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Ice sheet extent and deglacial history of the central western sector of the Greenland Ice sheet during the Last Glacial Maximum

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The offshore and coastal geomorphology of central west Greenland record evidence for the advance and decay of the Greenland ice sheet during the Last Glacial Maximum (LGM). Regional ice flow patterns to the south of Sisimiut show an enlarged ice sheet that extended southwestwards on to the shelf along topographically constrained basal flow pathways, probably forming an 'isbrae' flowing into Holsteinsborg Dyb. This is further supported by striae and roche moutonnée long axes orientations along the coast at Itvidleq which show a southwesterly flowing ice stream that deflected east to west flowing locally sourced valley glaciers. Neighbouring periglacial terrain composed of blockfield and tors is dated to between 111 – 161 ka using Al 26 and Be 10 cosmogenic exposure ages. These limit the maximum surface elevation of the LGM ice sheet to c. 750 – 810 m asl, and demonstrate that terrain above this level has been ice free since MIS 6. Ice thickness of this magnitude means that the ice sheet likely reached the outer shelf edge and implies that the Outer Hellefiske moraines in this area are of LGM age.

Exposure dates record down wasting of ice from 21.3 to 9.9 ka in the Itvidleq/Nagtoralinguaq area. In Nagtoralinguaq, rates of surface downwasting vary from 0.06 to 0.11m yr and were accelerated by the buoyant lift off of the Nagtoralinguaq valley glacier between 16.5 and 9.9 ka, when active marginal calving lead to the formation of a De Geer moraine train on the Nagtoralinguaq valley floor. The regional orientation of this moraine train suggests that the Itvidleq ice stream persisted on the coast and controlled the position of the Nagtoalinguaq glacier calving front between 16.5 and 9.9 ka. This is supported by cosmogenic ages that show the Itvidleq ice stream lingered over the outer coast until c. 10 ka, due to greater ice thickness and larger ice flux from the main ice sheet. The early downwasting of the Nagortoralinguaq and Itvidleq glaciers coincides with increased air temperatures over Greenland running up to the Bolling (GIS1e) temperature maximum at c. 14 ka and was predominantly driven by surface ablation, although the early deglaciation of local valley glaciers was also influenced by buoyant lift off and marine calving under high sea levels. As the Itvidleq ice stream remained along the coast until c. 10 ka, it operated on the inner shelf throughout the Younger Dryas.

This pattern of delayed ice stream retreat is directly comparable to evidence from the Jakobshavns ice stream in Disko Bugt, located to the north of the study area, which too only retreated from the outer coast after c. 11 ka BP. Evidence from these two areas suggest rapid ice stream collapse post the onset of the early Holocene, in contrast to previous models of deglaciaion, that favour initial retreat of the marine-based ice sheet from the continental shelf between c. 16 – 11 ka BP.