Flocculation and Settling Dynamics of Carbonate Plumes to Improve Transport Predictions

Dredging Operations Environmental Research (DOER) Program

U.S. ARMY CORPS OF ENGINEERS BUILDING STRONG®

Focus Area

Sediment and Dredging Processes

Problem

USACE dredging in carbonate environments threatens sensitive habitats such as coral reefs and hard bottoms. While physical removal impacts are predictable, turbidity and sedimentation remain difficult to forecast. Adding to this difficulty is the lack of scientific understanding of carbonate mud flocculation behavior and settling. The impact magnitude and extent of sedimentation is strongly related to the size and settling velocity of the generated particles from dredging. This uncertainty increases project risk, mitigation costs, and legal liability.

Study Description

This study will establish the first known scientific foundation for understanding the flocculation and settling behavior of natural and dredge-generated carbonate muds. Laboratory experiments using a Taylor–Couette chamber and the Particle Imaging Camera System (PICS) will quantify particle size, density, and settling dynamics in real time. Field sediment flux measurements collected during an active dredging project will help validate the laboratory findings and enhance the accuracy of Particle Tracking Model (PTM) inputs for carbonate environments.

Products

- (FY26, YR-1) Conference abstract: Initial laboratory observations on the flocculation behavior of natural and dredge-simulated carbonate muds.
- (FY27, YR-1: Journal article: Flocculation and settling behavior of natural and dredge-simulated carbonate muds: A laboratory study using a Taylor-Couette cell.
- (FY27, YR-2) ERDC Technical Report: Dispersion and Dynamics of Carbonate Plumes Generated from Dredging Activities: Case Study of the Port Everglades Expansion Project.
- (FY28, YR-3) CHL Technical Note: Revising PTM sediment inputs for dredged carbonate environments.
- (FY28. YR-3) Tool that will streamline and generate the native and source sediment input files required by PTM.
- (FY28, YR-3) Journal article: Quantifying flocculation and settling rates of carbonate muds to improve sediment fate predictions.
- (FY28, YR-3) Training workshop & report: Representing carbonate plumes in the Particle Tracking Model (PTM).

Summary

This research will establish the first known scientific understanding of how carbonate muds flocculate, settle, and disperse during dredging. Flocculation experiments using a Taylor-Couette cell will provide the empirical data comparing the floc behavior of natural versus dredge-generated muds. Field measurements of carbonate plumes during an active dredging project will validate the laboratory results and help refine PTM sediment inputs to improve transport predictions. Improved PTM predictions enables a more reliable assessment of sedimentation impacts to reduce environmental, legal, and financial risk to USACE.

Balancing operational and environmental initiatives and meeting complex challenges of dredging and dredged material placement in support of the navigation mission.

Anthony M. Priestas
ERDC Coastal & Hydraulics Laboratory • Anthony.M.Priestas@usace.army.mil

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Research Products

Product Type	Product Title

Anthony M. Priestas
ERDC Coastal & Hydraulics Laboratory • Anthony.M.Priestas@usace.army.mil