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Surface exposure dating of glacial lake shorelines: implications for constraining ice margin positions and meltwater outbursts during the last deglaciation

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The Laurentide ice sheet (LIS) played an important role in the climate variability of the last deglaciation, notably through large discharges of meltwater to the North Atlantic that disturbed the ocean's circulation and heat transport. Deglaciation of the northeastern sector of the LIS was complex and included the development of large ice-dammed lakes that were confined within the main river valleys draining northward into Ungava Bay. The history of these lakes is closely related to the temporal evolution of the Labrador ice dome, but large uncertainties regarding the position and dynamic of the ice margin through time currently limit our understanding of these glacial lakes. In the Ungava lowlands, glacial lake Naskaupi invaded the George River valley, leaving a series of well-developed shorelines and deltas. These spectacular raised shorelines are 10 to 20 meters wide and can be followed for several kilometers. Our field investigations and remote sensing analysis indicate that Lake Naskaupi experienced a complex history, as shown by the succession of shorelines that likely reflect the opening of new topographic outlets during ice retreat. Constraining the timing of the different phases of the lake and its drainage has traditionally been challenging, as organic material suitable for radiocarbon dating is scarce or lacking. Recent progress in Surface Exposure Dating (SED) by cosmogenic nuclides now inspires novel approaches to glacial and deglacial geomorphology. Here we apply 10Be SED to boulders that form part of these shorelines and mark the main (high-level) stage of Lake Naskaupi. We sampled 4-6 multi-meter size boulders at 4 different sites. Preliminary results show high internal consistency and, indicate that the main lake phase developed very late in the regional deglaciation, which extends from about 8500 to 6800 cal. yr BP (Dyke and Prest, 1987). We also present SED results from boulders deposited by a substantial outburst flood presumably associated with the sudden and abrupt drainage of Lake Naskaupi. The mapped and sampled flood deposit consists of a thick accumulation layer (25 m) of imbricated meter-size boulders and mega-size ripples that extend over 3 km. Upcoming results will help placing this meltwater discharge into the North Atlantic deglacial framework and thereby contribute to evaluate the sensitivity of the thermohaline circulation to freshwater forcing events of this scale. This pilot study yields motivating evidence that the application of SED to glacial lake shorelines and outburst flood deposits represents a promising approach to constrain the evolution of former glacial lakes and thereby refine paleogeographic reconstructions.