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New insights into turbidity current formation from submarine flowslides

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Submarine landslides and debris-flows are some of the most prominent and effective mechanisms of sediment transport from continental shelves to deep ocean basins. Recent seismic surveys of the seafloor near continental margins have revealed complex morphological features associated with mass flow deposits. In proximal zones, facies tracts tend to be characterised by poorly sorted, massive sands, interpreted as deposits of dense, inertial flows, which are replaced, in distal regions, by finer-grained laminae that have aggraded progressively beneath relatively dilute gravity currents. This stratigraphy is consistent with deposition from bipartite flows in which sediment, eroded from the leading edge of surge fronts as ambient fluid is deflected from their paths, is entrained into the overlying water column generating subsidiary turbidity currents. Although there appears to be a general consensus that many turbidites originate from the gradual transformation of sand-rich debris-flows into turbidity currents, very little research has been specifically directed at quantifying these processes in order to understand the basin-ward variation of deposit composition and architecture. Results from a series of highly instrumented flume tests are used to constrain the mechanics governing post-failure flow transformation in order to develop a quantitative framework in which to interpret process-oriented facies tracts. Flow processes are explored as functions of the original sediment composition and coherence of the dense parent phase. Through the simultaneous measurement of internal velocity and concentration gradients, both the volume fraction of sediment reworked into an overriding turbidity current and the degree to which the original dense flow is diluted through ingestion of ambient seawater are determined. This information is necessary input data for many theoretical models of seascape evolution and is, therefore, prerequisite for predicting the complex interactions and feedback mechanisms involved in current generation.