# Autogenic Controls on Sediment Delivery to Submarine Lobes Revealed by Novel Time-Lapse Seafloor Surveys of a Highly Active Channel-Lobe System

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## Abstract

Submarine channels are the primary conduit of sediment transport to deep-water, sometimes extending for thousands of kilometres. The turbidity currents that travel through these systems deposit the most voluminous sediment accumulations on our planet, and form important hydrocarbon reservoirs. These often-powerful flows pose a hazard to important seafloor infrastructure, such as pipelines and cables. The depositional termini of these channel systems (submarine lobes) have been proposed to hold valuable archives of Earth's history to reconstruct hazard frequency or palaeoenvironments. Despite their global importance, our understanding of how submarine lobes are built remains unclear. This knowledge gap is largely due to the lack of direct observations of active submarine channel-lobe systems from source to sink. Therefore, we rely upon small-scale observations and scaled-down experiments to calibrate interpretations made from ancient deposits. Here we present a unique monitoring dataset comprising: i) the first ever detailed time-lapse seafloor surveys performed over a decade along the full-length of the active Bute Inlet submarine channel-lobe system to reveal its architectural evolution, ii) direct measurements of turbidity currents made over two years at multiple locations down the system, and iii) discharge from the river feeding the system. We show that tens of flows occur yearly in the upstream domain of the channel. However, most turbidity currents do not contribute to lobe-building, and instead dissipate within the channel. In contrast to conventional models of channel erosion, bypass and deposition, we observe a complex pattern of alternating zones of erosion and deposition along the channel. These alternations are due to the upstream migration of steep-faced knickpoints, which rework channel deposits and transport sediment step-wise downstream. Sediment delivery to the lobe is much more episodical and does not necessarily require a strong external trigger. Autogenically-triggered upstream migration of the knickpoint immediately upslope of the lobe coincides with periods of rapid aggradation on the lobe. We suggest that submarine lobes partly preserve a record of autogenic perturbations, rather than the upstream flow events and their external triggers. This has important implications for how to interpret lobe deposits and their use in reconstructing Earth's history and geohazard assessments.

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