The Role of Physicochemical Processes in Sediment Transport by Turbidity Currents

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Award Number: N00014-01-1-0955

LONG-TERM GOALS

Understanding of sediment transport by debris flows and turbidity currents is necessary to support Navy activities related to mine burial and strata formation processes. The long term goal of this effort is to provide quantitative tools to predict the transport and deposition of sediments in turbidity currents. Considerable previous work has focused on analyzing the physical aspects of debris flows and turbidity currents. Physicochemical particle-particle interactions may also influence such sediment transport phenomena, but the significance of these processes has not been evaluated. This project will contribute understanding of the role of particle-particle interactions within turbidity currents.

OBJECTIVES

This project will involve a set of experiments to demonstrate the extent to which physicochemical particle-particle interactions can influence the behavior of turbidity currents. The primary objectives of this work are to determine if these types of interactions should be included in models for sediment transport in turbidity currents, and to indicate the best directions for future Navy research in this area.

APPROACH

In order to understand how particle-particle interactions can influence the behavior of turbidity currents, a series of laboratory experiments will be executed with different particle types and background water chemistries. Experimental conditions will be selected in order to examine a spectrum of particle-particle interactions ranging from highly repulsive to attractive. The major chemical parameters to be varied include the salinity and pH of the turbidity current.

Preliminary experiments will also be conducted in a small laboratory channel with an inclined plane of length 2 – 3 m, and later experiments will be conducted in a large turbidity current tank at the Hydrosystems laboratory at the University of Illinois at Urbana-Champaign. Various physicochemical effects will be evaluated in the small channel, and then the large tank will be used for the full-scale demonstration with more-realistic flow conditions and the opportunity to develop extensive sediment deposits. The large turbidity current tank has been used for a considerable amount of ONR-funded work. Though previous experiments in this facility were all directed at the study of physical processes,

the tank can also accommodate a wide range of chemical conditions. Arrangements have been made with Prof. Marcelo Garcia, Director of the Hydrosystems lab, for access to this facility.

WORK COMPLETED

This project was initiated just two months ago. We are currently constructing and assembling the equipment that will be used for this project. This work is on schedule and we will begin experiments around the beginning of November.

RESULTS

N/A.

IMPACT/APPLICATIONS

The proposed laboratory experiments will indicate the relative role of physicochemical processes in controlling sediment transport and deposition in turbidity currents. Some variables, such as the aggregation state of the sediment, are clearly important and need to be considered in sediment transport models. This study will indicate the extent to which particle-particle interactions can change net behavior of turbidity currents, and particularly how net transport changes with water chemistry. This demonstration project will indicate if the Navy will need to conduct additional investigations of these processes.

TRANSITIONS

N/A

RELATED PROJECTS

None.