PRF#: 57811-ND8
Project Title: Do Muds Sort? Experimental Test of a Hypothesis Key to Understanding Marine Bottom Currents
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Project Goals:

The following narrative summarizes the first year (September 2017-August 2018) of ACS-PRF 'New Directions' grant #57811-ND8. The goal of the project is to experimentally constrain the relationship between velocity of currents transporting mixtures of silt and clay with the grain-size distribution of deposits. The coarse silt fraction has been used for >20 years by paleoceanographers to infer deep-sea bottom-current history (i.e., mean of the 10-63 μm range), but there is a surprising lack of laboratory validation. Our results will show to what degree such size sorting occurs in relation to known parameters (flow velocity, suspended sediment concentration, input grain-size distribution), which will allow us to refine the validity and interpretation of grain-size metrics from natural deposits. More broadly, we anticipate our work to improve the fundamental understanding of sediment transport processes of clay/silt mixtures relevant to numerous geoscience and engineering problems.

Work Done To Date (Year 1):

The project is on track to achieve the primary goal within the two-year grant period. Our objectives required the design and construction of a new sediment transport flume housed in the *Kelso Baker Environmental Hydraulics Laboratory* at Virginia Tech (Fig. 1). A non-recirculating flume was designed to transport water and sediment at a variety of velocities (up to 35 cm/s, concentrations, and mixtures. We need to supply mixtures of sediment at constant concentrations and to be consistent in the adjustment of independent variables such as flow rate and sediment input rate to ensure experiment repeatability.

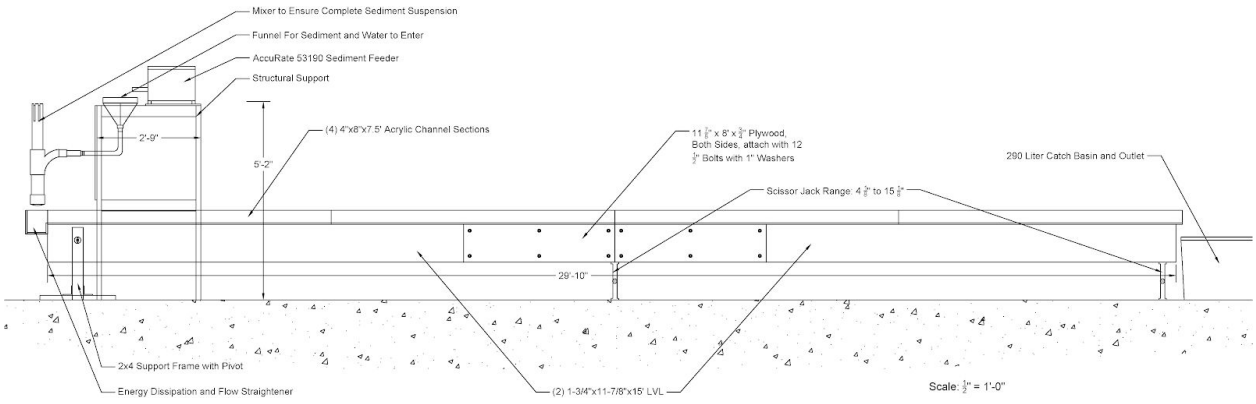

Figure 1: Side view of 30 ft. long flume that was designed and constructed for this project. This flume is now operational and we are currently running tests in advance of main set of experiments.

The new flume finished construction in May 2018 and is novel in its use of fine sediment compared to existing feed flumes and in its ability to maintain a constant concentration unlike racetrack or annular flumes. The flume was used in August-September 2018 to conduct pre-experiment runs to ensure

calibration of flow rates, to allow testing of observational procedures (e.g., photography), and to refine our sampling protocol. We also used this time to refine the workflow for sample preparation and grain-size analysis (Fig. 2). The entire team has contributed to the development of all procedures during the test phase.

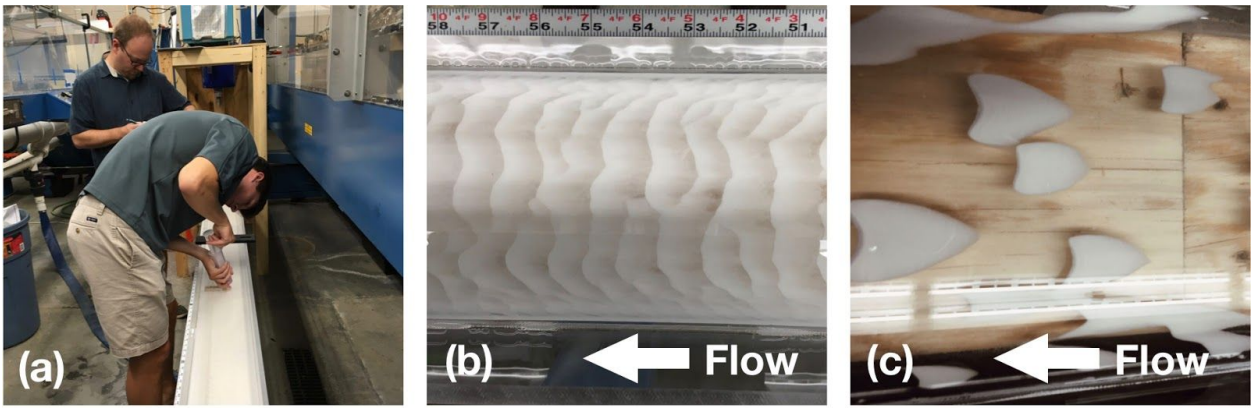

Figure 2: Testing different deposit sampling methods (a); examples of deposit bedforms under different flow conditions (b,c).

Looking Forward (Year 2):

The next phase of this project (October-December 2018) is to run the first set of experiments within our experimental matrix, which varies flow velocity, sediment concentration, and sediment mixture (i.e., ratio of silt to clay). These experiments will serve as a preliminary data set for a poster presentation at American Geophysical Union (AGU) Fall Meeting in December 2018 in Washington D.C. The remainder of the experimental matrix will be complete by the early part of 2019 (January-February), after which the team will transition to data analysis, interpretation, and manuscript (thesis chapter) preparation.

Impact on PIs and Student Participants:

This project is funded via a 'New Directions' grant and includes methods not previously employed (i.e., laboratory experiments) by PI Romans. The first months of the project included collaborative planning of the experimental design between PI Romans, Co-PI Strom (>decade of experience conducting physical experiments), and two participating graduate students. PI Romans' approach to sedimentological problems is already being influenced by this collaboration in form of a more 'forward' view of process-deposit relationships and with a quantitative mindset. Co-PI Strom is benefiting by enhancing his knowledge of oceanographic processes in the deep sea via discussions and recommended literature. A master's student in Civil and Environmental Engineering (advisee of co-PI Strom) co-designed and led the construction of the flume and is currently running of the experiments. A Ph.D. student in Geosciences (advisee of PI Romans) participated in experimental design and pre-experiment tests and is leading the sampling and grain-size analysis of the experimental deposits. Both Parent and Culp have benefitted through the multi-disciplinary interaction and discussion inherent to this project and will make significant contributions to the synthesis and communication of the eventual results.