Lacustrine Records of Mountain Glacier Fluctuations from Western Greenland (C13B - 0440)

Avriel D. Schweinsberg[1] (a.schweinz@gmail.com) Jason P. Briner[1] Ole Bennike[2]

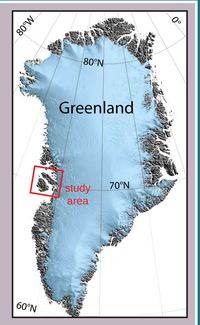
1. Department of Geological Sciences, University at Buffalo, Buffalo, NY, 14260 USA *2. Geological Survey of Denmark and Greenland, Øster Voldgade 10, 1350 Copenhagen-K, Denmark*

INTRODUCTION

The relative timing of mountain glaciation during the Holocene in Greenland is poorly understood (Kelly and Lowell, 2009).

The main objectives of this study are to:

- **present records of mountain glacier variability** from continuous proglacial lake sediment sequences recovered from two glaciated catchments in eastern Nuussuaq, western Greenland
- **combine** lake sediment analysis with cosmogenic ^{10}Be dating of Holocene moraines and ^{14}C dating of ice-cap-killed vegetation
- **test the hypothesis** that times of persistent snowline lowering recorded by *in-situ* vegetation correspond to enhanced glacier activity documented in lake sediment records
- **provide insight on local ice cap variability and implications for climate change** in western Greenland during the Neoglacial period



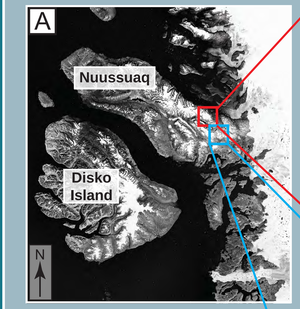
BACKGROUND and METHODS

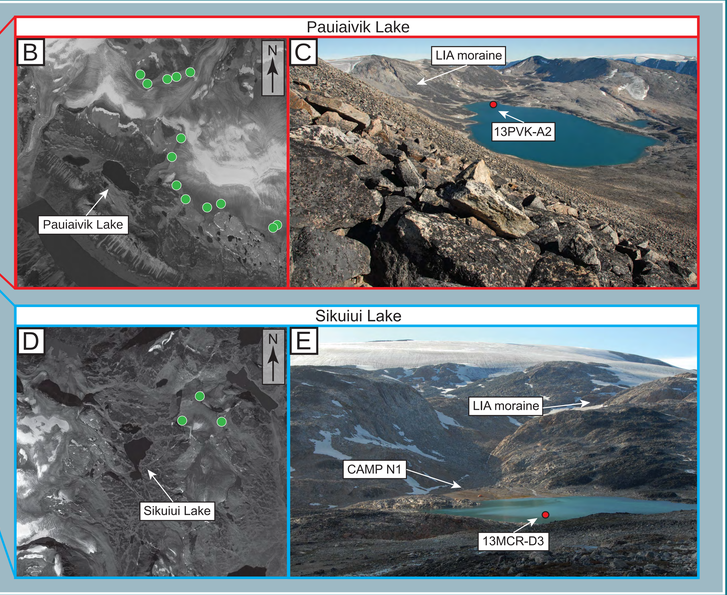
- Mountain glacier fluctuations in western Greenland are largely constrained by geologic mapping and historical observations (e.g., Pjetursson, 1898; Weidick, 1986; Ingólfsson et al., 1990).
- The timing of local glacier fluctuations has been developed in selected locations from radiocarbon dating and historical accounts of late Holocene maximum ice extents (e.g., Kelly, 1985; Steenstrup, 1990; Ingólfsson et al., 1990).

Left: *Ole Bennike with core 13MCR-D3.* ***Top right:*** *ITRAX XRF core scanner at UMass Amherst.* ***Bottom right:*** *Geotek core scanner analyzing 13PVK-A2 for magnetic susceptibility and color spectrophotometry at UMass Amherst.*

- Lake sediment analyses include loss-on-ignition (LOI; 0.5 cm), moisture content (0.5 cm), magnetic susceptibility (2 mm), gamma density (2 mm), color spectrophotometry (2 mm), and ITRAX elemental abundance analysis and digital imagery (2 mm).

FIELD SITES



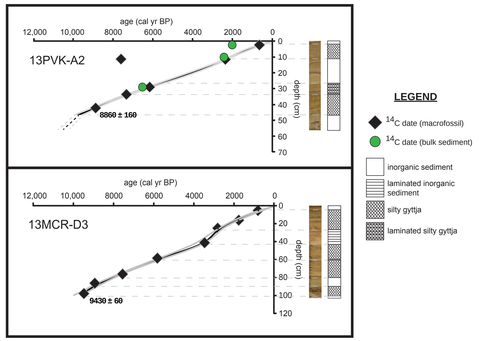


(A) *Map of study area showing the locations of lakes cored in this study. Red box illustrates boundaries of the Pauiaivik Lake inset map; blue box represents the inset map for Sikuiui Lake (both shown to the right).*

(B) and (C) *Inset map and photo of Pauiaivik Lake, respectively. Green circles refer to in-situ vegetation samples collected along local ice cap margins in summer 2013. View in the photo is to the southeast.*

(D) and (E) *Inset map and photo of Sikuiui Lake, respectively. View in the photo is to the west.*

AGE-DEPTH MODELS



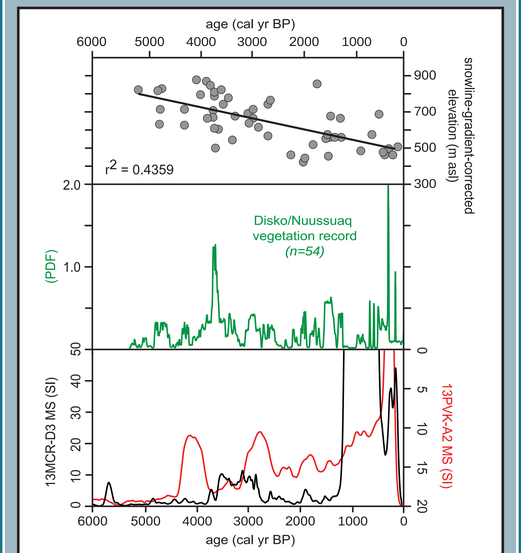
Age-depth models and stratigraphy for cores 13PVK-A2 (top panel) and 13MCR-D3 (bottom panel). Lowermost radiocarbon ages provide minimum ages for regional deglaciation. Gray dashed lines represent boundaries of major stratigraphic units.

Age-depth models were constructed from aquatic macrofossils and bulk sediment samples.

ACKNOWLEDGEMENTS

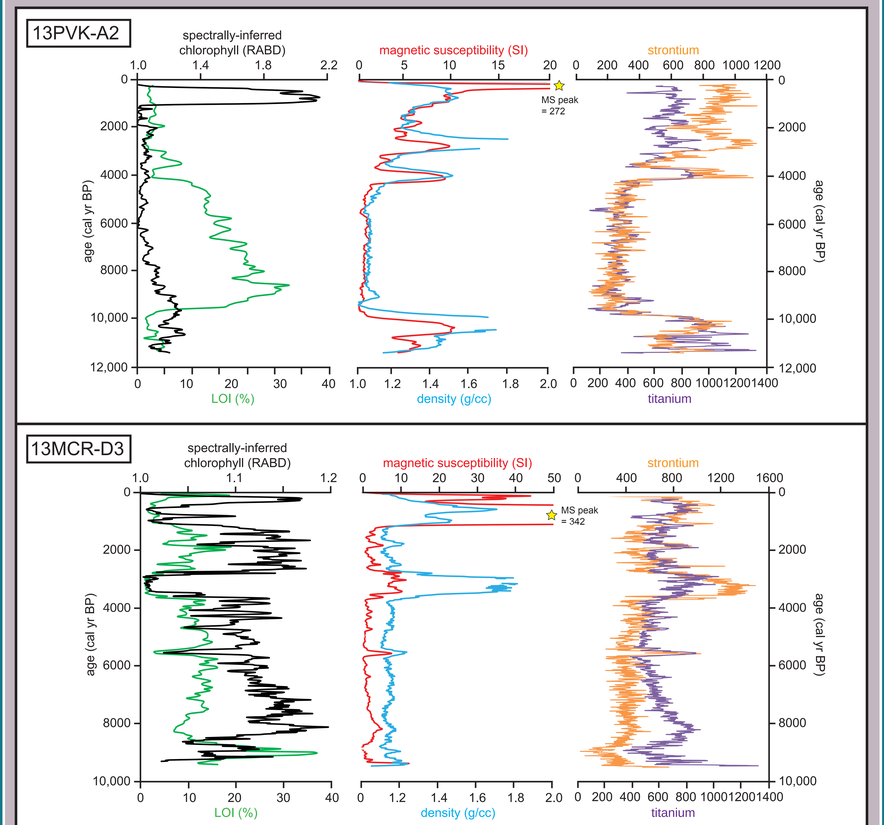
This research was supported by NSF grant ARC-1204005. We thank Dr. Julie Brigham-Grette and Dr. J.M. Rhodes for the opportunity to use the Geotek and ITRAX XRF core scanners, Dr. Gifford Miller, Casey Beel and KISS for their assistance in the field, and Sandra Cronauer for help with generating data in the UB paleoclimate lab.

PROXY COMPARISONS



Comparison of MS records from Pauiaivik and Sikuiui Lakes against the Disko/Nuussuaq vegetation record associated with this project. Peaks in the vegetation ages correspond to times of persistent snowline lowering and subsequent ice cap expansion.

LAKE SEDIMENT ANALYSES



Results for Pauiaivik Lake (core 13PVK-A2; top panel) and Sikuiui Lake (core 13MCR-D3; bottom panel).

- Basal ^{14}C ages provide minimum-age constraints on deglaciation from Sikuiui and Pauiaivik lakes of ~9,430 and ~8,860 cal yr BP, respectively.
- Low minerogenic sediment from deglaciation until ~5.0 ka in Pauiaivik Lake suggests minimal glacial activity there while slightly elevated MS values from ~9.0 - 7.0 ka in Sikuiui Lake may reflect early Holocene glacial activity.
- Increasing minerogenic input from ~5.0 ka to present in Pauiaivik Lake indicates increasing intensity of Neoglaciation that is consistent with gradual snowline lowering over the past ~5.0 ka recorded by the vegetation dataset.
- Peaks in vegetation kill dates are broadly correlative to elevated minerogenic input in Pauiavik and Sikuiui Lakes. Ice cap expansion phases at ~4.8, ~3.7, ~3.0 and ~1.5 ka occur just before, or in-step with, increased minerogenic input.
- Lake sediment core sites and the vegetation record both reveal periods of local ice cap expansion associated with the LIA.

SELECTED REFERENCES

Ingólfsson, O., Frich, P., Funder, S., Humlum, O., 1990. Palaeoclimatic implications of an early Holocene glacier advance on Disko Island, west Greenland. Boreas 19, 297-311.
Kelly, M., 1985. A review of the Quaternary geology of western Greenland. In: Andrews, J.T. (Ed.), Quaternary Environments in Eastern Canadian Arctic, Baffin Bay and Western Greenland. Allen and Unwin, Boston, pp. 461-501.
Kelly, M.A., Lowell, T. V., 2009. Fluctuations of local glaciers in Greenland during latest Pleistocene and Holocene time. Quaternary Science Reviews 28, 1-19.
Pjetursson, H., 1898. Geologiske optegnelser. In: Petersen, F., (Ed.), Opmaalingsekspeditionen til Egedesminde-Distrikt. Meddelelser om Gronland 14, 288-348.
Steenstrup, K.J.V., 1900. Beretning om en unders−gelsesrejse til Oen Disko i sommeren 1898. Meddelelser om Gronland 24, 249-307.
Weidick, A., 1968. Observations on some Holocene glacier fluctuations in west Greenland. Meddelelser om Gronland 165, 1-202.