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Late Wisconsinan paleoglaciology of the western Gulf of St. Lawrence and adjoining areas

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The Estuary and Gulf of St. Lawrence form a large-scale embayment along the Atlantic coast of Canada that reaches depths of >500 m in the Laurentian Channel. The bathymetry and bordering topography of this embayment strongly controlled the dynamics and patterns of ice flow and ice retreat during the last glaciation, by hosting major ice streams and forming series of submarine and terrestrial ice-marginal depositional landforms. High-resolution swath bathymetry and subbottom profiler data, together with coastal LiDAR data, low altitude aerial photographs, sediment cores and cross-section data collected in and around the Gulf of St. Lawrence have recently allowed to improve our understanding of the paleoglaciology of this inner continental shelf. Swath bathymetry data allowed us to image for the first time on the seafloor a set of mega-scale glacial lineations (MSGLs) associated with the St. Lawrence Ice Stream, whereas terrestrial LiDAR topographic data allow the observation of a late phase of this ice stream as the ice margin reached the Québec City area. These observations indicate the time-transgressive nature of the ice stream and that these phases extended far inland within evolving ice catchments. Grounding-zone wedges, morainal banks and ice-contact fans extending laterally along the shelf and coastal zone of the western Gulf of St. Lawrence record a phase of episodic retreat of the marine-based Laurentide Ice Sheet margin that occurred after 14.8 cal ka BP, following its rapid retreat in the deeper waters of the Laurentian Channel. The occurrence of the grounding-zone deposits along distinct isobaths indicates that bathymetry exerted a strong control on ice stabilization during deglaciation by reducing the relative water depth at the ice margin and thereby the buoyancy and rate of iceberg calving. However, fluctuations and re-advances of the ice margin are also recorded by the overprinting of grounding-zone wedges, potentially suggesting an additional response to climate-driven forcing. As the ice margin stabilized along the modern coastline areas, a strong bedrock slope gradient promoted rapid ice flow that carved a large system of perpendicular-to-coast mega-grooves observed today over a distance of >500 km. As the ice margin became terrestrial, former submarine fans aggraded to form sandur-deltas as sediment were being rapidly delivered and relative sea-level was rapidly falling due to initial glacio-isostatic rebound.