Assessing Change in Summer Arctic Moisture Source and Aridity over the Past 7,000 Years Using Leaf Wax δ^2H in Baffin Island Lake Sediment

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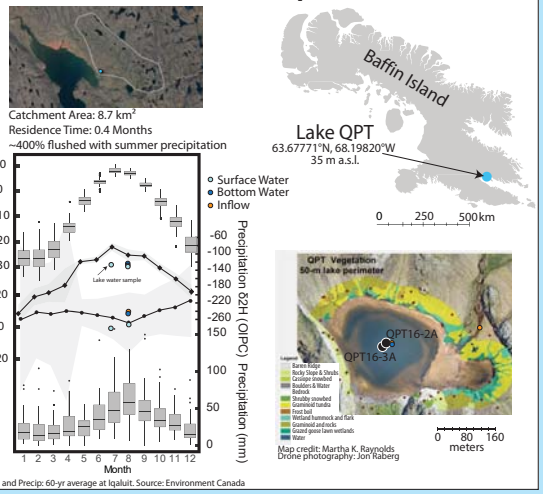
Background and Research Questions

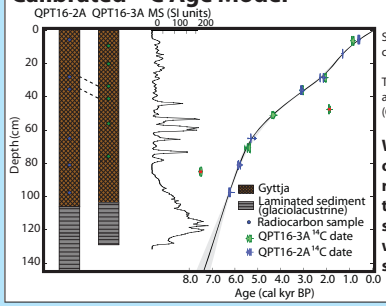
In lakes with short residence times, terrestrial plant wax δ^2H reflects summer precipitation plus evaporation; aquatic plant wax δ^2H reflects summer precipitation.

How does summer aridity in southern Baffin Island change over the past 6 ka?
Do changes in plant community impact the plant wax chain length distribution or δ^2H values?

Modern Climate at Lake Qaupat (QPT)



Calibrated ^{14}C Age Model[1]



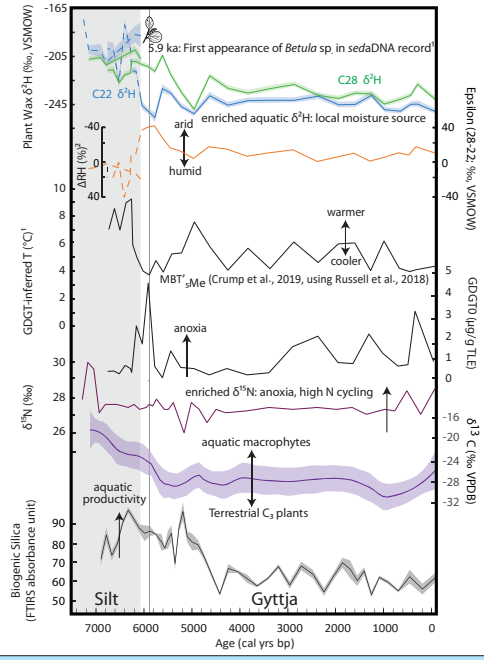
Smooth-spine, age-depth curve created using CLAM

Transition from silt to gyttja occurs at 104 cm (QPT16-3A) and 106 cm (QPT16-2A)

We interpret silty lithology to be indicative of remaining glacier ice in the catchment, thus the source water for aquatic waxes is ice melt, not summer precipitation

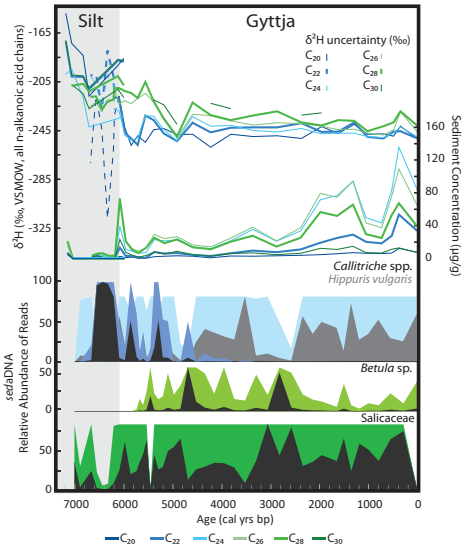
Between 6.3 ka and the modern day:

1. **Summer moisture source is relatively stable at Lake QPT**
2. **Summer precipitation is sourced from warm, local origins**
   -aquatic waxes are δ^2H-enriched relative to other lakes on Baffin Island
3. **Colonization of *Betula* sp. is synchronous with peak aridity**



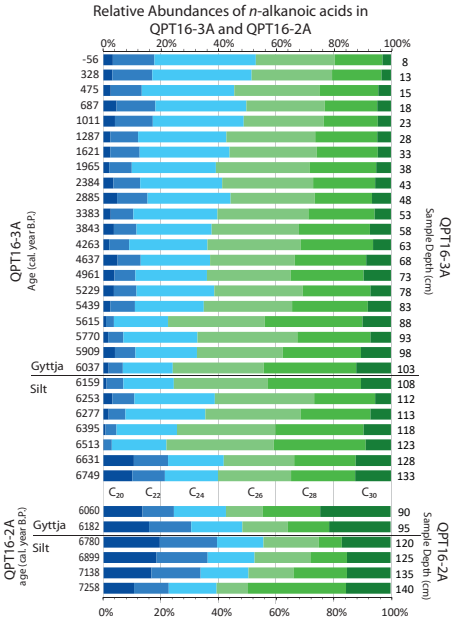
Plant Community Changes at QPT

1. **$\delta^{13}C$, BSi and *sed*aDNA records suggest that aquatic plants are abundant in the record before 6.3 ka, but plant wax δ^2H and relative wax abundance records suggest terrestrial plants dominate during this time**
   -If aquatic plants were dominant in the record, we would expect mid-chain waxes to be ^2H-depleted relative to long-chain waxes (lake fed by ^2H-depleted glacial meltwater)[4]
   -Mid-chains are ^2H-enriched relative to long chains, which is typical when sourced from the same plants as biosynthesis causes longer chain lengths to be ^2H-depleted
2. **Concentrations of *n*-alkanoic acids in sediment is not sensitive to the dominant plant species**



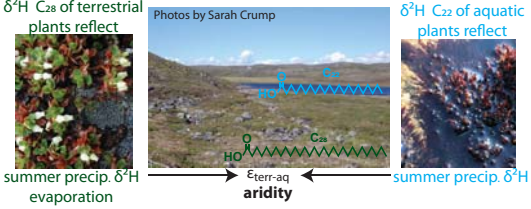
Broadly, the *sed*aDNA record shows a transition from aquatic to terrestrial plant dominance around 5.5 ka[1].

We propose that a shallowing of the lake inflow delta around 5.5 ka caused a shift in DNA and plant wax delivery to the site.



Proxies

Aquatic and Terrestrial Plant Wax δ^2H

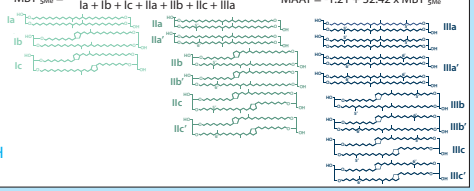


Branched GDGTs

brGDGTs primarily produced in lake, likely reflect summer temperature

$$MBT'_{5Me} = \frac{Ia + Ib + Ic}{Ia + Ib + Ic + IIa + IIb + IIc + IIIa}$$

$$MAAT = -1.21 + 32.42 \times MBT'_{5Me}$$



Future Research Questions

1. Do species-specific effects fractionation effects bias plant wax δ^2H during times of low species diversity?
2. What are the chain length distributions of modern plants in the QPT catchment, and how are they represented in lake sediment?
3. How does species diversity change through time at QPT?
4. How does Holocene precipitation source vary across a latitudinal transect of Baffin Island and Northern Labrador?

Acknowledgments

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References

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