



Proglacial deltaic landforms and stratigraphic architecture as a proxy for reconstructing past ice-sheet margin positions

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Deltaic landforms and related stratigraphic architectures are frequently used as proxy for reconstruction of past continental or marine environmental evolutions. Indeed, in addition to autocyclic processes, emplacement of deltaic systems is primarily controlled by changes in sediment supply and relative sea-level (RSL). In our study, we investigated several proglacial deltaic complexes emplaced since the last deglaciation over more than 700 km along the St. Lawrence North Shore (Québec, Canada). Their geomorphic and stratigraphic records allowed us to infer the retreat pattern of the Laurentide Ice Sheet fronts.

Field investigation of representative deltaic complexes revealed an archetypal morphostratigraphic evolution forced by the retreat of the ice margin in a context of falling RSL (glacio-isostatic rebound). The base of the stratigraphic successions consists of outwash fan deposits emplaced in the early deglaciation when ice margin stillstanded immediately beyond the depositional area. The middle part of the succession consists of proglacial delta deposits corresponding to the retreat of the ice margin in the hinterland. At that time, glaciogenic supplies allowed an active progradation preventing fluvial entrenchment in spite of the forced regressive context. The upper part of the succession consists of staged shoreline deposits reworking the rim of the proglacial deltas. These deposits mark the retreat of the ice margin from the drainage basin and the subsequent drop in glaciogenics. Important fluvial entrenchment occurred in the same time, though rates of RSL fall were reduced.

We generalize this stratigraphic framework by using solely the landforms (from DEM, aerial photographs or satellite images) tied to deltaic complex developments along the St. Lawrence North Shore. This approach permits an integrated study at the scale of the whole basin even where no field data is available. Recognizing the three steps evidenced from the stratigraphic record adds constraints on the successive ice margin positions through deglaciation. Top surface of the outwash fans, marking the deglaciation of the area, lies at or near the marine limit (highest altitude reached by the post-glacial sea) and is commonly flat; the top surface of the proglacial deltas, recording the upland recession of the ice margin, is gently-sloped basinward, without evidence of fluvial entrenchment; finally, the top surface of coastal deposits, marking the retreat of the ice margin from the drainage basin, is characterized by raised beaches incised by meandering rivers. Determining ages of these successive landforms (14C dating, sea-level curves) allowed us to reconstruct the pattern of ice-sheet retreat since the Younger Dryas up to almost the final disappearance of the Quebec Ice Dome at ~6 kyr BP.