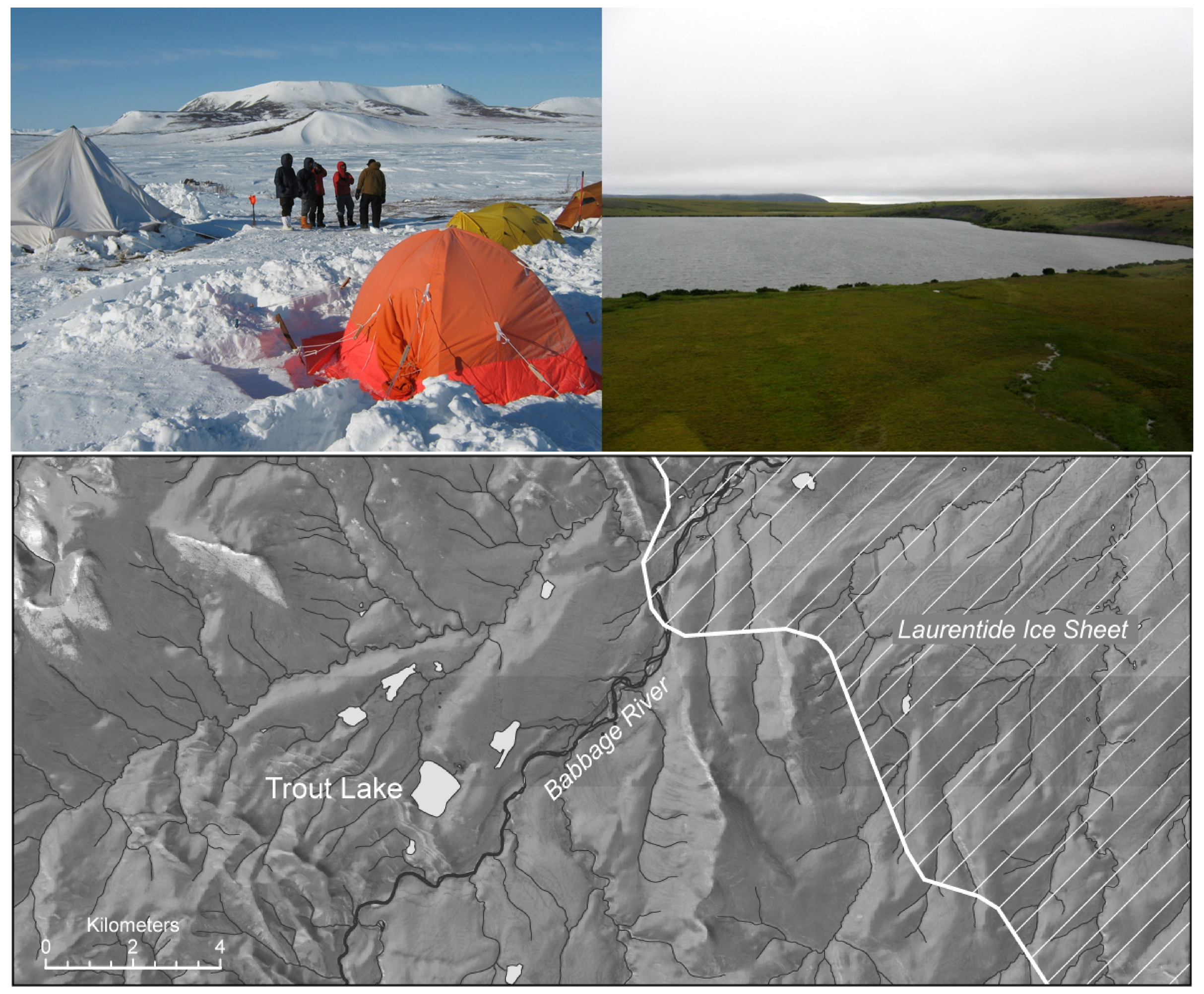
Permafrost and climate development in the northern Yukon since the LGM: East Beringia vs. Laurentide Ice

AWI Alfred-Wegener-Institut für Polar- und Meeresforschung in der Helmholtz-Gemeinschaft

McGill

Michael Fritz, Ulrike Herzschuh, Wayne H. Pollard, Hugues Lantuit

Trout Lake (162 m asl)

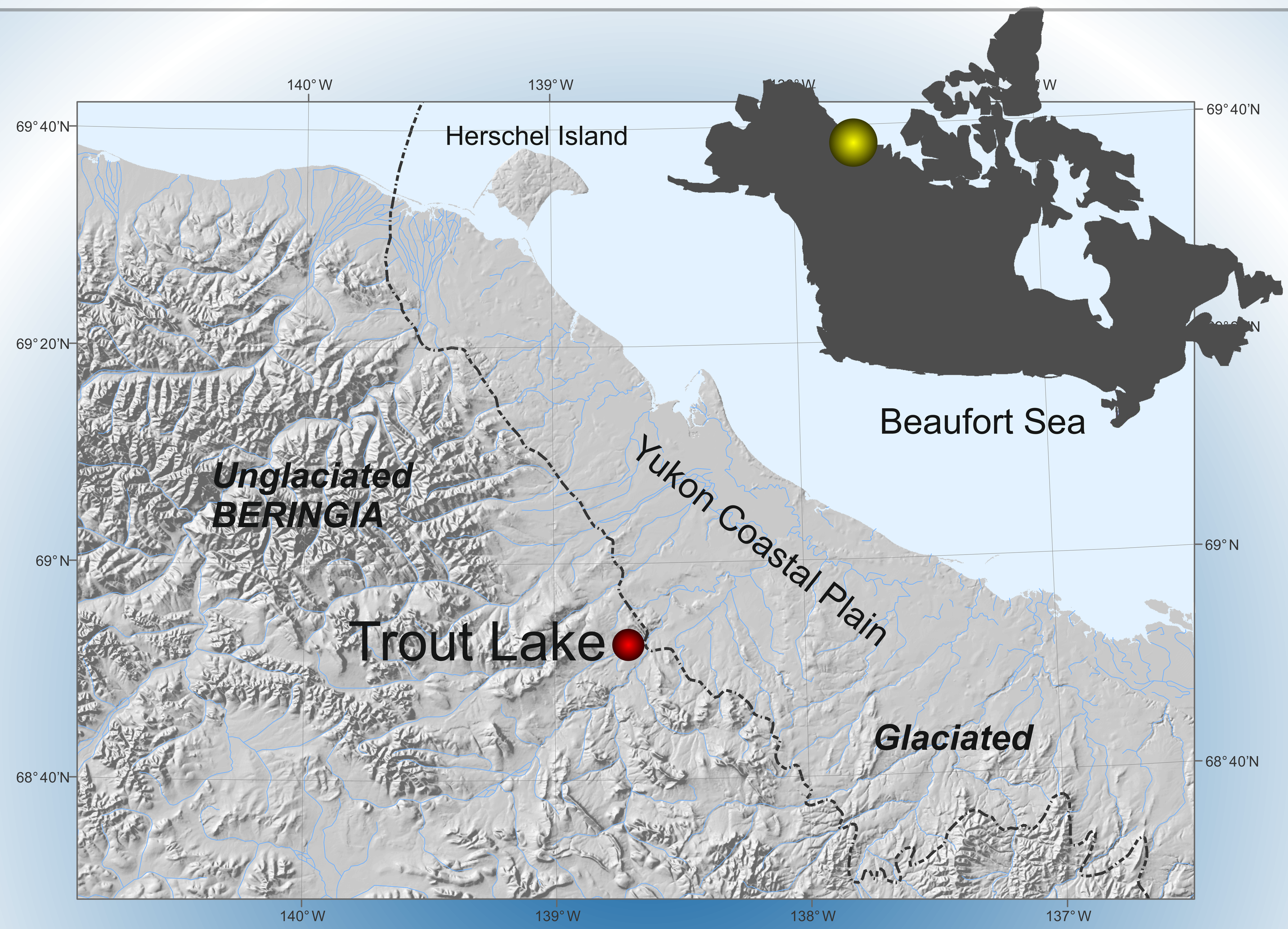


Trout Lake (68°49.73'N, 138°44.78'W) is located 163 m above sea level in the foothills of the British Mountains, approximately one kilometer west of the Babbage River and about 42 km south of the Beaufort Sea.

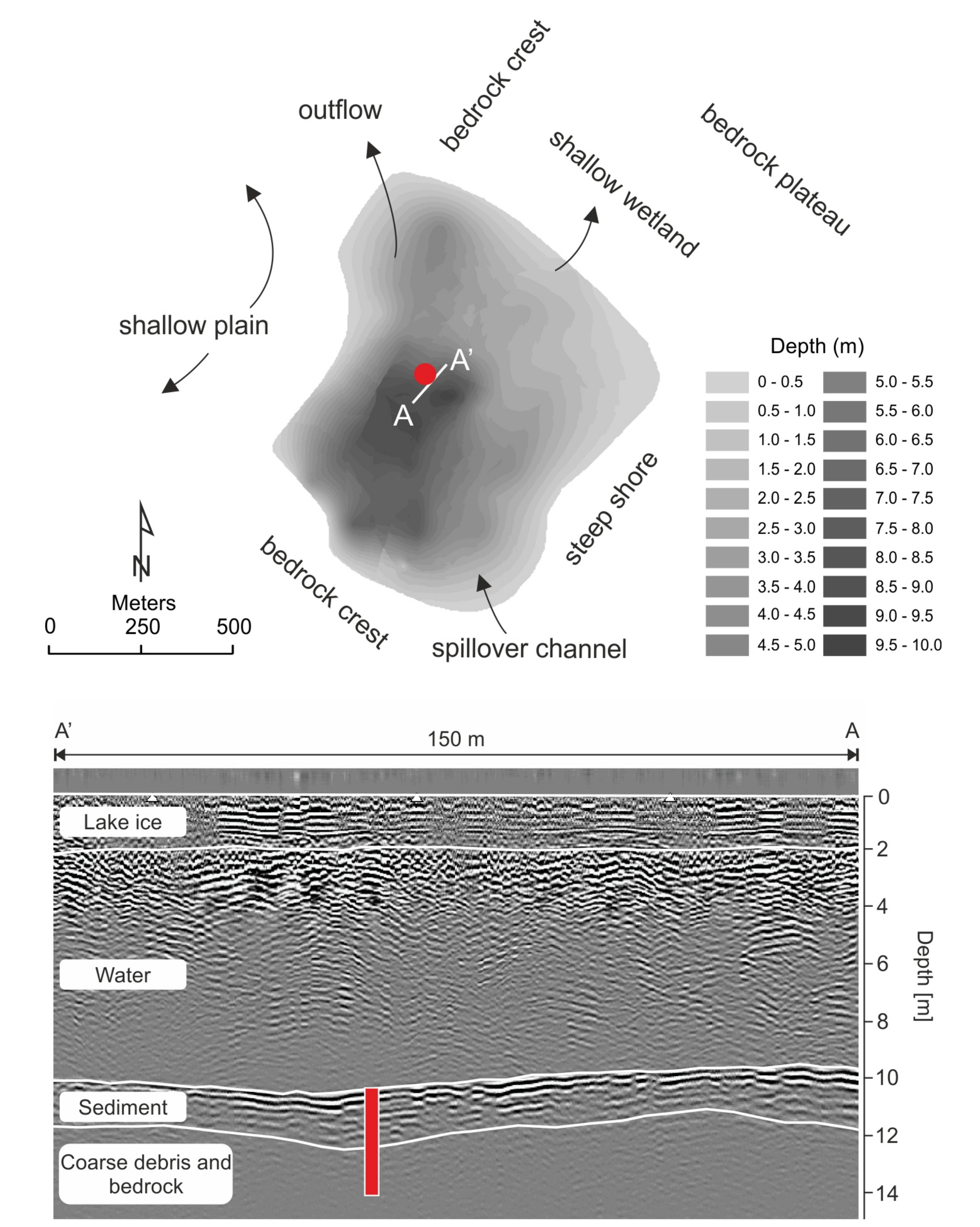
Trout Lake in the northern Yukon Territory represents the northernmost lake sediment archive of unglaciated Beringia studied so far, and has recorded local sedimentation history and regional vegetation changes since ~16 cal ka BP.

Key Questions

- How did lake sedimentation respond to late glacial–Holocene transition and the Younger Dryas stadial close to the collapsing Laurentide Ice Sheet?
- What have been the mean July temperature magnitudes in ice-marginal east Beringia since the late glacial–Holocene transition?
- How did pollen-inferred moisture pattern correspond to LIS retreat and Holocene warming?

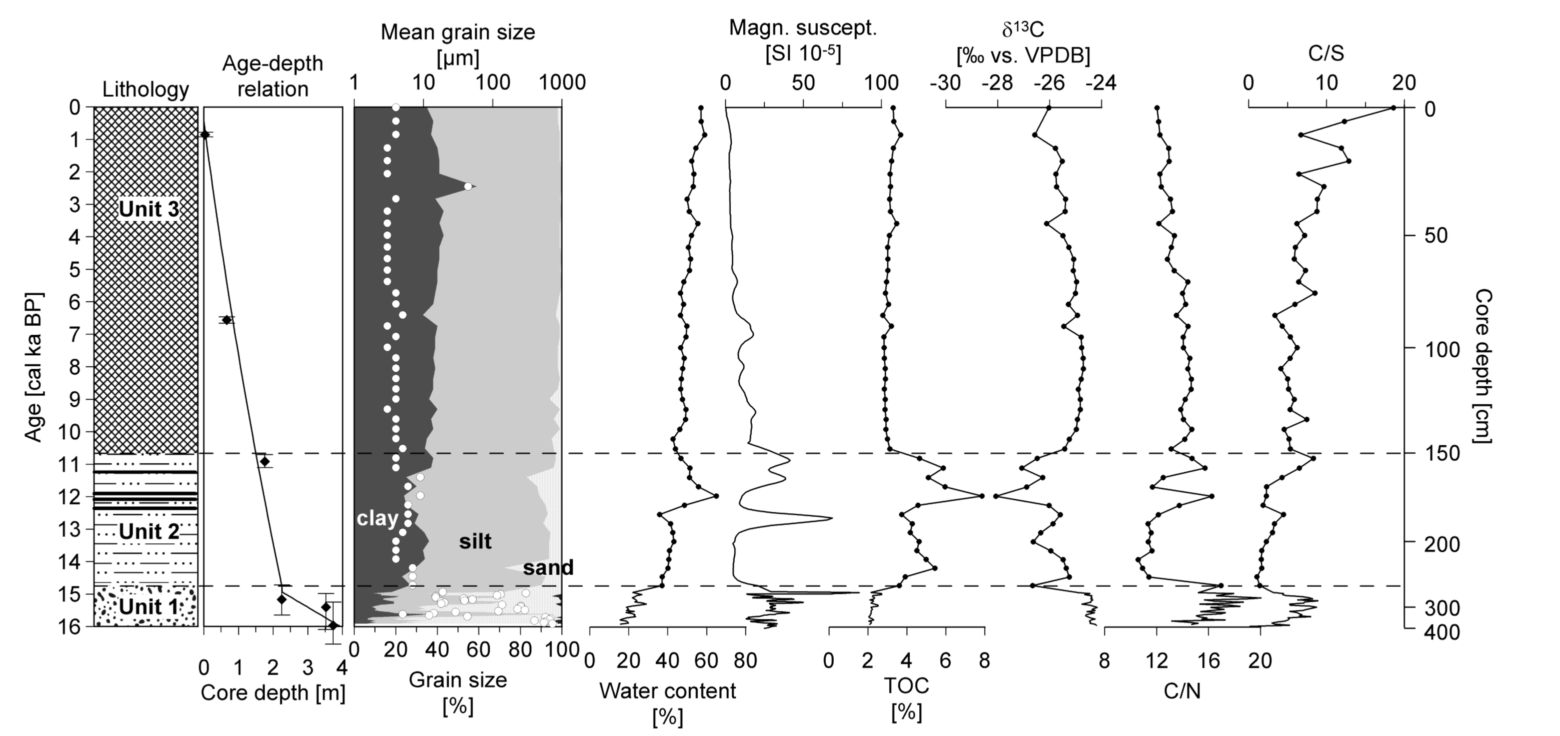


Site survey and coring



Trout Lake bathymetry and coring location (red circle) in April 2009. The bathymetry map is based on echosoundings and depths extracted from ground penetrating radar (GPR) tracks collected on the lake ice. Interpreted GPR profile (100 MHz) across the coring location (red bar).

Sediments and Chronology

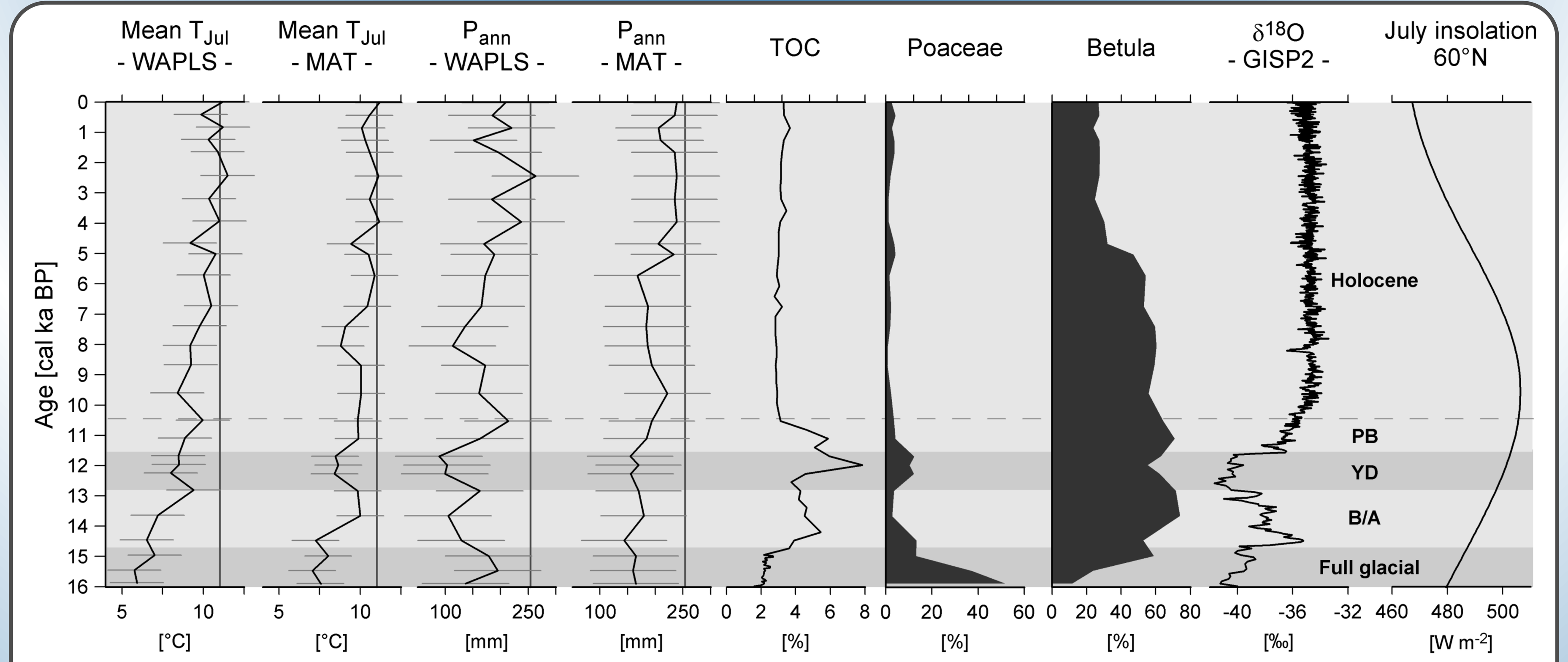


Summary plot of age-depth relationship and lithological, sedimentological, and biogeochemical parameters from Trout Lake, northern Yukon.

Sedimentological analyses of lake sediments suggest that depositional environments changed rapidly during the late glacial–Holocene transition near the collapsing Laurentide Ice Sheet. A late-glacial drainage diversion of the Babbage River probably led to episodic spillovers of Laurentide meltwater that initially filled the bedrock-controlled Trout Lake basin with coarse-grained sediment. Since the Holocene depositional conditions remained relatively stable.

- Fritz, M., Herzschuh, U., Wetterich, S., Lantuit, H., De Pascale, G.P., Pollard, W.H., Schirrmeister, L. (2012). Late glacial and Holocene sedimentation, vegetation, and climate history from easternmost Beringia (northern Yukon Territory, Canada). Quaternary Research 78, 549-560.

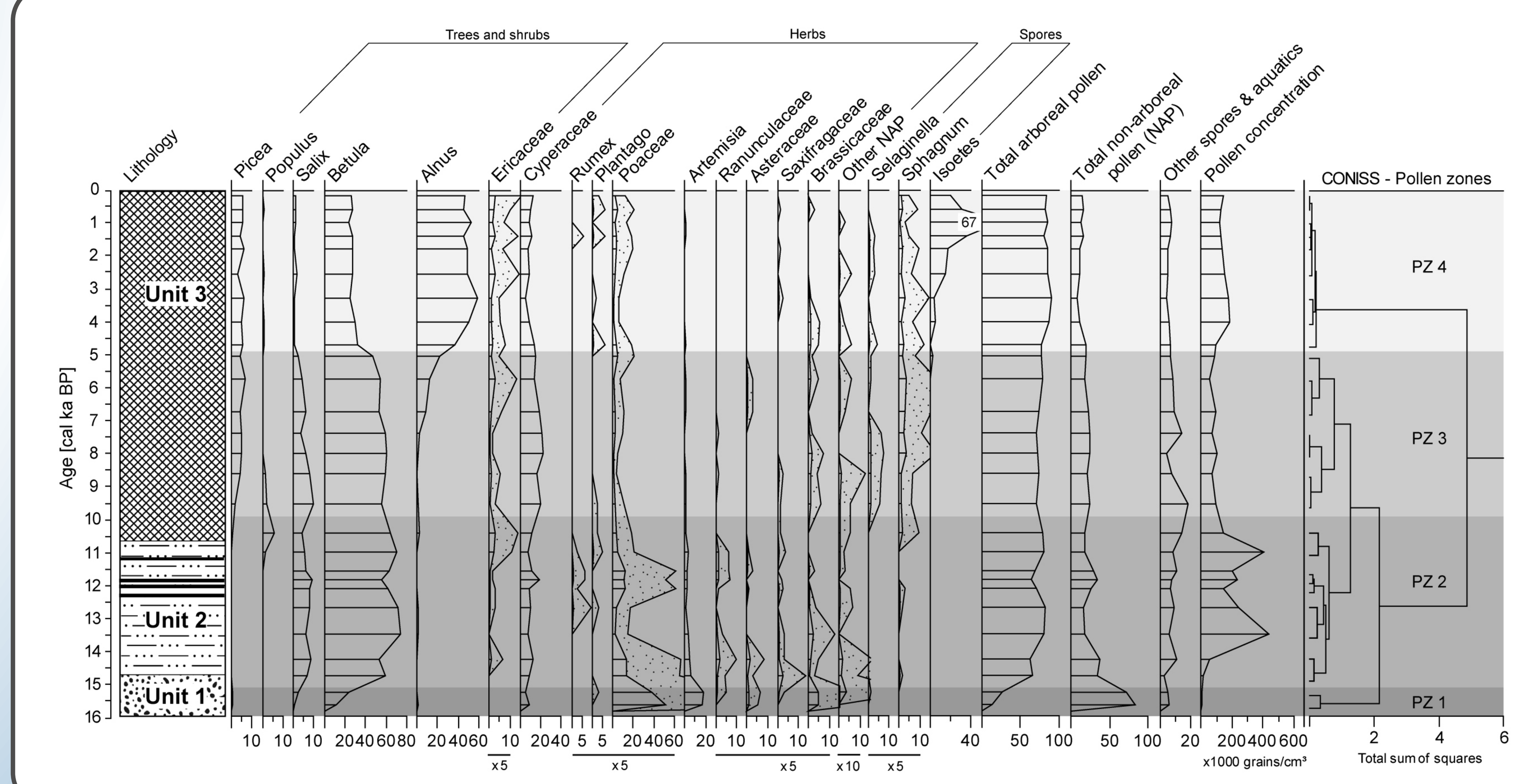
Climate reconstruction



Temperature and precipitation reconstructions, total organic carbon (TOC) of lake sediments, and selected pollen percentages from Trout Lake compared with isotope curve from GISP2 (Grootes and Stuiver, 1997) and mean summer insolation (July, 60°N; Laskar et al., 2004) of the last 16 cal ka BP. Reconstructed mean July air temperatures (T_{Jul}) and annual precipitation (P_{ann}) are based on pollen using weighted averaging partial least squares regression (WAPLS) transfer function and the modern analogue technique (MAT). Modern mean T_{Jul} and P_{ann}: 11.2°C; 254 mm (Environment Canada, 2000).

July air temperature reconstructions indicate a rapid climate warming by ~4°C, from cold full-glacial conditions towards the B/A interstadial, followed by a distinct YD stadial, which had not been reported for the northern Yukon so far. Limited moisture availability in the northern Yukon during rising temperatures across the western Arctic in the early Holocene may have been responsible for a concealed HTM. Permafrost aggradation and a moisture increase since the middle Holocene supported the establishment of an extensive alder/birch shrub tundra north of the arctic tree line in many parts of east Beringia.

Pollen spectra



Herb-dominated tundra persisted until ~14.7 cal ka BP. During the Bølling/Allerød interstadial a *Betula-Salix* shrub tundra established. Dry- and cold-adapted taxa (*Artemisia*, Poaceae) briefly recovered during the Younger Dryas (YD) stadial. An *Alnus-Betula* shrub tundra became dominant from ~5 cal ka BP until present. The tree line (*Picea*) never reached the Trout Lake area during the last 16 cal ka BP.

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DAAD Deutscher Akademischer Austauschdienst German Academic Exchange Service

Michael Fritz
Alfred Wegener Institute for Polar and Marine Research
Department of Periglacial Research
Telegrafenberg A43
14473 Potsdam
Germany

Tel: +49-331-288-2168
Fax: +49-331-288-2188
Email: Michael.Fritz@awi.de
http://www.awi.de/People/show?mfritz
http://www.awi.de/en/go/coper