Submarine Channel Processes: Experimental Insights into the Location and Magnitude of Channel Overspill

Keevil, Gareth [1]; McCaffrey, William D.[1] (1) School of Earth & Environment, University of Leeds, Leeds, United Kingdom.

Submarine channels act to control the distribution of clastic sediment into deep oceans. In order to understand the distributary mechanisms it is necessary to investigate the fluid dynamics that operate within submarine channels; it is the details of the fluid dynamics that governs sediment deposition patterns. The majority of recent laboratory and numerical studies have focused on the structure of fluid velocity within single bends. Coherent flow structures are common within submarine channels, but these structures differ significantly from those found within fluvial channels. This paper focuses on the processes of overspill and entrainment associated with fluid flow within compound channels.

The results from a series of experiments are presented in which saline gravity currents flowed through a fixed form channel model which comprised 10 bend pairs, where the channel model was contained within an elongate flume tank. The series of experiments comprised two subsets: in the first subset the channel overspill was allowed to escape laterally, modeling the likely flow process within aggradational channel systems. The second subset modeled the processes likely within an erosive channel contained within a bounding topography; the overspill fluid was not able to escape laterally, but was forced to flow longitudinally. The results from both series of experiments reveal significant channel overspill and the presence of secondary flow cells best developed at bend apexes. The downstream velocity distribution showed significant differences between the two series of experiments. In both cases the within channel discharge was shown to decrease downstream with distance until equilibrium was reached at which point the discharge remained constant.

Previous work has demonstrated that compound bends significantly adjust or tune the flow within submarine channels. This tuning acts to equilibrate the magnitude of the flow with the geometric capacity of the channel. This study reveals in detail the process of flow adjustment to channel form and highlights the autogenic nature of this. A greater understanding of flow within compound channel bends will lead to a better understanding of bend evolution, channel migration, stability and also bed thickness distribution patterns within levees and terminal lobes. This work suggests that the distribution of overbank sediments will be highly complex and controlled by the interaction of both discharge and channel geometry.