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Glacial landforms of the southern Ungava Bay region (Canada): implications for the late-glacial dynamics and the damming of glacial Lake Naskaupi

Hugo Dube-Loubert (1,2) and Martin Roy (1)

(1) UQAM University, Geotop, Earth and Atmospheric Sciences, Canada (hugo.dube-loubert@mrn.gouv.qc.ca), (2) Quebec Geological Survey, Val-d'Or, Canada (hugo.dube-loubert@mrn.gouv.qc.ca)

The Laurentide ice sheet played an important role in the late Pleistocene climate, notably through discharges of icebergs and meltwater. In this context, the Ungava Bay region in northern Quebec–Labrador appears particularly important, especially during the last deglaciation when the retreating ice margin dammed major river valleys, creating large proglacial lakes (e.g., McLean, aux Feuilles). The history of these lakes is closely related to the temporal evolution of the Labrador-Quebec ice dome. There are, however, large uncertainties regarding the position of its ice divide system through time, thereby limiting our understanding of the history of these glacial lakes. Here we focus on glacial and deglacial landforms present in the George River valley, south of Ungava Bay, in order to bring additional constraints on the late-glacial ice dynamics of this region, which also comprised glacial Lake Naskaupi. This work is based on surficial mapping using aerial photos and satellite imagery, combined with extensive fieldwork and sediment sampling. Our investigation showed significant differences in the distribution of glacial landforms across the region. The area east of the George River is characterized by well-developed Naskaupi shorelines while the elevated terrains show a succession of geomorphological features indicative of cold-based ice or ice with low basal velocities. In the easternmost part of this sector, ice flow directional data indicate that the ice was flowing towards ENE, against the regional slope. Eskers show paleocurrent directions indicating a general ice retreat from east to west. In the western part of this sector, near the George River valley, eskers are absent and the region is covered by felsenmeer and ground moraine that likely reflect the presence of a residual ice mass that was no longer dynamic. The presence of a stagnant ice represents the best mechanism to explain the formation of glacial lakes in the George River valley and its main tributaries. In contrast, the area west of the George River valley shows very few shorelines, implying that Lake Naskaupi was mostly in contact with the decaying ice margin. The abundance ice-marginal meltwater channels allowed the reconstruction of the general ice retreat pattern. The area is also characterized by abundant WNW-trending drumlins and crag-and-tails indicating an important ice flow towards Ungava Bay. These glacial lineations may be linked with eskers further to west that terminated into the postglacial Iberville Sea, forming large ice-contact deltas. This setting suggests that this landform assemblage likely developed during the deglaciation. Our results thus underlie important differences in the subglacial regime across the ice divide of the Labrador sector during the late-glacial and early deglacial interval. The so-called horseshoe unconformity appear to delineate an inner area characterized by warm-based conditions that allowed a massive deglacial ice flow to developed in Ungava Bay, while the area under and proximal to the divide in the east appears to have evolved towards cold-based ice conditions, resulting with a stagnant ice mass that dammed the major proglacial lakes.