

Submarine deposition and braiding under experimental density current

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Turbidity currents are the geomorphic agents of submarine deposition systems that rework and transfer silico-clastic material to the deep ocean. These high density currents carve giant, meandering canyons along the steep continental slopes and deposit submarine lobes when the canyon reaches the oceanic basin floors. Characterizing the dynamics of density current is therefore key for better understanding the origin and architecture of deep-sea sedimentary deposits as well as their implications for source-to-sink transfers and reservoir geometry.

We present a series of experiments conducted at the St Anthony Falls Laboratory, University of Minnesota, under both subaerial and submarine conditions in order to investigate surface and sub-surface dynamics of aggrading clastic systems. The density current was a saline solution that was introduced either through a line or point source in order to test the impact of aspect ratio on planform geometry. We used light (density 1.25) plastic sediments that were introduced with water at a constant rate during each experiment. The experimental basin was designed with two slope breaks along the test section, one upstream and one downstream, that successfully allowed for aggradation of the deposits. Under similar discharge conditions, the submarine case resulted in steeper longitudinal slopes than the subaerial case, affecting the overall depositional patterns. Surface evolution, captured using topographic scans, showed deposition patterns of alternating deep-scouring channels connected to depositional lobes, sheet-flow developed at the outlet of these channels as well as braid plains that occurred across the whole test-section. We show that lobe deposition initiated at each slope break, leading to aggradation and widening of the lobes until a threshold was reached and the feeding channel avulsed elsewhere. Using a flow routing-based technique as a mapping tool, we were able to quantify objectively the aspect ratio of bars and its variations with input conditions. Finally, we showed lengthened avulsion timescale in a bedload-dominated turbidity experiments, a behavior that is commonly assumed to result only from levees growing in submarine aggrading systems.