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Improved reconstruction of the southeastern Laurentide Ice Sheet deglaciation: constraining ice thinning using in-situ cosmogenic 10Be and 14C and critically evaluating different retreat rate chronometers

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In the northeastern United States, there are extensive geochronologic and geomorphic constraints on the deglaciation of the southeastern Laurentide Ice Sheet; thus, it is an ideal area for large-scale ice volume reconstructions and comparison between different ice retreat chronometers. Varve chronologies, lake and bog-bottom radiocarbon ages, and cosmogenic nuclide exposure ages constrain the timing of ice retreat, but the inferred ages exhibit considerable noise and sometimes disagree. Additionally, there are few empirical constraints on ice thinning, forcing ice volume reconstructions to rely on geophysically-based ice thickness models. Here, we aim to improve the understanding of the southeastern Laurentide Ice Sheet recession by (1) adding extensive ice thickness constraints and (2) compiling all available deglacial chronology data in the region to investigate discrepancies between different chronometers.

To provide insight about ice sheet thinning history, we collected 120 samples for in-situ ^{10}Be and 10 samples for in-situ ^{14}C cosmogenic exposure dating from various elevations at 13 mountains in the northeastern United States. By calculating ages of exposure at different elevations across this region, we reconstruct paleo-ice surface lowering of the southeastern Laurentide Ice Sheet during deglaciation. Where we suspect that ^{10}Be remains from pre-Last Glacial Maximum periods of exposure, in-situ ^{14}C is used to infer the erosional history and minimum exposure age of samples.

Presently, we have measured ^{10}Be in 73 samples. Mountain-top exposure ages located within 150 km of the southeastern Laurentide Ice Sheet terminal moraine indicate that near-margin thinning began early in the deglacial period (~19.5 to 17.5 ka), coincident with the slow initial margin retreat indicated by varve records. Exposure ages from several mountains further inland (>400 km north of terminal moraine) collected over ~1000 m of elevation range record rapid ice thinning between 14.5 and 13 ka. Ages within each of these vertical transects are similar within 1σ internal

uncertainty, indicating that ice thinned quickly, less than a few hundred years at most. This rapid thinning occurred at about the same time that varve records indicate accelerated ice margin retreat (14.6–12.9 ka), providing evidence of substantial ice volume loss during the Bølling-Allerød warm period.

Our critical evaluation of deglacial chronometers, including valley-bottom ^{10}Be ages from this project, is intended to constrain ice margin retreat rates and timing in the region. Ultimately, we will integrate our ice thickness over time constraints with the existing network of deglacial ages to create a probabilistic reconstructions of the southeastern Laurentide Ice Sheet volume during its recession through the northeastern United States.