PALEOLIMNOLOGICAL DYNAMICS IN THE ALASKAN ARCTIC
Climate Drivers versus Local Disturbances

Josefine LENZ*°, Guido GROSSE*, Benjamin M JONES#, Sebastian WETTERICH*

* Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany
° University of Potsdam, Institute for Earth and Environmental Sciences, Germany
U.S. Geological Survey, Alaska Science Center, Anchorage, AK/USA

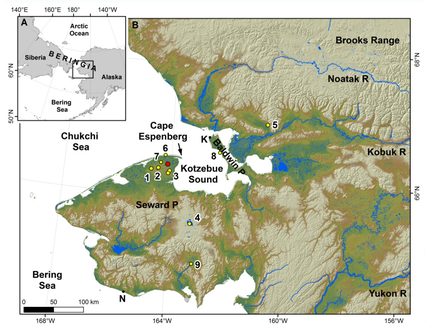
contact:
Josefine.Lenz@awi.de

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 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:

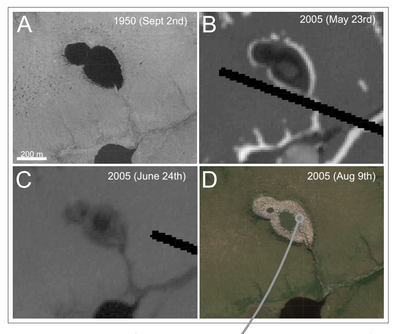
How did thermokast develop in the past?
What triggers Arctic lake development:
Climate changes or local disturbances?

STUDY AREA



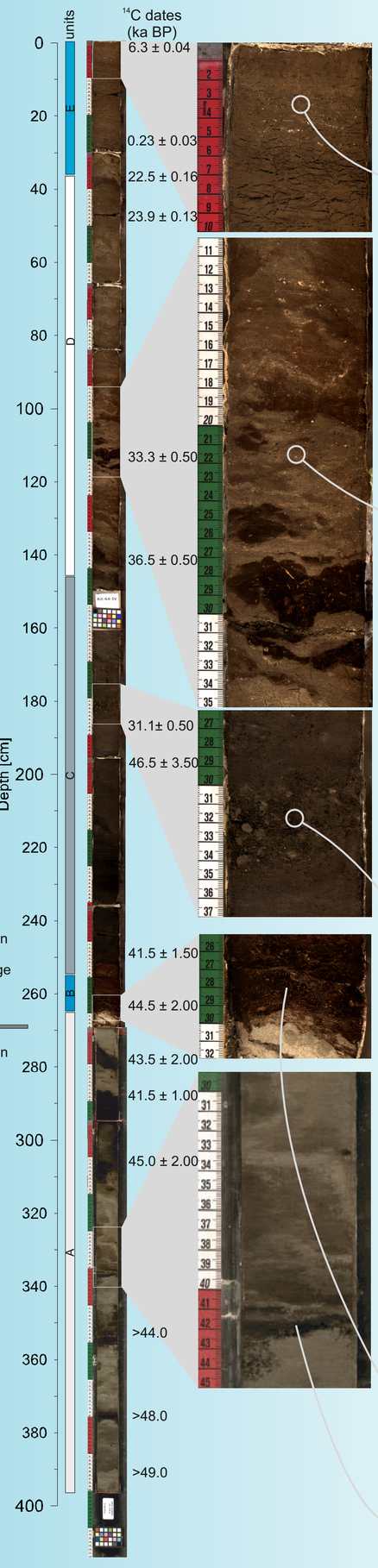
Location of studied basin on the Northern Seward Peninsula/Alaska (USA).

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.



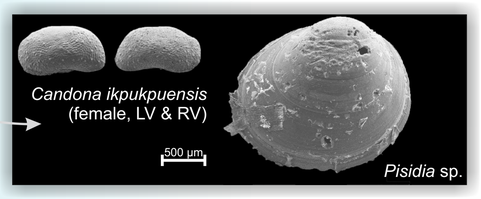
Time series of remote sensing imagery of studied basin: Ice-coverd in May and drained in June 2005

RESULTS



Unit E

distinct lamination, mollusk shells as well as well preserved ostracods



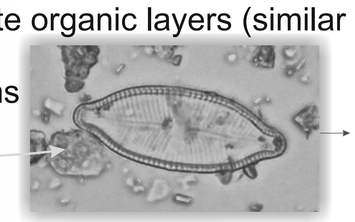
→ indicate shallow, cold freshwater ecosystem of 300 yrs duration
→ **local permafrost disturbance due to global climate amelioration**

Unit E/D

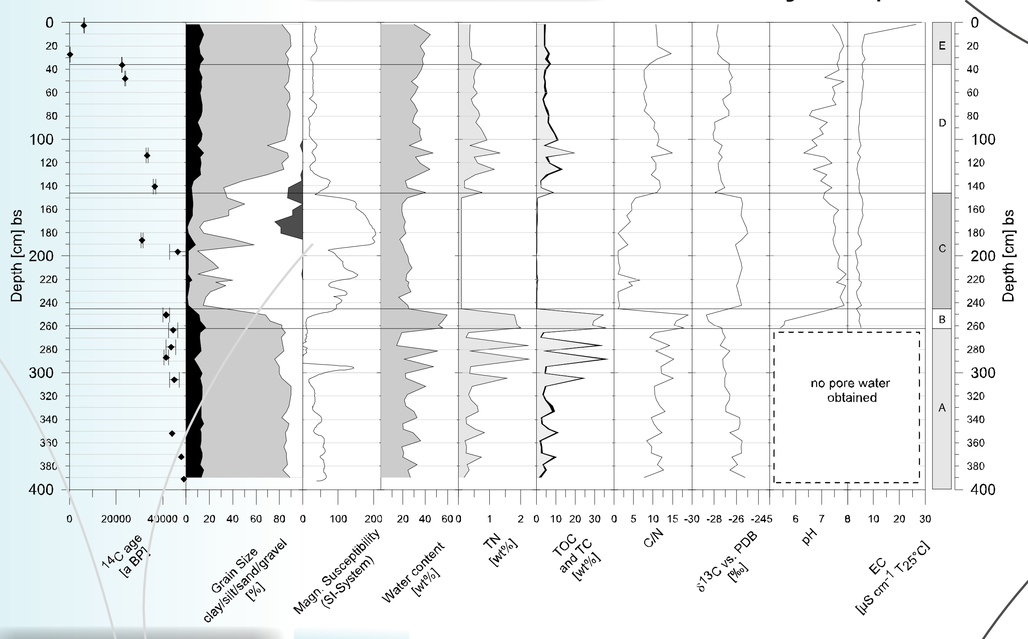
depositional hiatus 22.5±0.16 and 0.23±0.03 ka BP → point towards lack of deposition/ erosion of surficial sediments on **local/regional scale**

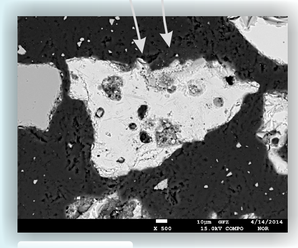
Unit D

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

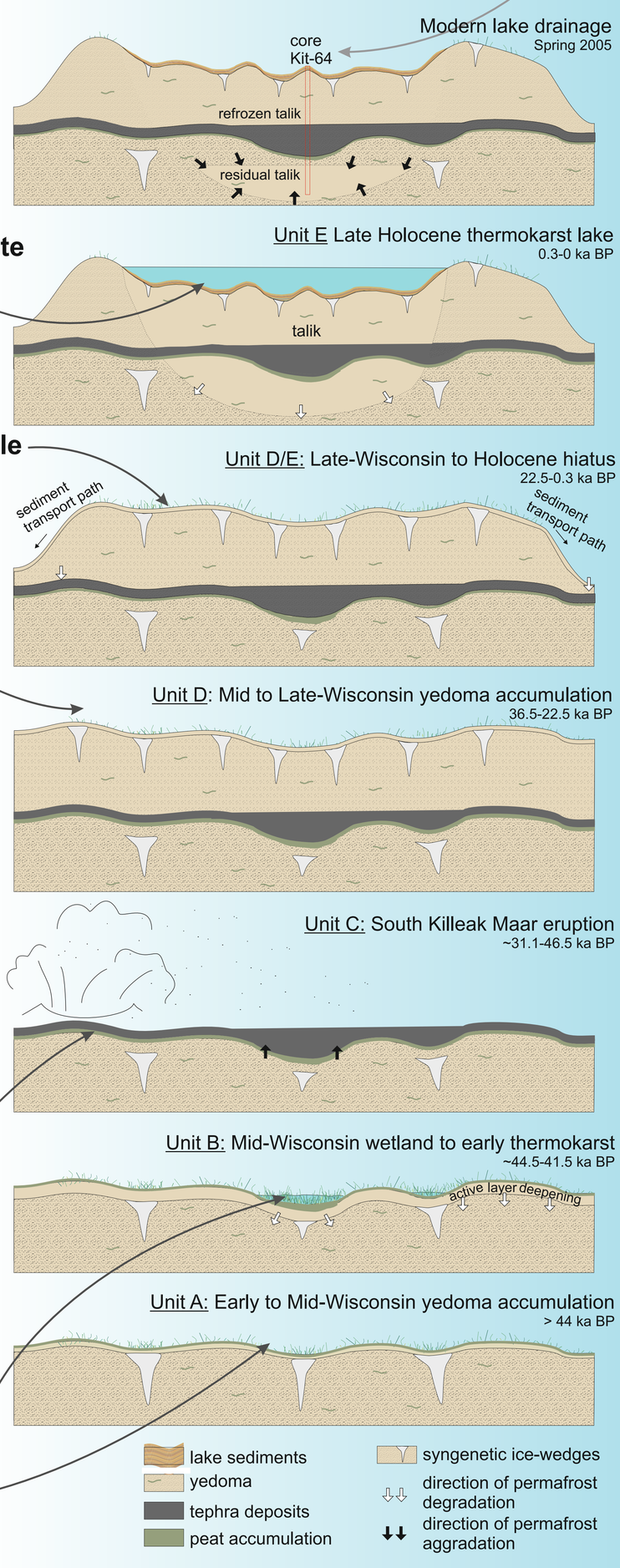
Unit B

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

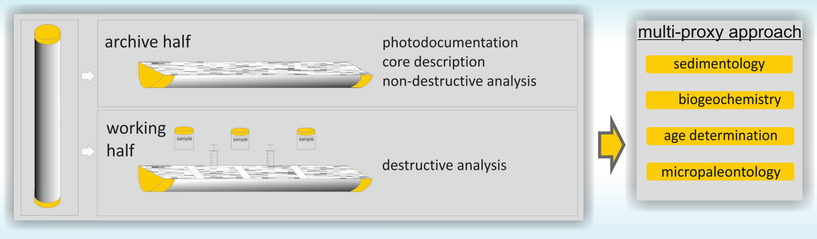
silty sediments with interbedded organic-rich material
→ yedoma accumulation in **cold and dry climate conditions** (transferred to unfrozen taberit due to talik development/unit E)

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.

2015 Aquatic Sciences Meeting: Global And Regional Perspectives - North Meets South