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Improving the timing of middle Holocene retreat and late Holocene advance of Jakobshavn Isbrae, Greenland

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The Greenland Ice Sheet is undergoing dramatic change. How the ice sheet continues to respond to climate change has important ramifications for global climate and sea level rise, but the observation-based record of ice sheet change is extremely short. We use glacial-geologic techniques to determine the behavior of the Greenland Ice Sheet over longer timescales. In particular, we focus on the Holocene history of Jakobshavn Isbrae, one of the key ice streams on Greenland that is responsible for disproportionate mass loss of the Greenland Ice Sheet. Radiocarbon ages from basal lake sediments and ^{10}Be exposure ages of bedrock spanning from the present ice margin to Disko Bugt, ~50 km west, reveal rapid deglaciation between ~8 and ~7 ka. After ~7 ka, the ice margin continued to retreat inland behind its present position. Although it is difficult to reconstruct how far inland the ice margin retreated, the Little Ice Age advance reworked marine bivalves that date from 2.2 to 6.1 ka (Weidick and Bennike, 2007). The bivalve ages indicate that the ice margin was behind its Little Ice Age position between ~6 and ~2 ka, and that its Neoglacial advance post-dates ~2 ka. We improve the timing of the Neoglacial advance of Jakobshavn Isbrae by collecting sediment cores from lakes that are beyond the Little Ice Age margin but close enough to receive ice sheet meltwater during the Little Ice Age advance. The sediments in these "threshold" lakes contain distinct units of varved sediments (representing a proglacial environment) that sharply overlie gyttja (representing a non-glacial environment). Four radiocarbon ages of the sedimentary contacts from three different lake sites range from 530±10 to 370±60 cal yr BP (1410-1640 AD), and reveal when Jakobshavn Isbrae neared its maximum Little Ice Age margin. Furthermore, the lake sediments reveal that between early Holocene deglaciation and the Little Ice Age, Jakobshavn Isbrae never spilled into these lake basins, indicating that the Little Ice Age was the most extensive position of this sector of the Greenland Ice Sheet since deglaciation. Future work will be focused on generating climate reconstructions from lake sediments and microfossils (chironomids), and subsequently drawing links between past climate change and corresponding glacier response.