# Understanding Thermokarst Lake Dynamics in Arctic Alaska: A Case Study based on Sediment Cores


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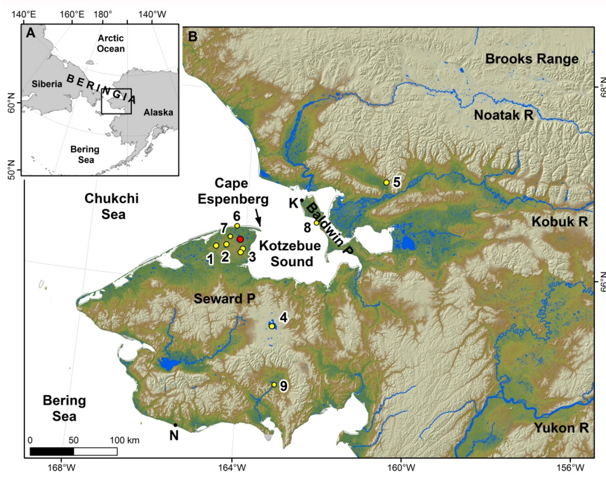
## INTRODUCTION

Arctic landscape dynamics are an indicator of global climate change. The degradation of ice-rich permafrost since the Pleistocene-Holocene transition was responsible for the formation of numerous thermokarst lakes in the Arctic. However, these lakes typically undergo a cycle of initiation, expansion, drainage, and re-initiation that may or may not be coupled to global change or local disturbances. Our study of a recently drained lake basin in Arctic Alaska (USA) provides insights into past landscape dynamics in the continuous permafrost region to answer the questions: **How did thermokast develop in the past?**

**What triggers Arctic lake development:**

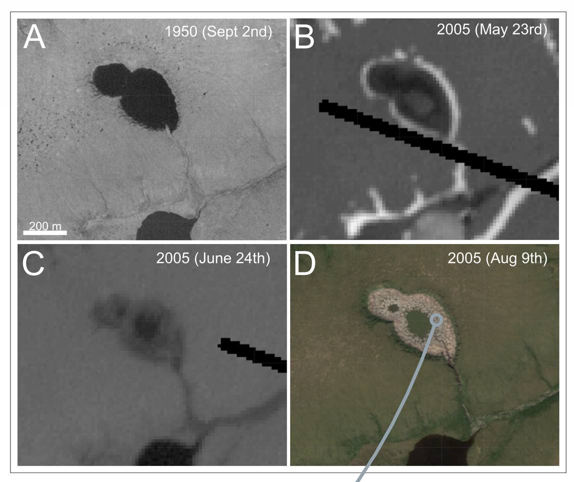
**Climate changes or local disturbances?**

## STUDY AREA



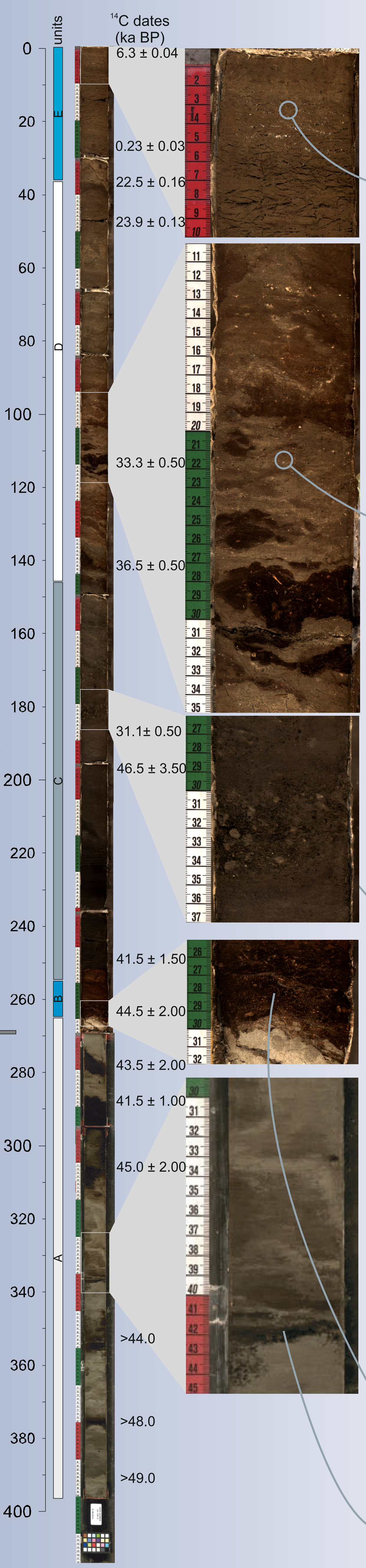
*Location of studied basin on the Northern Seward Peninsula/Alaska (USA).*

The study region of the Northern Seward Peninsula is part of the Bering Land Bridge National Preserve and remained unglaciated during the Last Glacial Maximum. It represents one of Alaska`s major lake districts and is underlain by ~100 m of continuous, ice-rich permafrost called yedoma. The studied sediment core (core ID: Kit-64) was recovered from a 12 ha thermokarst basin which drained in Spring 2005.



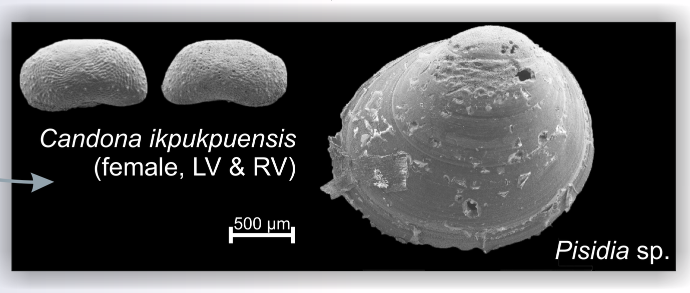

*Time series of remote sensing imagery of studied basin: Ice-coverd in May and drained in June 2005.*

## RESULTS




### Unit E

distinct lamination, mollusk shells as well as well preserved ostracods



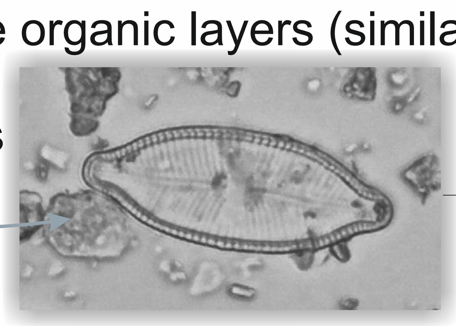

→ indicate shallow, cold freshwater ecosystem of 300 yrs duration
→ **local permafrost disturbance due to global climate amelioration**

### Unit E/D

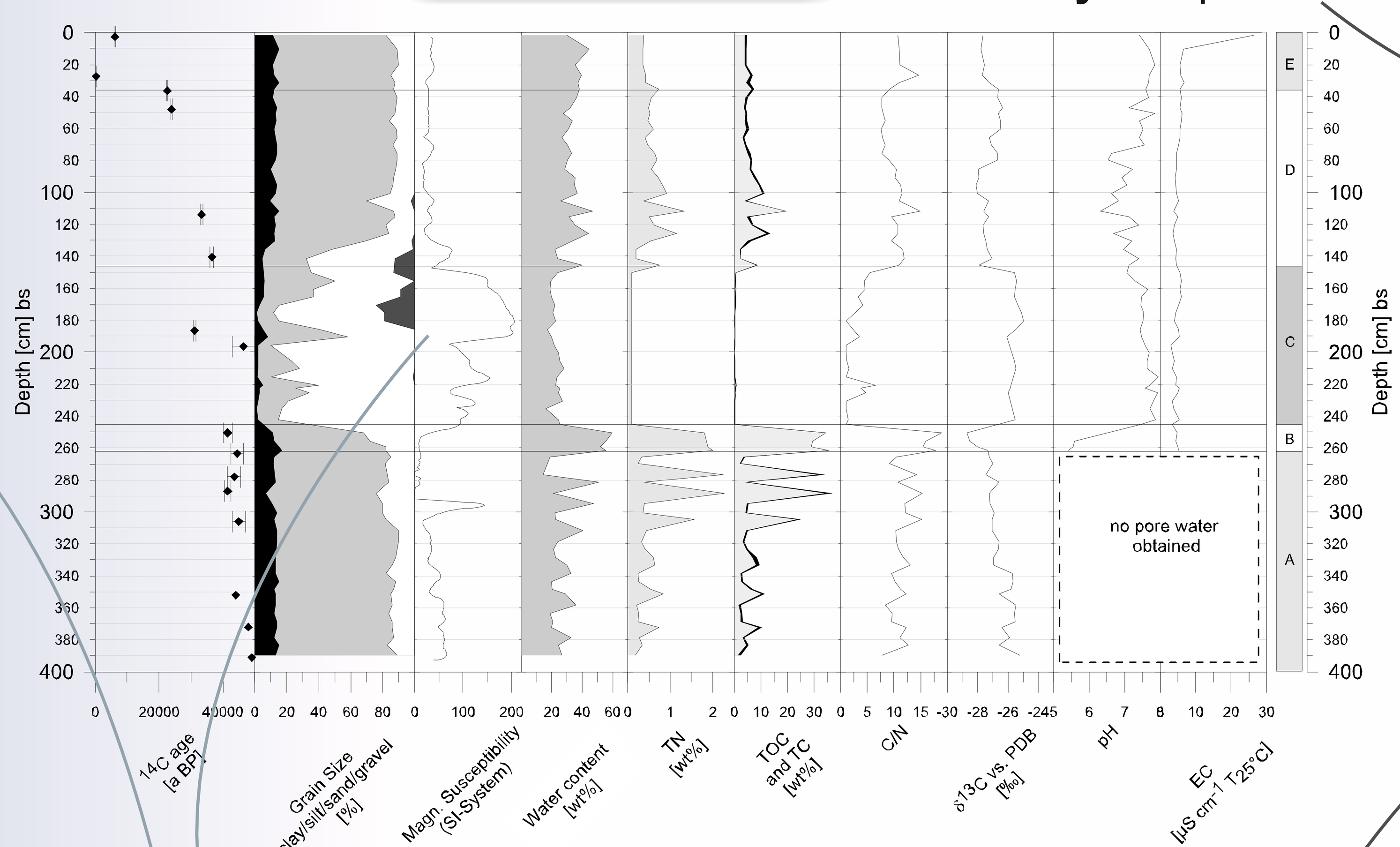
depositional hiatus 22.5±0.16 and 0.23±0.03 ka BP → point towards lack of deposition/ erosion of surficial sediments on **local/regional scale**

### Unit D

silt with intermediate organic layers (similar to unit A) with occasional presence of diatoms

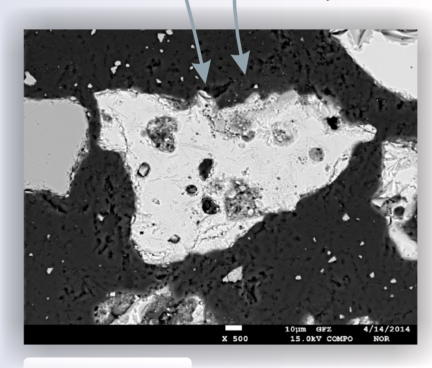


→ generally cold and dry **circumpolar climate conditions** allow terrestrial yedoma accumulation with **seasonally wet** phases




### Unit C

1-m air-fall tephra with particles up to 7 mm



→ associated with the 42 ka BP South Killeak Maar eruption of **regional scale**
→ terminated potential thermokarst development

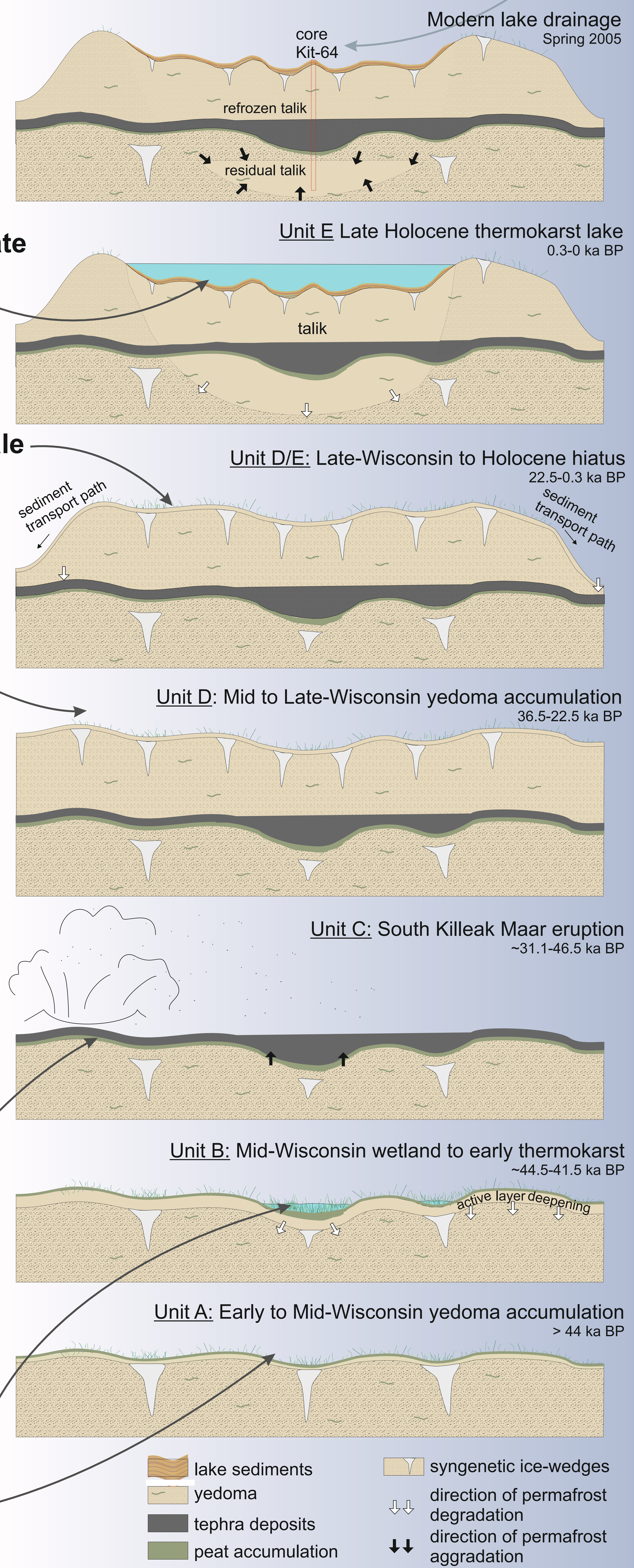
### Unit B

peaty layer with high TOC contents of 29-35 wt%, high C/N ratio
→ high bioproductivity by **local wet conditions** causing initial ponding

### Unit A

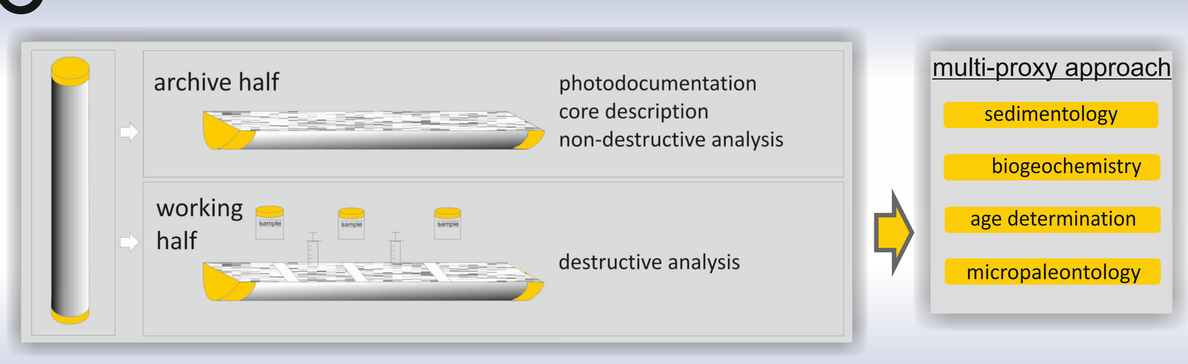
silty sediments with interbedded organic-rich material
→ yedoma accumulation in **cold and dry climate conditions** (transferred to unfrozen taberit due to talik development/unit E)

## DISCUSSION




## METHODS

We applied a multi-proxy approach on a ~ 4 m long sediment core covering the following methods:




## CONCLUSION

Our investigation demonstrates that lake development in the permafrost-affected terrestrial Arctic can be triggered but also interrupted by **global climate change** (e.g. rapid **warming & wetting in the Early Holocene**), **regional environmental dynamics** (e.g. nearby **volcanic eruptions** & tephra deposition) or **local disturbance** processes (e.g. **lake initiation & drainage**). The present study emphasizes that Arctic lake system and periglacial landscapes are dynamic and sensitive to rapid change.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