US Army Corps of Engineers®
Engineer Research and Development Center

Research Brief: Effect of Organic Contents on Properties of Fine Sediment Beds

Issue

Most of the fine sediments occurring in natural environments such as lakes, wetlands, and estuaries contain organic material. The type and amount of organic contents are site-specific and may vary to a great extent. The bulk density and erosion rates of fine sediment beds are significantly affected by the organic contents; however, their influence has not been adequately quantified. Organic materials, nutrients, and bacteria are attached predominantly and preferentially to fine sediments due to physical and electrochemical properties of clays. The erosion of fine sediment beds brings millions of fine particles into suspension, which significantly changes the turbidity and chemistry of the water column and adversely affects water quality. Hence, quantification of the process of release of nutrients and suspended sediments into the water column is essential.

Objective

Provide new knowledge of cohesive sediment erosion processes and release of associated nutrients plus improved algorithms for erosion/release rate as a function of bulk density, organic content, and other easily measured parameters.

Research/Design

This work will test the following hypotheses: a) decreasing organic content generally correlates with increasing bed density; in other words, higher organic content decreases bed density, b) higher organic contents make the bed more resistant to erosion, and c) rate of release of organic contents from the bed into the water column is a function of the type of organic and rate of erosion.

Laboratory experiments for measurement of nutrient release will be conducted. Field data already available, and those proposed to be collected by ERDC at various project sites, will be used for comparison with the laboratory results. Data collected by European institutions under the Marine Science and Technology program and those collected by other researchers, including U.S. universities, will be included in the analyses. The organic substances used will be water-soluble and will consist of both biogenic and industrial products. The work will consist of the following components.

- Laboratory measurements of bulk density of clays and clay mixtures with varying amounts of water and types and amounts of organic matter.
- Laboratory experiments on erosion of cohesive sediment beds of varying properties and composition in terms of clays and water and organic content.
- Laboratory measurement of nitrogen and phosphorus released in the water column during erosion.
- Analysis of existing and new field data on release of nutrients and comparison results with laboratory measurements. New field measurements will be coordinated with the work unit, “Framework for Integrated Solutions.”

- Formulation of a revised theoretical framework for fine sediment erosion and nutrient release and testing against data.
- " Creation of a new general algorithm on sediment erosion including the effect of organic contents and release of nutrients and delivery to the improved multidimensional sediment processes models.
- Restructuring for compatibility. The model will be structured so that it can be embedded in the Inland Morphology Modeling System (created separately under RSM).

Application

Correlation of erosion and nutrient release rate with organic content and other simple parameters will improve the accuracy of numerical models used for prediction of erosion of natural sediments found at several Corps projects. Improved knowledge of the processes will lead to more accurate models, which will increase public confidence in Corps project evaluations and enable engineers to design and operate projects that enhance the aquatic environment. The results of this work will also serve the System-Wide Modeling, Assessment, and Restoration Technologies (SMART) research program.

Products

Links and information will be posted here. View online at http://www.wes.army.mil/rsm/.

Research Team

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