

Supplemental information

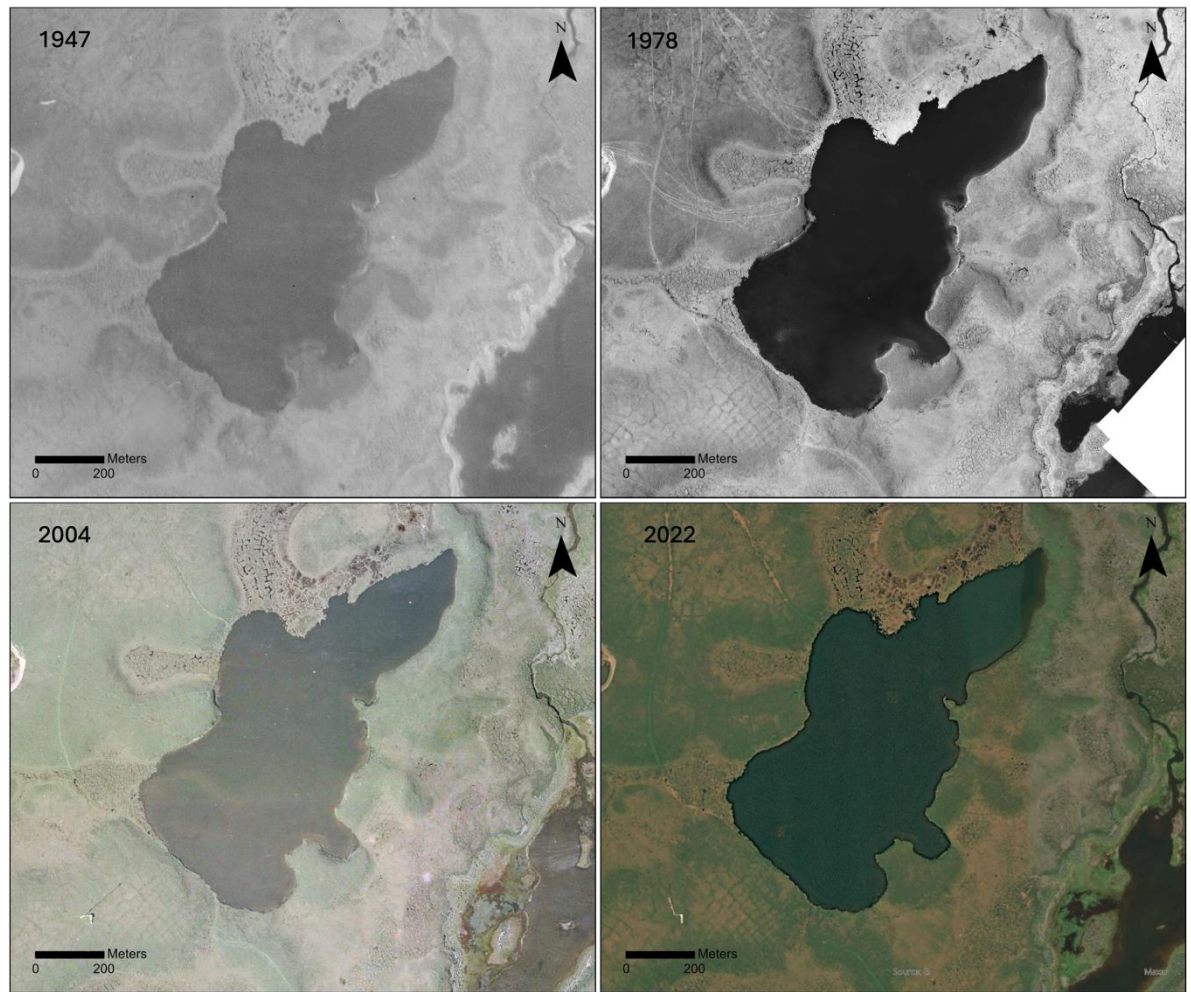


Figure S1. Temporal variability of the lake surrounding RP polygonal ground (North of lake), showcasing stability since 1947. Historical imagery was supplied by Natural Resources Canada Air Photo Library.

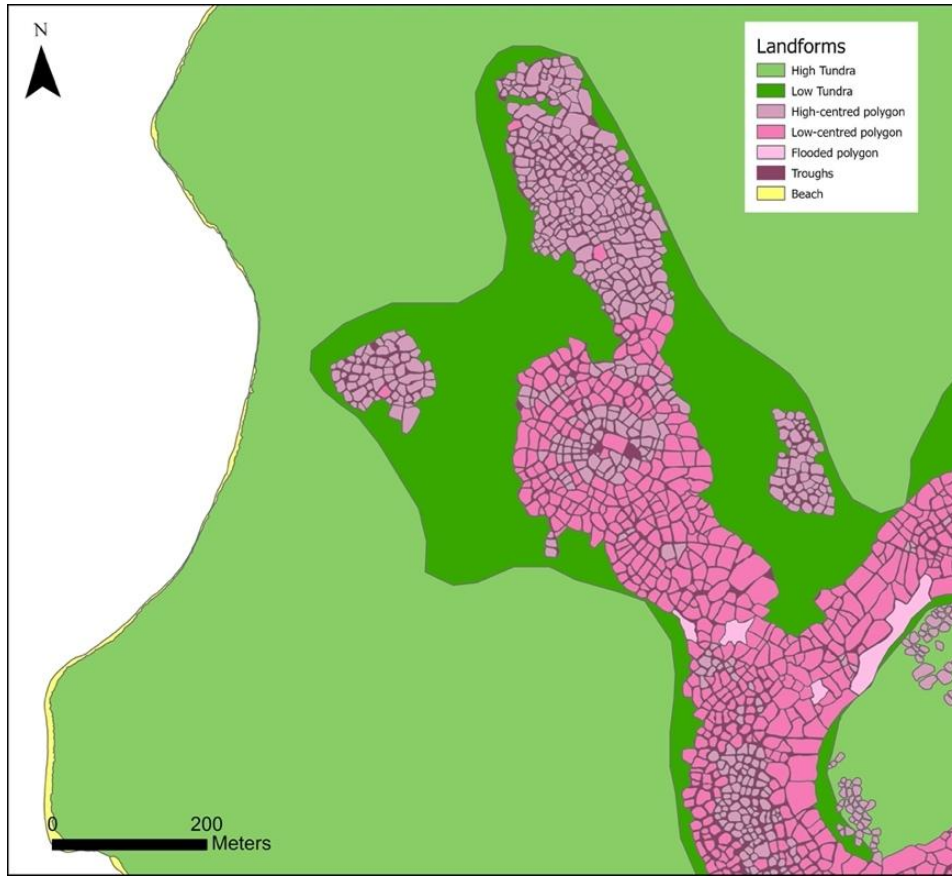


Figure S2. Map of Reindeer Point sampling site with delimitation of geomorphological polygonal forms. Forms were drawn based on aerial imagery from 2022.

Table S1. Total area occupied by geomorphological landforms, calculated based on manual mapping of landforms in QGIS.

Landforms	Total Area (m ²)	Total Area (km ²)
Beach	6015.912428	0.006015912
Low-centred polygon	118900.6299	0.11890063
High-centred polygon	80309.59466	0.080309595
Troughs	36151.97771	0.036151978
Low Tundra	164338.4158	0.164338416
High Tundra	942531.362	0.942531362



Figure S3. High-resolution satellite imagery of a) Reindeer Point (10A, 10B, 10C, 10D) and b) Toker Point (07, 08, 09) (ESRI, 2022 | Powered by Esri).

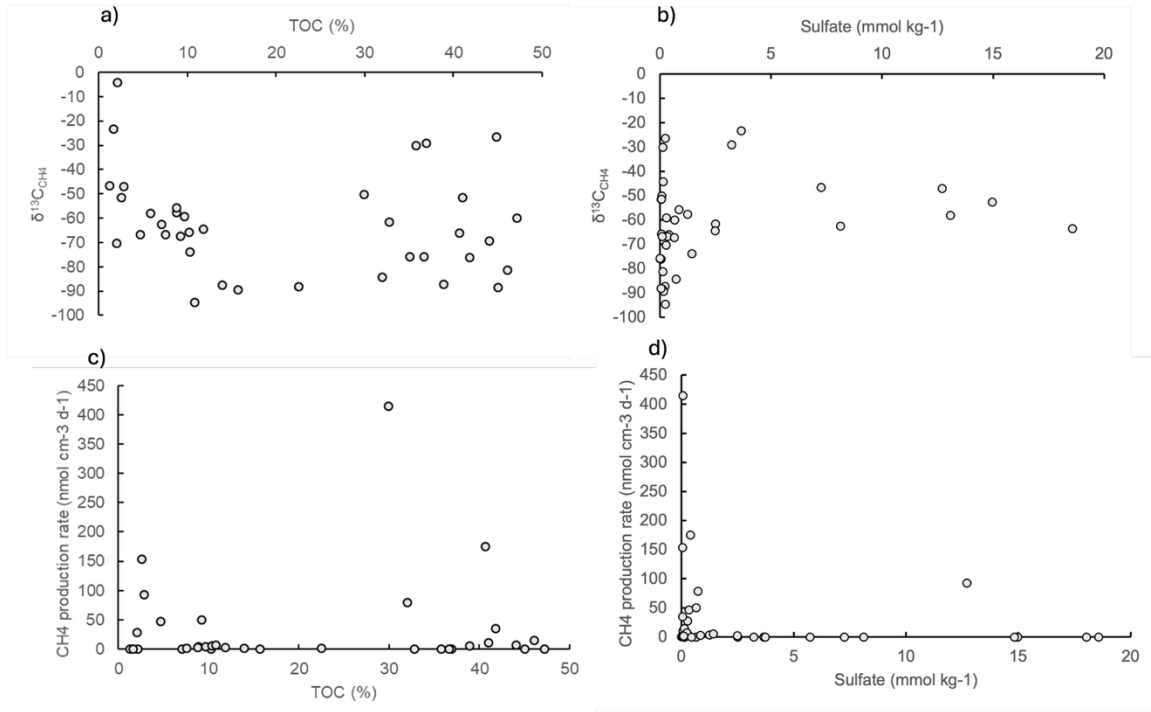


Figure S4. Relationships between stable carbon isotope composition of methane ($\delta^{13}\text{C}-\text{CH}_4$), total organic carbon (TOC), sulfate concentration, and methane production rates across all sampled depths and sites. Upper

panels show $\delta^{13}\text{C}$ - CH_4 as a function of TOC (a) and sulfate concentration (b). Lower panels show CH_4 production rates as a function of TOC (c) and sulfate concentration (d). Each point represents one sampled depth. No consistent relationship is observed between $\delta^{13}\text{C}$ - CH_4 or CH_4 production rates and either TOC content or sulfate concentration across landforms or depths, indicating that isotopic signatures and CH_4 production are not straightforwardly predicted by bulk organic carbon abundance or sulfate availability at the scale investigated.

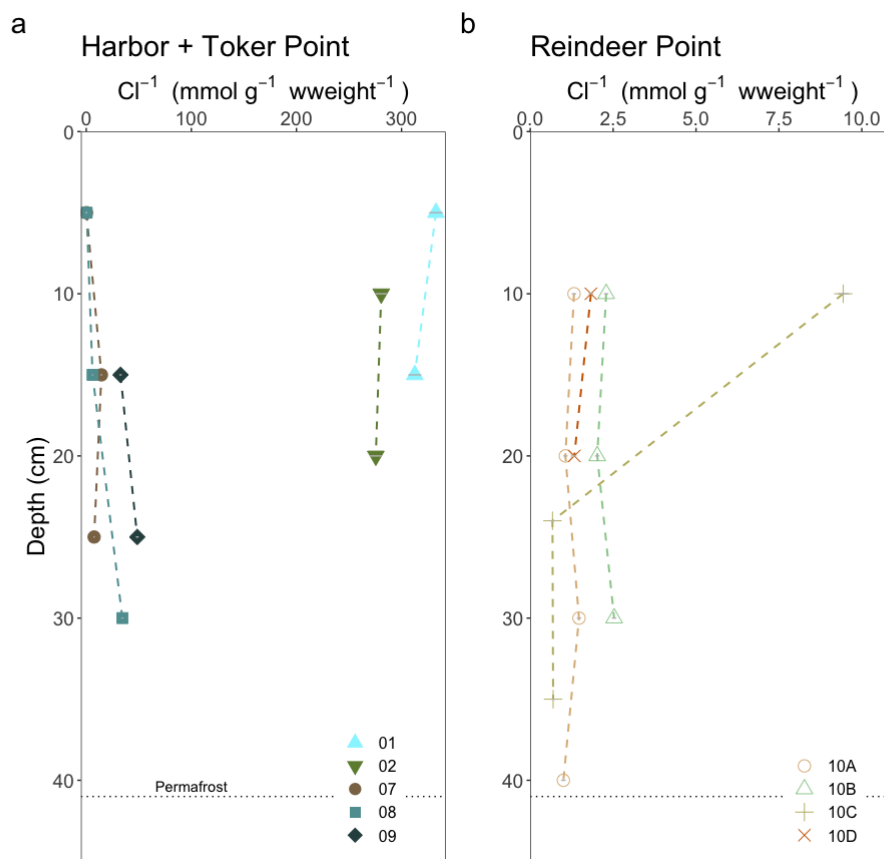


Figure S5. Cl⁻ concentrations in (a) Harbor + Toker Point and (b) Reindeer Point soil and sediments used in the incubation experiment.

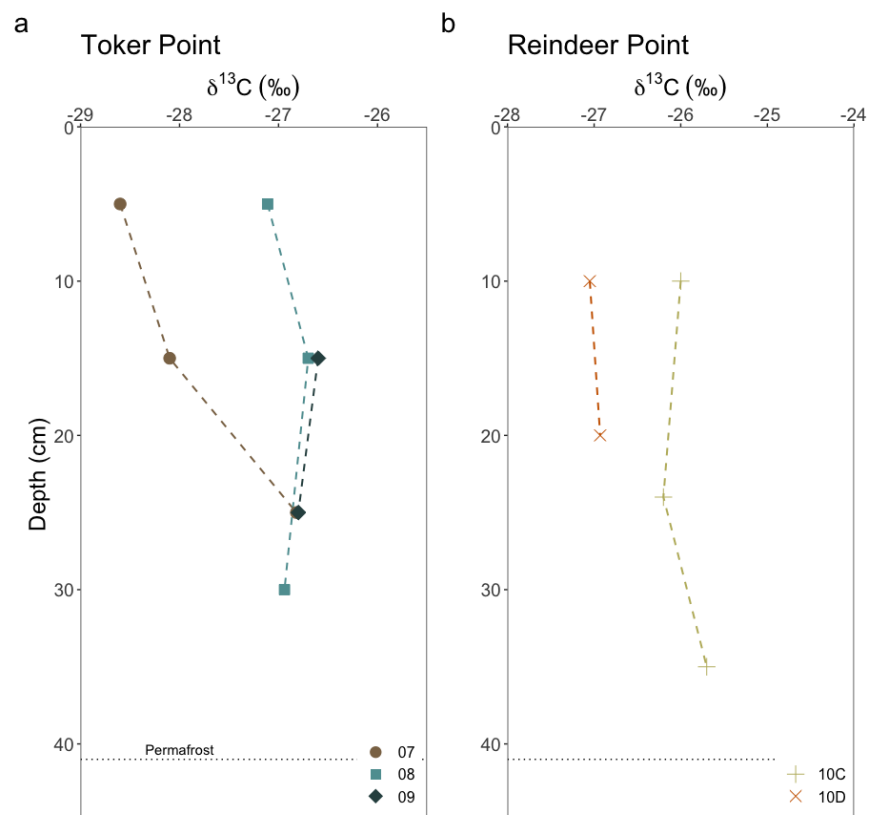


Figure S6. $\delta^{13}\text{C}$ of (a) Harbor + Toker Point and (b) Reindeer Point sediments used in the incubation experiment. Values measured within the range of terrestrial OM (Fu et al., 1993).

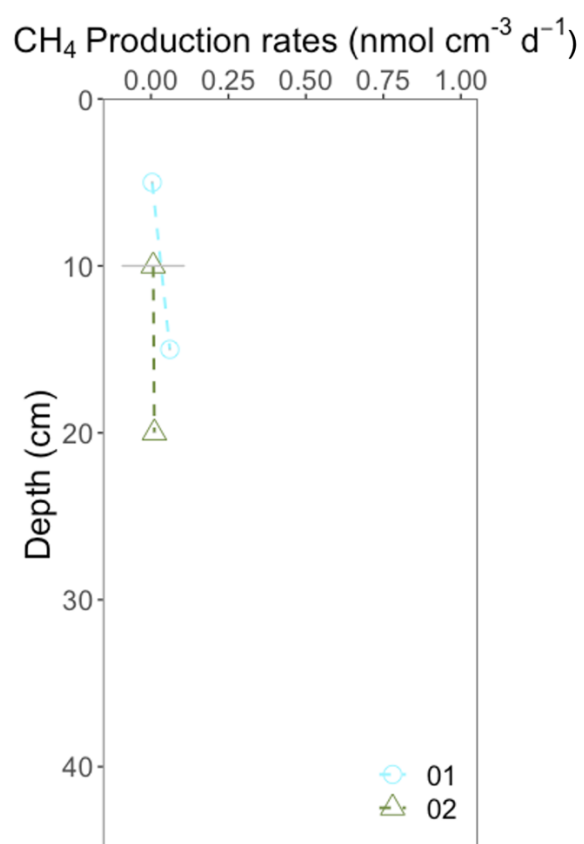


Figure S7. CH₄ production rates in marine sediments cores collected from the Harbor. The error bar on measured values represents the standard deviation on the mean of triplicates.