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Stratigraphic architecture and morphostructures of a recent glacio-isostatically forced-regressive delta: implications in terms of proglacial fluvial dynamics, North Shore of the St-Lawrence Estuary, Québec, Canada

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Proglacial deltaic systems provide information about ice margins evolution, related glacio-isostatic rebound and proglacial fluvial dynamic during ice-sheet retreat. Here, we document a case study based on the North Shore of the St-Lawrence Estuary, Québec, Canada, recording the recession of the Laurentide Ice Sheet after the Last Glacial Maximum (Upper Wisconsinian-Holocene). The entire deltaic succession is exposed throughout coastal cliffs and river-cut terraces. Field investigations involve sedimentary logs, 14C dating and the characterization of morphosedimentary structures in the hinterlands.

The delta initiates around 11 kyr Cal BP during an ice-front stabilization. Marine invasion on isostatically flexured lowlands led to the development of the Goldthwait Sea that reached a marine limit at the present-day 140 m elevation. At this time, ice contact and glaciomarine sediments were emplaced at the mouth of the major structural valleys. The subsequent glacial retreat farther inland turned the structural valleys into fjords into which deltas develop. The rapid fulfilling of these depocenters by glaciogenic sediments led to the emergence and coalescence of the deltas on the open sea. Lower delta front deposits are made up of mud while sand-sized, turbiditic deposits including facies related to supercritical flows (chutes, cyclic steps) prevail in the upper reaches. The delta plain is composed of gravelly facies deposited by braided streams. The progradation of the proglacial deltaic complex was about 10 km (thickness > 100 m) in only 1000 years in the open coast setting while the sea-level fall due to the glacio-isostatic rebound was up to 10 cm/yrs. This system remains active until the melting of the ice margins out of the catchment area at 10 kyr Cal BP. Sedimentary suites associated with the later paraglacial evolution comprise nearshore sand wedge (spit platform) and foreshore complexes.

Throughout the entire proglacial deltaic development, no major fluvial incision occurred in spite of significant rates of sea-level fall (50m/1000 yrs). This owes to a fluvial equilibrium profile steeper than the descending regressive shoreline trajectory mainly due to an important glaciogenic sediment supply. Alternatively, fluvial entrenchment actively arose as soon as the ice margins retreated out of the catchment area in a context enduring lesser rates of sea-level fall. Fluvial entrenchment processes are explored, including buffer/buttress incision processes and the key role of bedrock thresholds, rate of sea level-fall and the drawdown of the glaciogenic/paraglacial sediment supply.