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Revising the Limit of the NW Laurentide Ice Sheet: extensive glaciation in NE Beringia

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For the past half-century, reconstructions of North American ice cover during the Last Glacial Maximum have shown ice-free land distal to the Laurentide Ice Sheet, primarily on Melville and Banks islands in the western Canadian Arctic Archipelago. Both islands reputedly preserve at the surface multiple Laurentide till sheets, together with associated marine and lacustrine deposits, recording as many as three pre-Late Wisconsinan glaciations. The northwest corner of Banks Island was purportedly never glaciated and is trimmed by the oldest and most extensive glaciation (Banks Glaciation) considered to be of Matuyama age (>780 ka BP). The view that the western Canadian Arctic Archipelago remained largely ice-free during the Late Wisconsinan, serving as the NE extremity of Beringia, is reinforced by a recent report of two woolly mammoth fragments collected on Banks and Melville islands, both dated to ∼22 ka BP. Well developed periglacial features present, in particular on Banks Island, have also been considered to record a long interval of ice-free conditions throughout the LGM.

As a result of eight years of widespread fieldwork as part of the Canadian NSERC Northern Research Chair Programme (held by John England, University of Alberta) across the adjacent coastlines of Banks and Melville islands, a fundamental revision of this model is proposed including new dating of glacial and marine landforms and sediments. On Dundas Peninsula, southern Melville Island, AMS radiocarbon dates on ice-transported marine molluscs within the most extensive Laurentide till yield ages of 25-49 ka BP, spanning Marine Isotope Stage 3. Laurentide ice that crossed Dundas Peninsula (300 m asl) coalesced with Melville Island ice occupying Liddon Gulf and continued to advance westward through M'Clure Strait depositing granite erratics at ≥235 m asl that require grounded ice in M'Clure Strait, as do streamlined bedforms on the channel floor. Forty dates on shells collected from associated deglacial sediments associated with marine limit record near-synchronous ice retreat from M'Clure Strait and Dundas Peninsula to north-central Victoria Island ∼11.5 ka BP. Along the adjacent coast of Banks Island, deglacial shorelines also record the retreat of Laurentide ice both eastward through M'Clure Strait and southward into the island's interior. The elevation and age (∼11.5 ka BP) of deglacial marine limit at both localities are fully compatible with the record of ice retreat on Melville Island. The last retreat of ice from Mercy Bay (northern Banks Island), previously assigned to northward retreat into M'Clure Strait during the Early Wisconsinan, is contradicted by geomorphic evidence for southward retreat into the island's interior during the Late Wisconsinan.

This revision of the pattern and age of ice retreat across northern Banks Island results in a significant simplification of the previous Quaternary model. Our observations support the amalgamation of multiple till sheets - previously assigned to at least three pre-Late Wisconsinan glaciations – into the Late Wisconsinan. This revision also removes their formally named marine transgressions and proglacial lakes for which evidence is lacking. An extensive Late Wisconsinan Laurentide Ice Sheet across the western Canadian Arctic is compatible with similar evidence for extensive Laurentide ice entering the Richardson Mountains (Yukon) farther south and with the Innuitian Ice Sheet to the north. Widespread Late Wisconsinan ice, in a region previously thought to be too arid to sustain it, has important implications for modelling of the NW Laurentide Ice Sheet, clarifying the northeast limit of Beringia, understanding the rate of development of periglacial landforms in a landscape rich in buried ice, and identifying the source of ice and sediment delivery to the Arctic Ocean where evidence for former enigmatic ice sheets have been widely reported.