

Vegetation response to climate warming across multiple interglacials inferred from High Arctic lake sediment

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Crump, Sarah E.¹, Fréchette, Bianca², Miller, Gifford H.¹, Power, Matthew³, de Wet, Gregory¹, Thomas, Elizabeth K.⁴, Sepúlveda, Julio¹, Briner, Jason P.⁴, Raberg, Jonathan H.¹, Bunce, Michael^{3,5}

¹INSTAAR, University of Colorado Boulder; ²Géotop, Université du Québec à Montréal, ³Trace and Environmental DNA Lab, Curtin University; ⁴Department of Geology, University at Buffalo; ⁵New Zealand Environmental Protection Authority



The past and future (?) of Arctic tundra

Rapid summer warming in the Arctic is expected to drive an expansion of woody shrubs at high latitudes, with implications for both local ecosystems and for the broader climate system through multiple positive feedback mechanisms. Paleorecords of warmer-than-present intervals, including the Holocene Thermal Maximum (HTM) and the Last Interglacial (LIG; Marine Isotope Stage 5e), serve as useful partial analogues for tracking Arctic ecosystem responses to warming. Because of high summer insolation in the northern hemisphere, **the LIG was ~5 °C warmer than modern in the Canadian Arctic, making it a particularly useful period to investigate what the Arctic landscape may look like in a warmer world.** Here, we present vegetation reconstructions from Lake CF8 on northeastern Baffin Island, Arctic Canada.

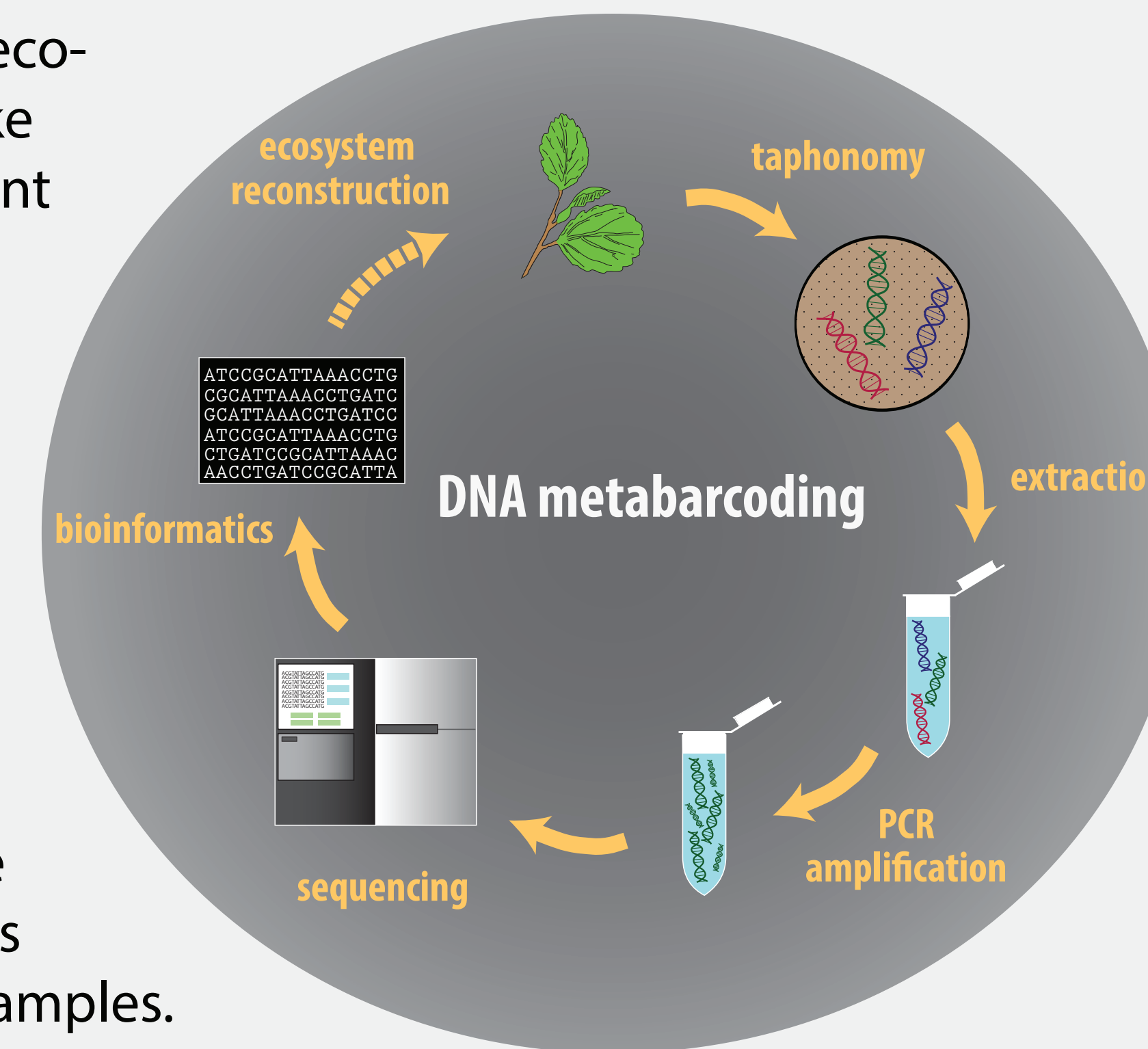


Approach: pollen and sedimentary aDNA

We took use two complementary paleoecological proxies for past vegetation at Lake CF8: fossil pollen and sedimentary ancient DNA (sedaDNA) metabarcoding.

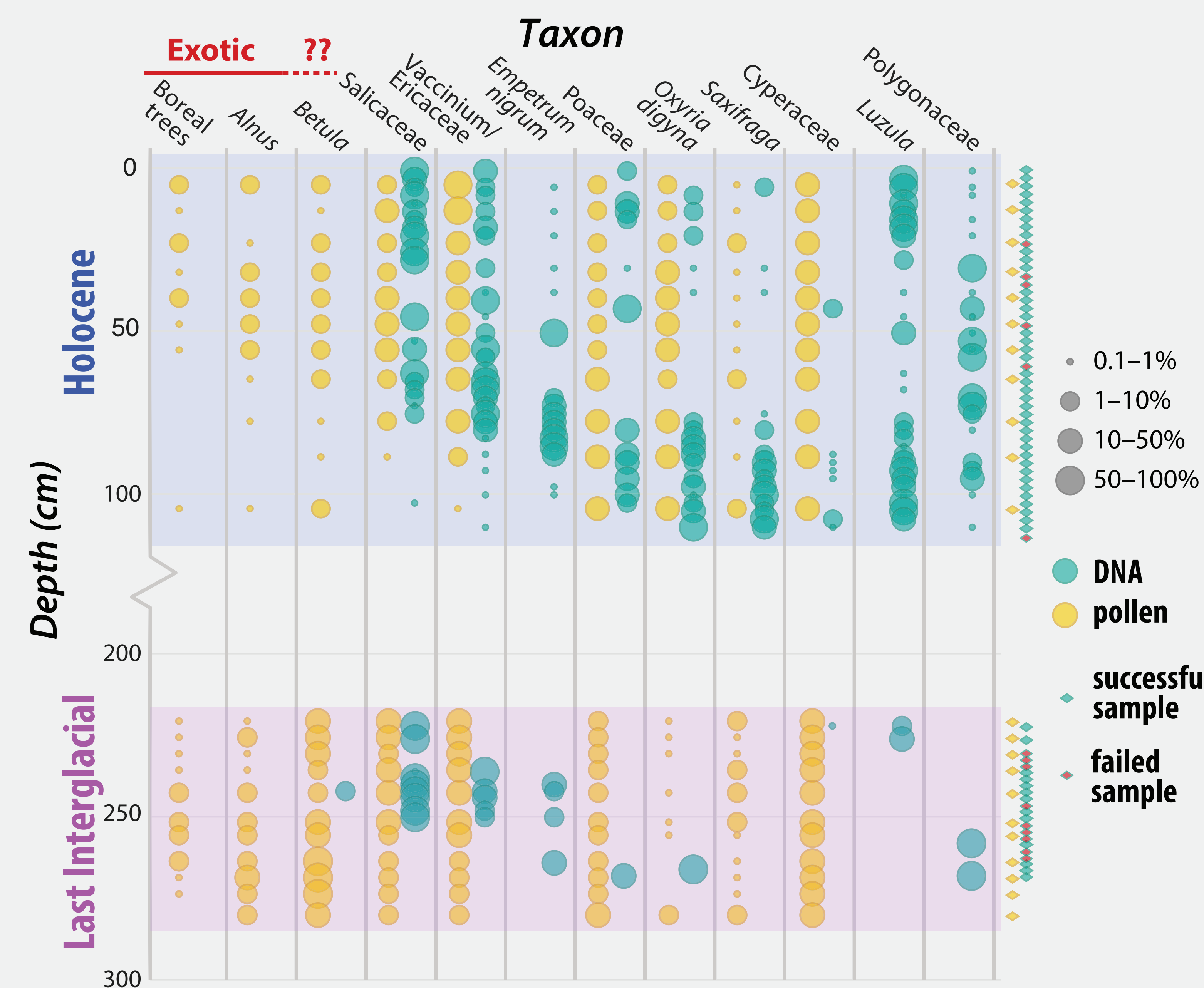
Pollen is well preserved in Quaternary sediment records and provides evidence of key tundra plants. However, long-distance wind transport of pollen means the plant signal is regional.

SedaDNA has a more local source area and is thus a sensitive indicator of local presence. However, DNA degrades more rapidly in the environment and is near its preservational limit in late Pleistocene samples.

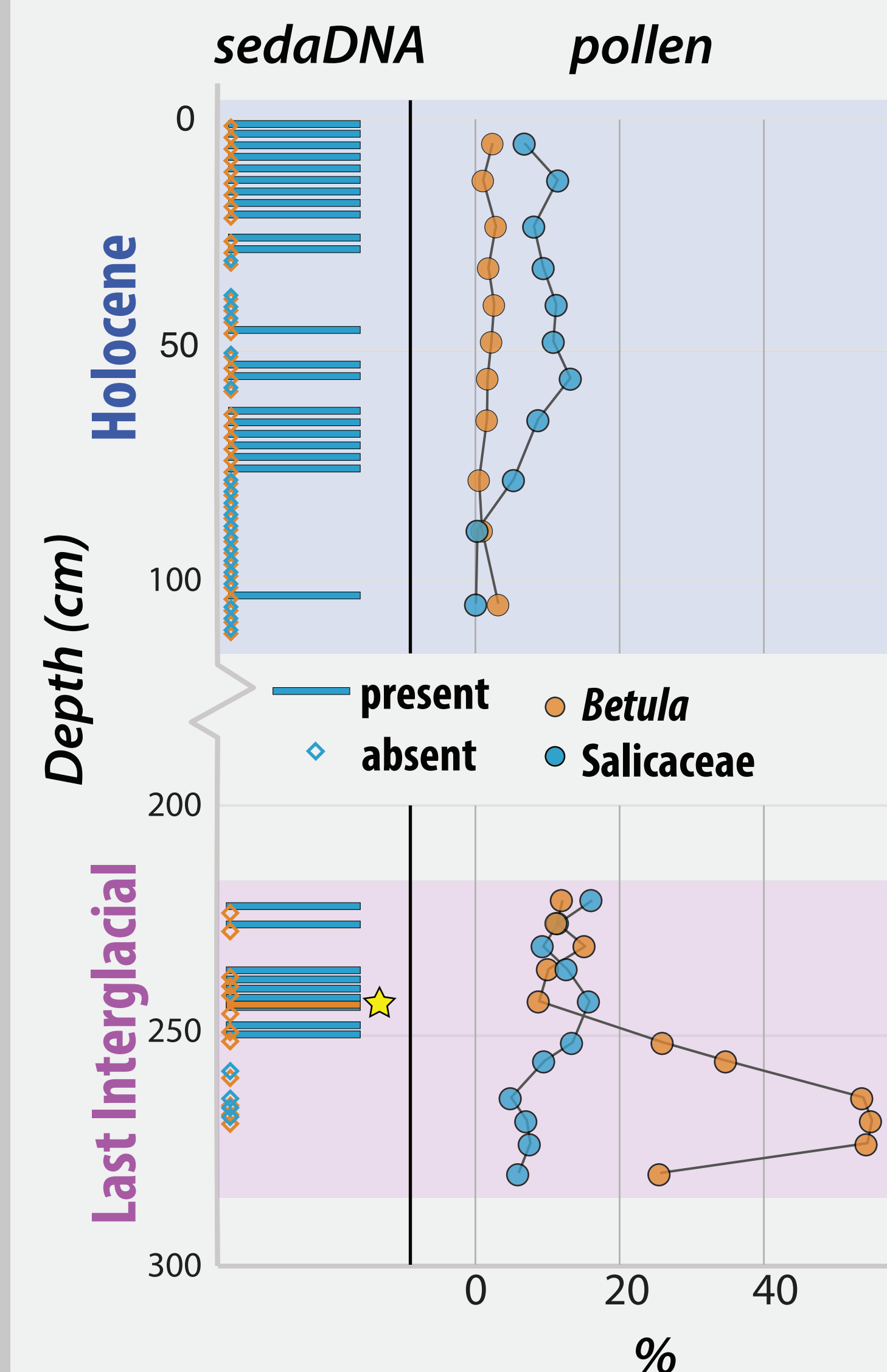


Vegetation change over two interglacials

Pollen and sedaDNA reveal some similar patterns in Holocene vegetation dynamics, including a delayed dominance of willow (Salicaceae). Exotic sources of pollen from boreal trees, alder (*Alnus*), and birch (*Betula*) are confirmed by the absence of DNA from these taxa in the Holocene. Pollen suggests a markedly warmer plant community during the LIG. We recovered amplifiable DNA from some levels in the LIG, although preservation is reduced.



Was birch present during the LIG?

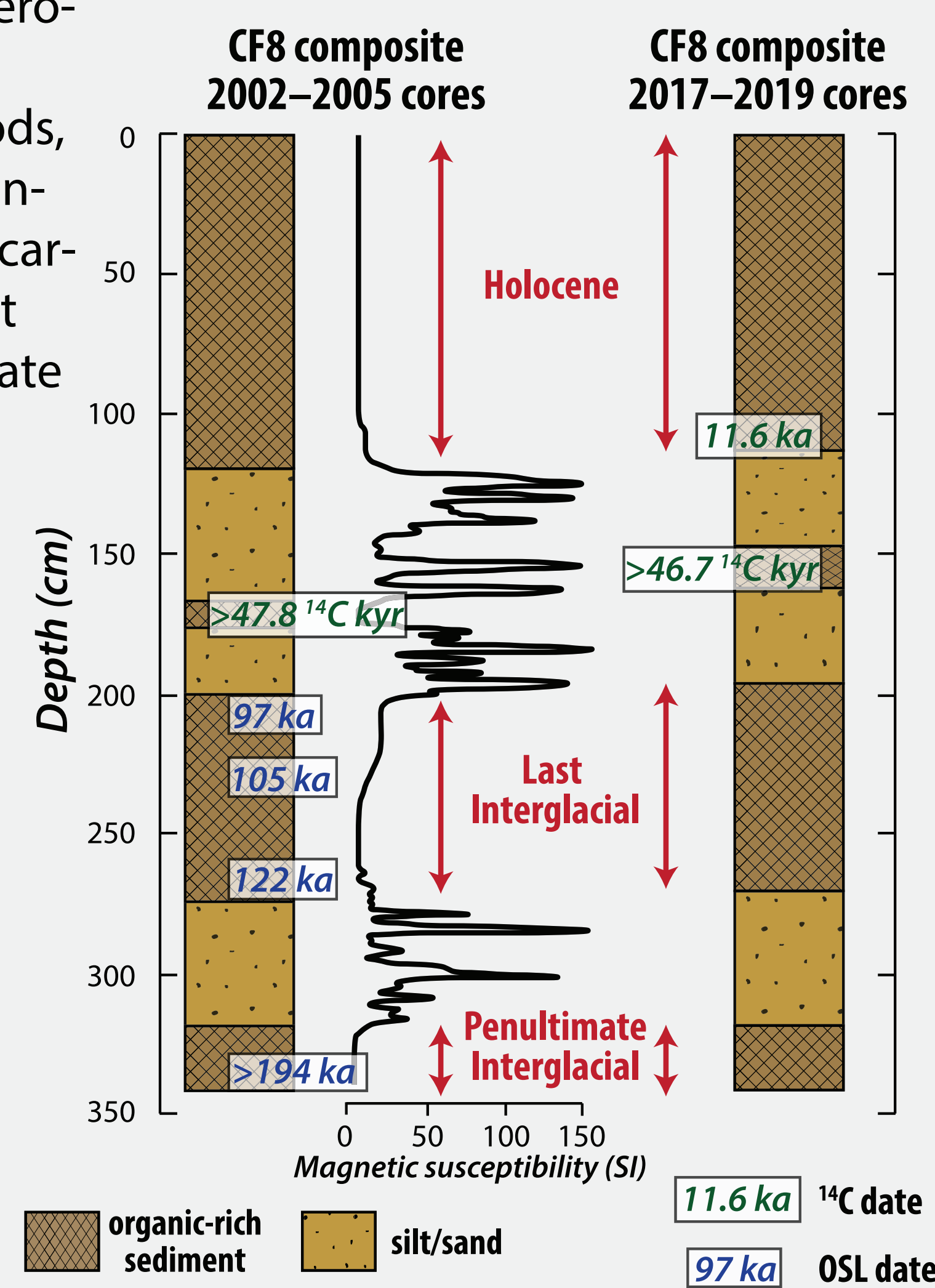


Low levels of birch pollen (<3%) during the Holocene is consistent with long-distance wind transport. This is supported by the **absence of birch DNA in all Holocene samples.**

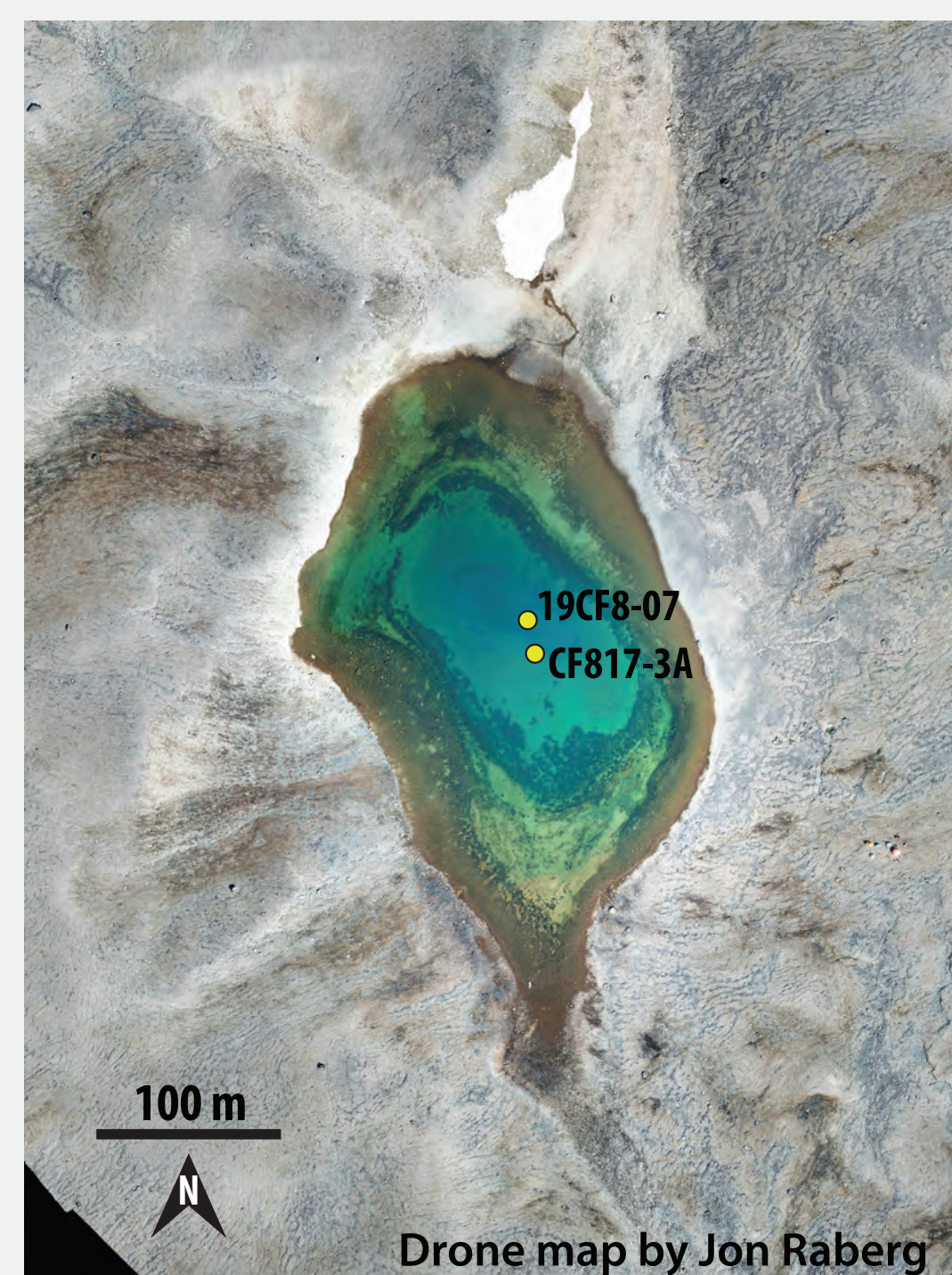
During the LIG, much higher levels of birch pollen (9–55%) suggest it was growing at or closer to the lake. Preliminarily, one LIG sample (yellow star) contains birch DNA, **hinting that birch was indeed present** in the catchment; however, this result needs to be replicated in order to validate this interpretation.

Multiple interglacials represented at a single site

Lake CF8 was covered by a non-erosive sector of the Laurentide Ice Sheet during recent glacial periods, leaving multiple generations of interglacial sediment intact. Radiocarbon and OSL dating indicate that the LIG and part of the Penultimate Interglacial are represented.



Briner et al., 2007; Axford et al., 2009, 2011; Wilson et al., 2012



Takeaways & next steps

- Pollen and sedaDNA are complementary paleovegetation proxies.
- Preliminary results suggest that birch was present at CF8 during the LIG, 400 km north of its current range limit.
- In situ* temperature measurements from Baffin Island sites indicate that the minimum July T for *Betula* growth is ~3°C warmer than present at CF8.
- Next: validate sedaDNA results with shotgun sequencing & additional metabarcoding.

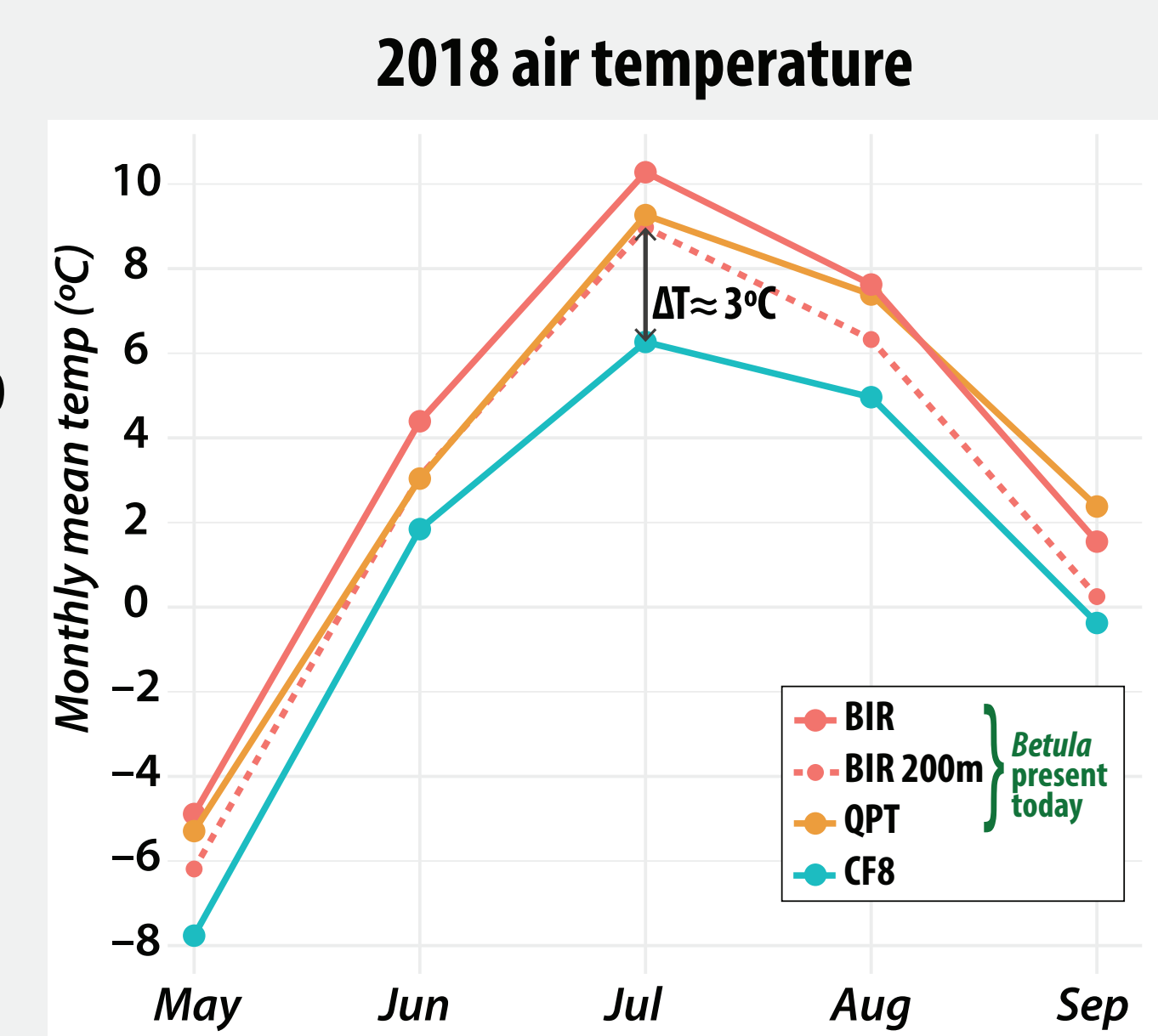


Photo: Zach Montes/Orijin Media

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