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Timing and controls on the delivery of coarse sediment to deltas and submarine fans on a formerly glaciated coast and shelf

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The evolution of deltas and submarine fans is often envisioned as largely controlled by relative sea-level (RSL) variations. However, in some cases, RSL can have less effect on delta and submarine fan activity than sediment supply and shelf geomorphology. In order to document the relative importance of these three factors on deltaic and submarine fan evolution in a former glaciated environment, this presentation documents the delivery of coarse sediment to the Laurentian Channel (eastern Canada). The well-constrained stratigraphic and geomorphological framework of both the glacio-isostatically uplifted deltas and the modern Laurentian Channel fans allow us to document and contrast the evolution of river-fed deltas, river-fed canyon/fan systems and longshore drift-fed fans during deglacial and postglacial times. The evolution of these different types of fans can be divided into three phases. The first phase is characterized by delta progradation on the shelf while RSL was at its maximum, although already falling, and the ice-margin gradually retreated inland. The second phase is characterized by the delivery of deltaic sediment in the deep realm of the Laurentian Channel, permitted by the supply of large amounts of glaciogenic sediments derived from the retreating ice margin and the lowering of the RSL. At the same time, sediment instability along the steep Laurentian Channel formed small incisions that evolved into submarine canyons where the narrow shelf allowed the trapping of longshore sediment. The third phase is characterized by the withdrawal of the ice-margin from the watershed of the main rivers and the drastic decrease in sediment supply to the deltas. Consequently, the delta fronts experienced strong coastal erosion, even though RSL was still lowering in some cases, and the eroded sediments were transferred onto the shelf and to adjacent bays. This transfer of coastal sediments allowed the continued activity of longshore drift-fed canyons. The retreat of the ice margin from the watersheds thus controlled the supply of sediment and induced a change in delta type, passing from river-dominated to wave-dominated. This presentation highlights the role of the type of sediment supply (ice-contact, glaciofluvial and longshore drift) in the timing and activity of submarine fans in high-latitude environments. It proposes a conceptual model for high-latitude shelves where sediment delivery to submarine fans is mostly controlled by structural inheritance (watershed area and shelf geomorphology) rather than RSL fluctuations. Therefore, although RSL fell during delta progradation, this study demonstrates that it was not the main contributor to delta and submarine fan growth. This has wider implications for the extraction of sea-level information from stratigraphic successions.