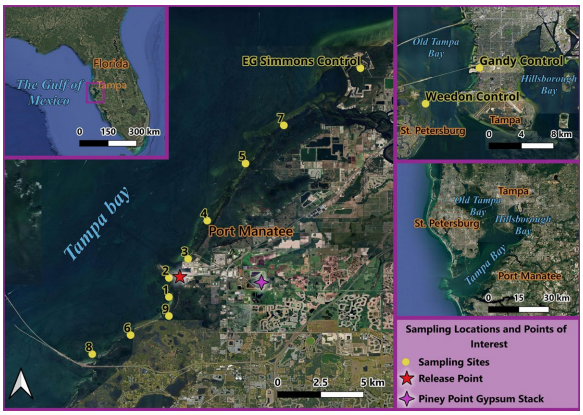
From nutrient pulse to sequestration: Long-term monitoring of the Piney Point industrial phosphate waste spill in Tampa Bay, FL, USA

MX. JONATHAN D MAJOR, TIAN FENG AND MATTHEW A PASEK

Rensselaer Polytechnic Institute



In March–April 2021, approximately 800 million liters of acidic industrial phosphate wastewater were discharged into the alkaline waters of Tampa Bay, Florida, USA, to prevent the structural failure of the Piney Point industrial phosphate waste facility [1]. While such high-volume nutrient pulses can trigger short term toxic algal blooms and reduction of oxygen in the water column [2], the long-term environmental impact depends on the geochemical mobility of the waste contributed phosphorus [3]. To characterize this impact, we monitored extractable phosphorus in estuarine sediments near, north, and south of the release point (see map) from July 2021 to May 2024 and performed laboratory mixing simulations using wastewater and seawater analogs.

Spatial analysis of the sediments revealed that phosphorus concentrations strongly correlated with the predicted plume flow [4] and proximity to the discharge point. Laboratory simulations further demonstrated that native sediment grains rapidly sequestered dissolved phosphate from the water column. Specifically, mineralogical assessments identified apatite, the primary mineral source of industrial phosphate, as the most efficient sink for the contamination. These results suggest that apatite-rich estuarine sediments provide a natural buffer, promoting the rapid sequestration of waste-contributed phosphate and maintaining its stability for at least three years post-discharge.

1. Initial estuarine response to inorganic nutrient inputs from a legacy mining facility adjacent to Tampa Bay, Florida, Beck, *et al.* (2007), *Marine Pollution Bulletin,* **178,** 113598.

2. Harmful algal bloom species and phosphate-processing effluent: Field and laboratory studies, Garrett et al., (2011), *Marine Pollution Bulletin* **62**, 596–601.

3. Rethinking early Earth phosphorus geochemistry, Pasek (2008), *Proceedings of the National Academy of Sciences* **105**, 853–858.

4. A tracer model nowcast/forecast study of the Tampa Bay, Piney Point effluent plume: Rapid response to an environmental hazard, Liu et al., *Marine Pollution Bulletin* **198**, 115840 (2024).