Rapid early- to mid-Holocene thinning of Pine Island Glacier detected using cosmogenic exposure dating

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Recent years have seen dramatic rates of thinning of major ice streams flowing into the Amundsen Sea, and in particular Pine Island Glacier. Onshore measurements of these changes are restricted to decadal timescales and in particular the satellite era, which makes it difficult to judge their significance and whether such changes are unprecedented. One way to place these events in a longer-term context is to study the geological record of past ice sheet change.

We report new cosmogenic exposure ages on erratic cobbles from nunataks in the Hudson Mountains, which are situated immediately north of Pine Island Glacier, and close to its present-day grounding line. We found erratics at all altitudes, from just at the modern ice surface, up to ~600 m above the ice. Here we use these as a vertical ódipstickô for tracing past fluctuations in thickness of the WAIS.

A lateral moraine was observed at 500 m above present ice. ^{10}Be exposure ages from samples collected below this show that the ice sheet thinned progressively in the early- to mid-Holocene, reaching close to present elevation by ~6 ka. Exposure ages from the lowermost 100 m of two nunataks (Mt Moses and Maish Nunatak) suggest that rapid thinning was sustained there over a few hundred years. We also report exposure ages from within 40 m of the modern ice surface at Meyers Nunatak.

In summary, we have detected a rapid thinning event of Pine Island Glacier in the early to mid-Holocene, which appears to have brought the ice sheet surface close to present elevation by ~6 ka, and is recorded by erratic cobbles from several nunataks in the Hudson Mountains.