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EXPERIMENTAL MODELLING OF TURBIDITY CURRENTS AS THEY UNDERGO A SIMULTANEOUS BREAK IN SLOPE AND LOSS OF LATERAL CONFINEMENT – AN ANALOGUE FOR CHANNEL-LOBE TRANSITION ZONES

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ABSTRACT

Results are presented from the current experimental campaign which aims to observe the character of supercritical turbidity currents and other supercritical sediment gravity flows (SGFs) as they respond to morphological transition zones e.g. slope breaks and losses of lateral confinement. This experimental setup aims to reproduce lower slope, channel-lobe transition zone, and, proximal lobe conditions, in order to be analogous to conditions found within deep-marine sedimentary environments such as those within foreland basins, and passive margins. Of particular interest is the sedimentological expression of these systems, and how variability, such as bedforms and scour fields, within them arises, and how does an understanding of current dynamics help in the prediction of these features.

1. Introduction

The study focuses on the flow dynamics of turbidity currents in lower slope and channel-lobe transition zones (CLTZs), and the resulting sedimentological features produced as currents pass over an erodible bed. Investigating the generation and preservation of supercritical bedforms, and the formation and fill of coalesced long-lived scours – both of which are critical features of lower slope and-lobe Transition-Zones (CLTZs). Thus, this study will yield new data on how turbidity currents impact multi-layered sedimentary beds and determine parametric controls on erosion, deposition and bed restructuring processes. Turbidity currents are scaled via dimensionless parameters representing prevalent flow (e.g. Reynolds, Densimetric Froude Number, and Shields Numbers) and sedimentary (e.g. Rouse and Reynolds Particle Numbers) conditions, following the scaling techniques of de Leeuw et al., (2016) which have now been tested in numerous experimental studies e.g. Pohl et al., 2019. This technique ensures that experimentally generated currents produce realistic patterns of erosion and deposition as they interact with an erodible substrate, as observed at field scale sites of turbidity current activity. The study itself is being carried out in a purpose-built facility (Figure 1) within the Environmental Fluid Mechanics Laboratory at the University of Dundee.

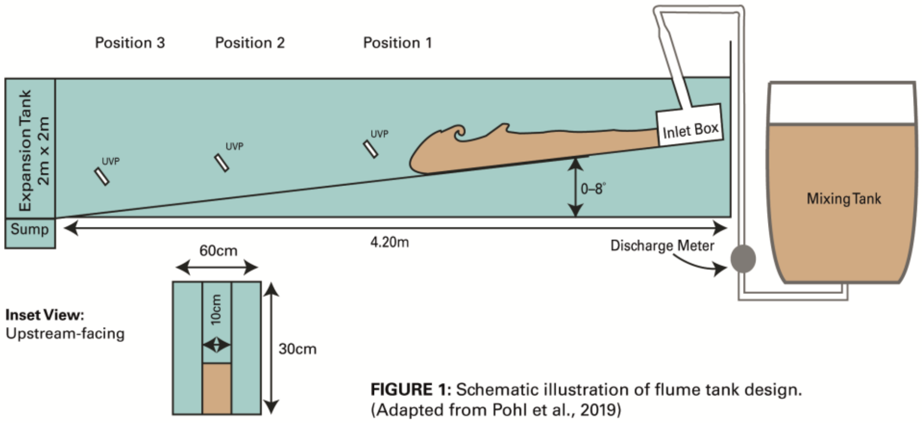

FIGURE 1: Schematic illustration of flume tank design. (Adapted from Pohl et al., 2019)

2. Planned experimental program

Investigating how varying experimental conditions such as, current parameters, severity of breaks in-slope, and, losses of lateral confinement impact the resulting depositional signature of lower slope, and channel-lobe transition zones. Of particular interest is the impact of previously developed bedforms upon current dynamics which will be studied via UVP (Figure 2) and ADV measurements, as well as through the application of digital elevation models (DEM) (Figure 3), which will be used to understand how systems evolve over multiple runs. DEM models will be generated using a photogrammetry technique that ensures the construction of a high-resolution model (±2mm). The results of which will then be linked to synchronous sedimentological packages – both on the modern seafloor and preserved within ancient geological outcrops – with the aim of enhancing the predictive sedimentological concepts applied to these systems when being interpreted within the subsurface.

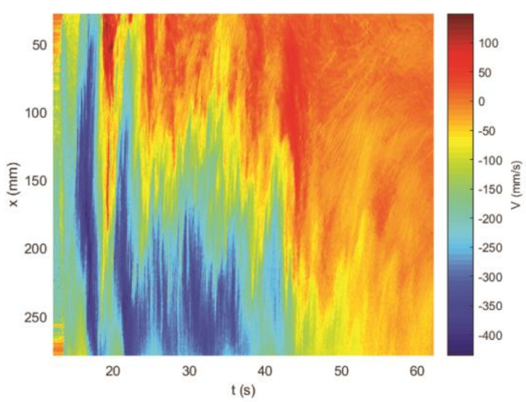

Figure 2: Velocity (UVP) colourmap displaying the profile of a turbidity current as it passess the probes position

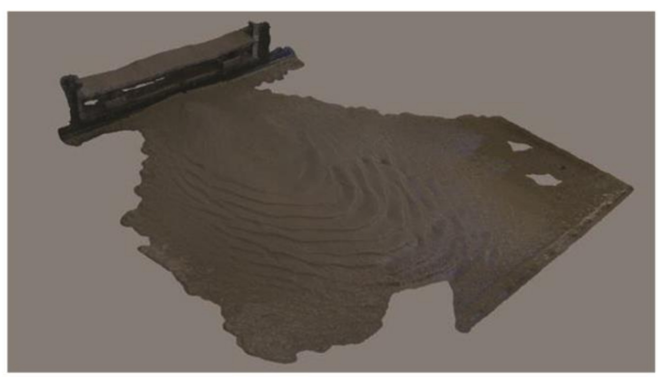

Figure 3: Photogrammetry model of the sedimentological expression produced by a turbidity current exiting from the channel into the basin.

3. Acknowledgements

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4. References

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