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PEAT AS A PORTAL TO THE PAST

What can a peat profile tell us about the evolution of drained lake basins?

The Evolution of Drained Lake Basins

Drained lake basins are extremely dynamic and create complex landscapes marked by repeated cycles of permafrost degradation through thermokarst lake formation, and permafrost aggradation following lake drainage.

The topography within drained lake basins is often composed of a wet and depressed margin that surrounds a slightly elevated centre with better drainage due to permafrost aggradation.

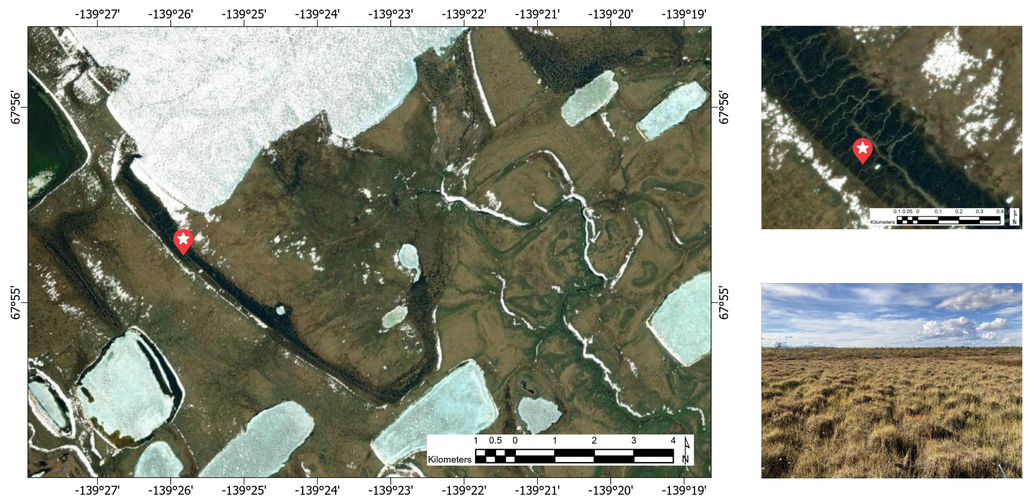
In OCF, modern DLBs host rapid willow growth, maintain large remnant ponds, and show uncertain permafrost aggradation in the decades following drainage.

While contemporary conditions in DLBs have been well documented, there are few paleo-environmental reconstructions of post-drainage basin evolution prior to anthropogenic climate warming.

Old Crow Flats, Canada

Old Crow Flats (OCF) is a lake-rich thermokarst landscape spanning 5,600 km^2 within the continuous permafrost zone of the Vuntut Gwitchin Traditional Territory, northern Yukon, Canada.

In recent decades, an increase in the rate of catastrophic lake drainages has been documented in OCF, as well as changes in vegetation composition.



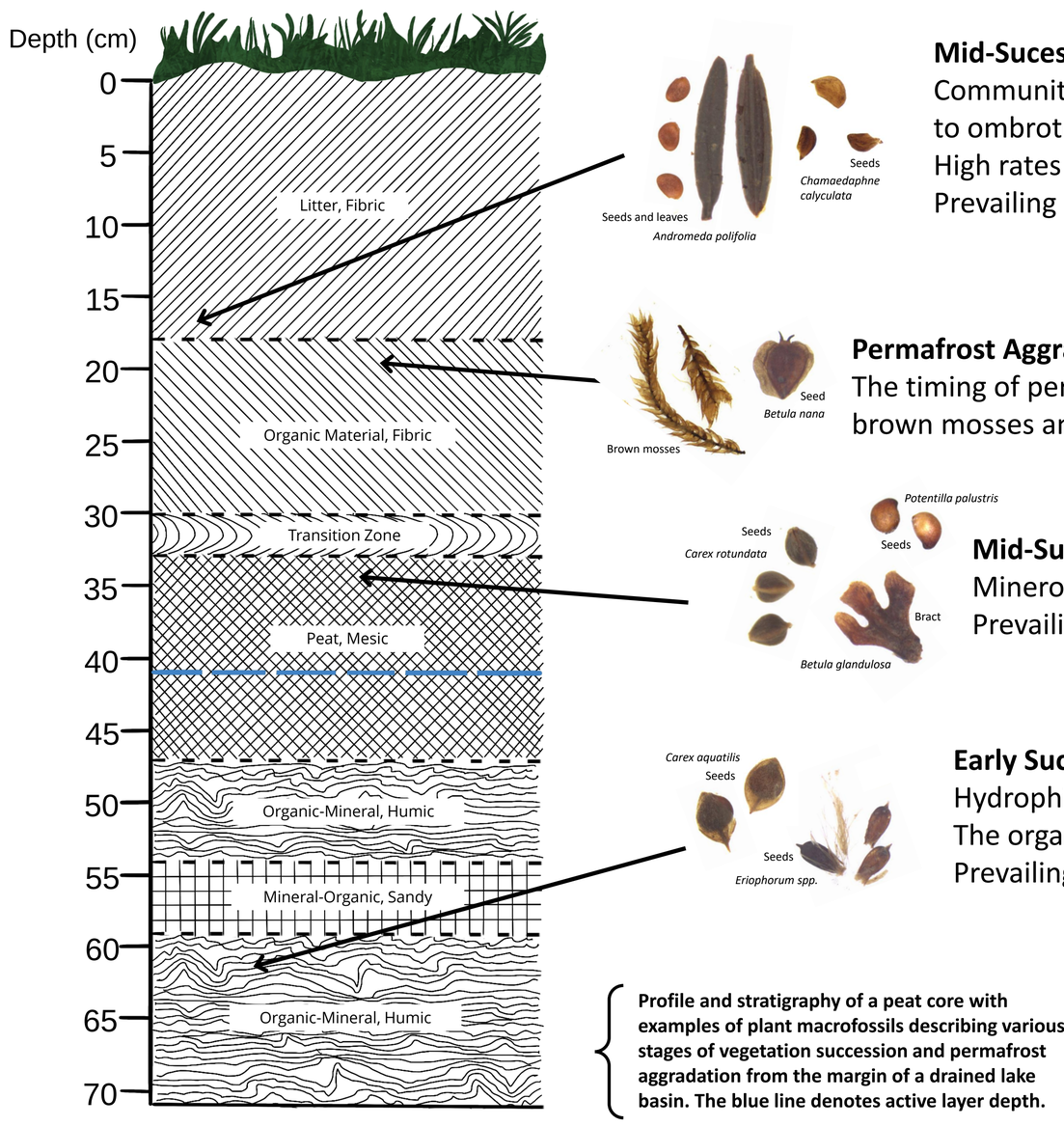
Map of study area with peat core sample site. Images to the right include string bog formations in the basin margin and a photo of the sample site.

Study Site

The peat core was collected from the northwestern margin of a large triangular basin (5.9 km^2) that once made up the southern tip of a large thermokarst lake and drained catastrophically approximately 920 years BP.

The site is characterized by string bog vegetation and low-centre ice wedge polygons that form a network of dry elevated ridges and wet hollows.

A local vegetation history will be reconstructed through radiocarbon dated plant macrofossil analysis.



Mid-Sucessional *Sphagnum* Bog Stage
Communities of *Sphagnum* replace the brown mosses, reflecting a transition of minerotrophic to ombrotrophic conditions.
High rates of peat accumulation and formation of hummocks.
Prevailing plants include: *Sphagnum fuscum, S. girgensohnii*, and Ericaceae.

Permafrost Aggradation
The timing of permafrost aggradation is associated with a transition from wet fen vegetation, such as brown mosses and Cyperaceae, to dry bog vegetation dominated by ericaceous shrubs and *Betula nana*.

Mid-Successional Wet Fen Stage
Minerotrophic conditions host communities of brown mosses, Cyperaceae, and dwarf shrubs.
Prevailing plants include: *Potentilla palustris, Carex rotundata, Betula glandulosa*, and *Salix.*

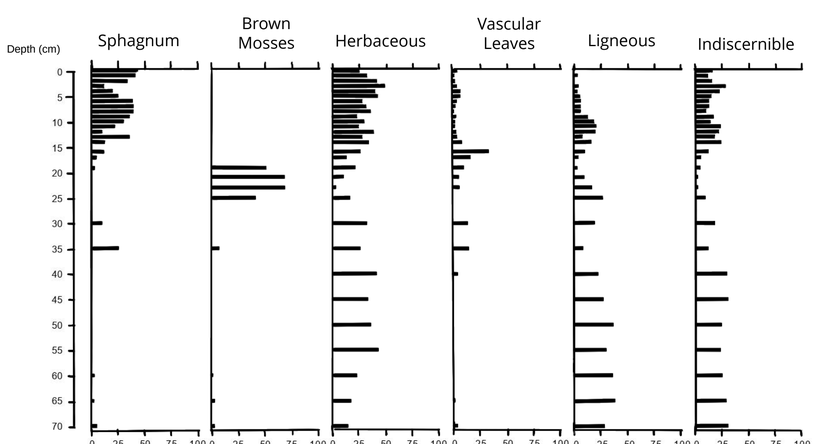
Early Successional Marsh Stage
Hydrophilic and flood tolerant communities of Cyperaceae and Poaceae.
The organic layer and peat begin to accumulate.
Prevailing plants include: *Carex aquatilis, Eriophorum spp., Hippuris, Potamogeton.*

Profile and stratigraphy of a peat core with examples of plant macrofossils describing various stages of vegetation succession and permafrost aggradation from the margin of a drained lake basin. The blue line denotes active layer depth.

Young Vs. Old Drained Lake Basins

By comparing vegetation succession in the margins of old and recently drained basins we can determine whether a successional stage of rapid willow development, as described by Lantz (2017), also occurred in the margins prior to anthropogenic warming.

This successional stage will be associated with a rapid onset and abundance of *Salix* species followed by increased *Salix* mortality in the macrofossil record.



Concentration of botanical groups (%) within a peat core from the margin of a drained lake basin, Old Crow Flats.

Many thanks / Mahsi' Cho

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