Holocene mountain glacier variability in the Sukkertoppen region, western Greenland (PP13A-2052)

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INTRODUCTION

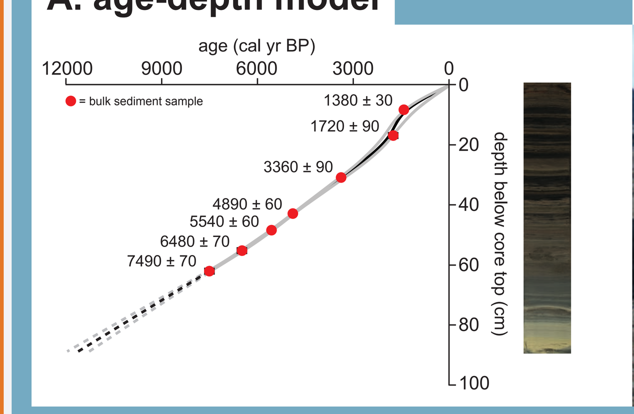
- Knowledge of past local glacier change on centennial timescales is lacking in Greenland (Kelly and Lowell, 2009).
- We reconstruct local glacier change through the Holocene using three methods: lake sediment analysis, exposure dating (^{10}Be and ^{14}C) and ^{14}C-dating of rooted mosses in the Sukkertoppen region of West Greenland.
- Our multi-proxy approach provides details not achieved with a single proxy and provides the first continuous records of local glacier change from this area.

METHOD 1: Sediment cores

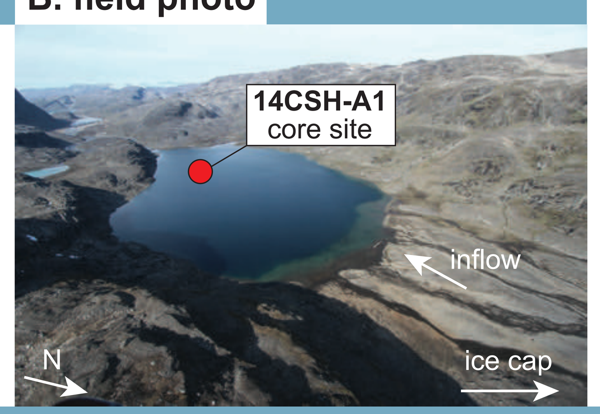
→ Sediment cores from proglacial lakes provide continous centennial-scale records of local glacier change.

Crash Lake

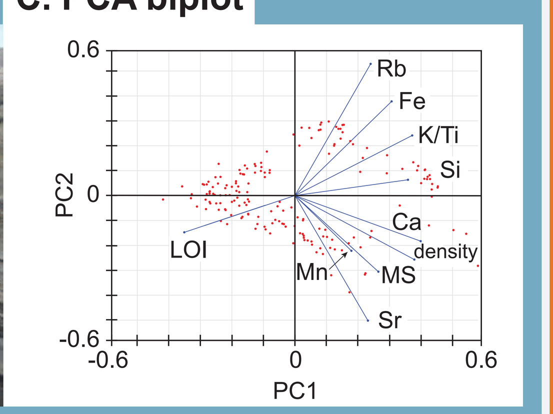
A. age-depth model



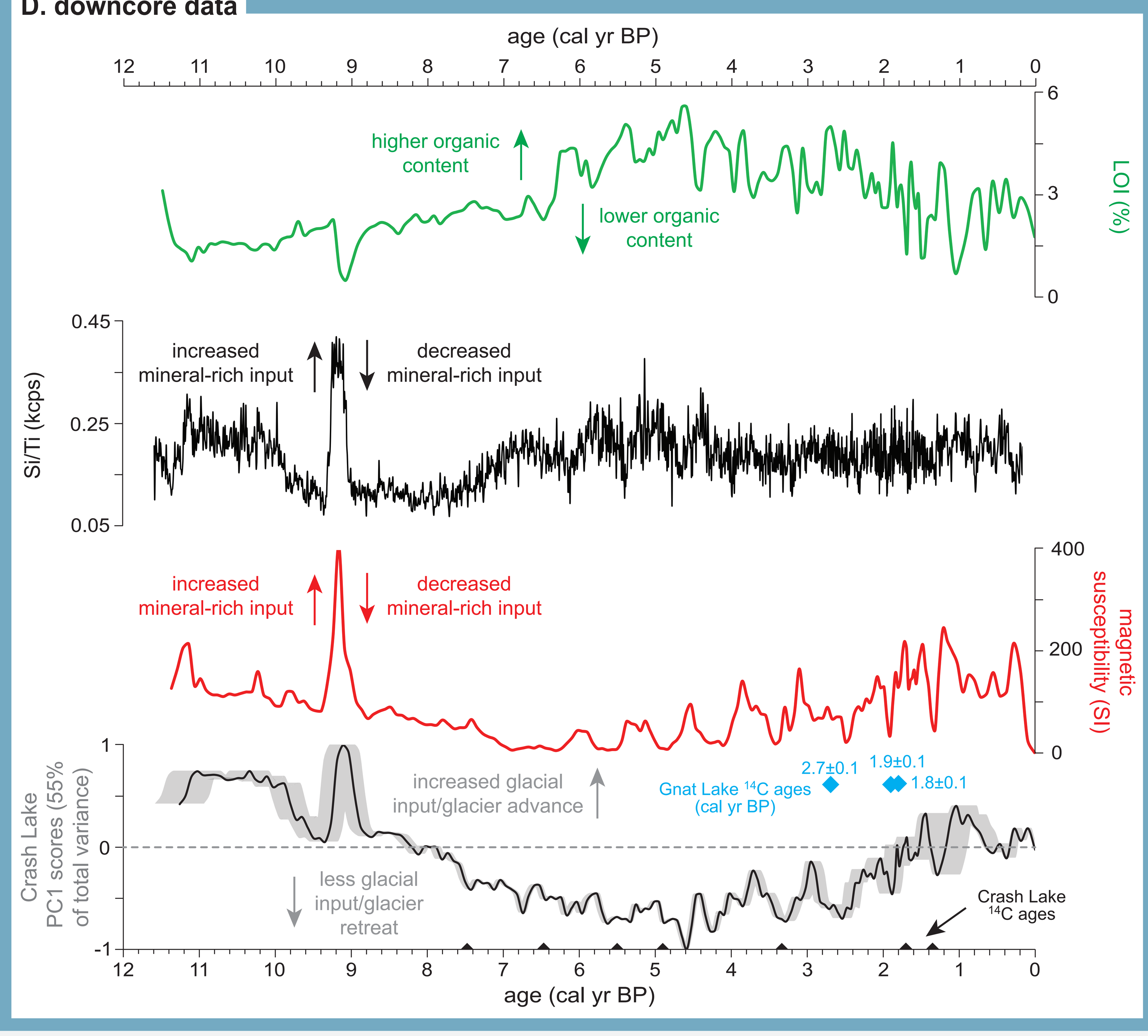
B. field photo



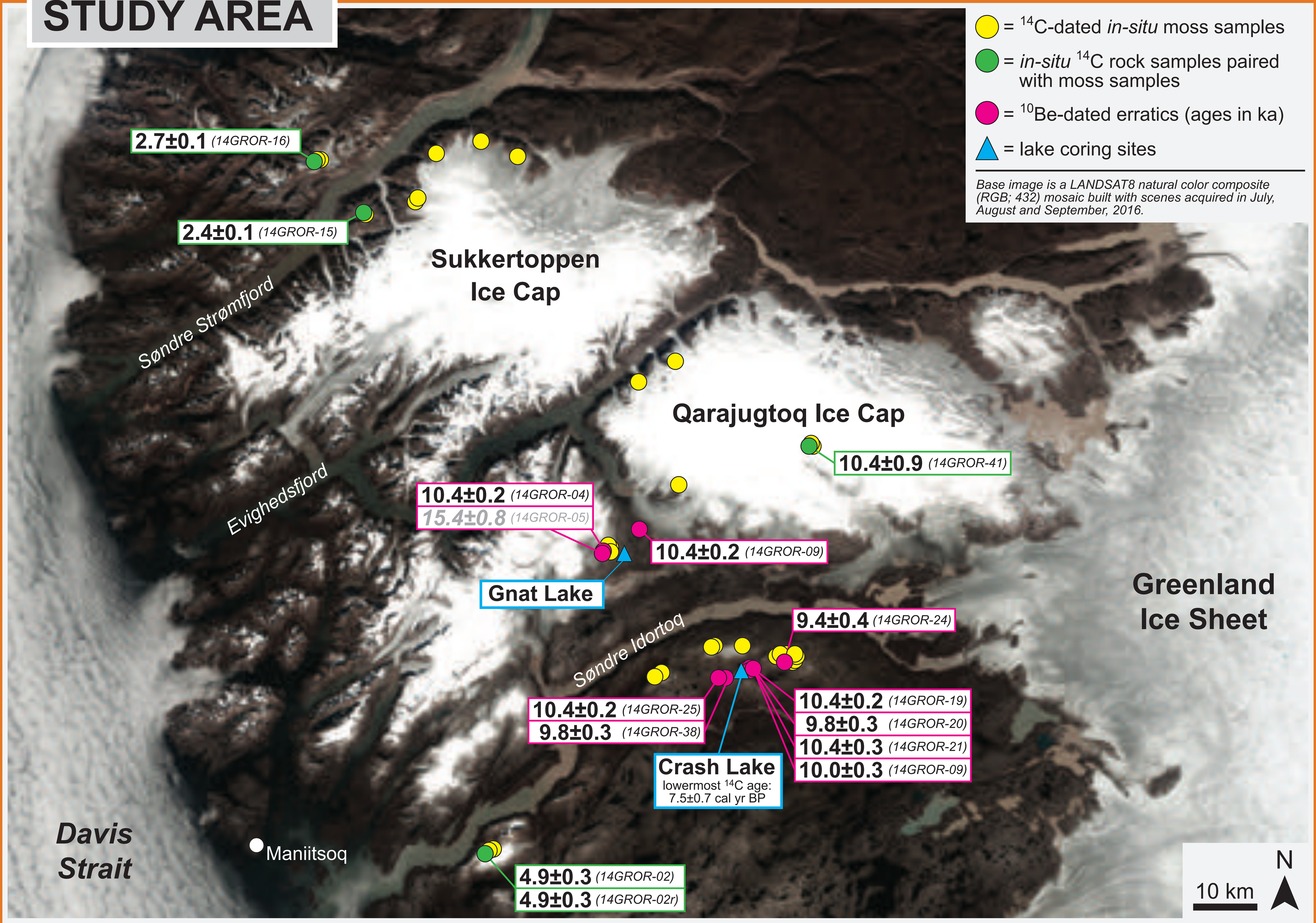
C. PCA biplot



D. downcore data



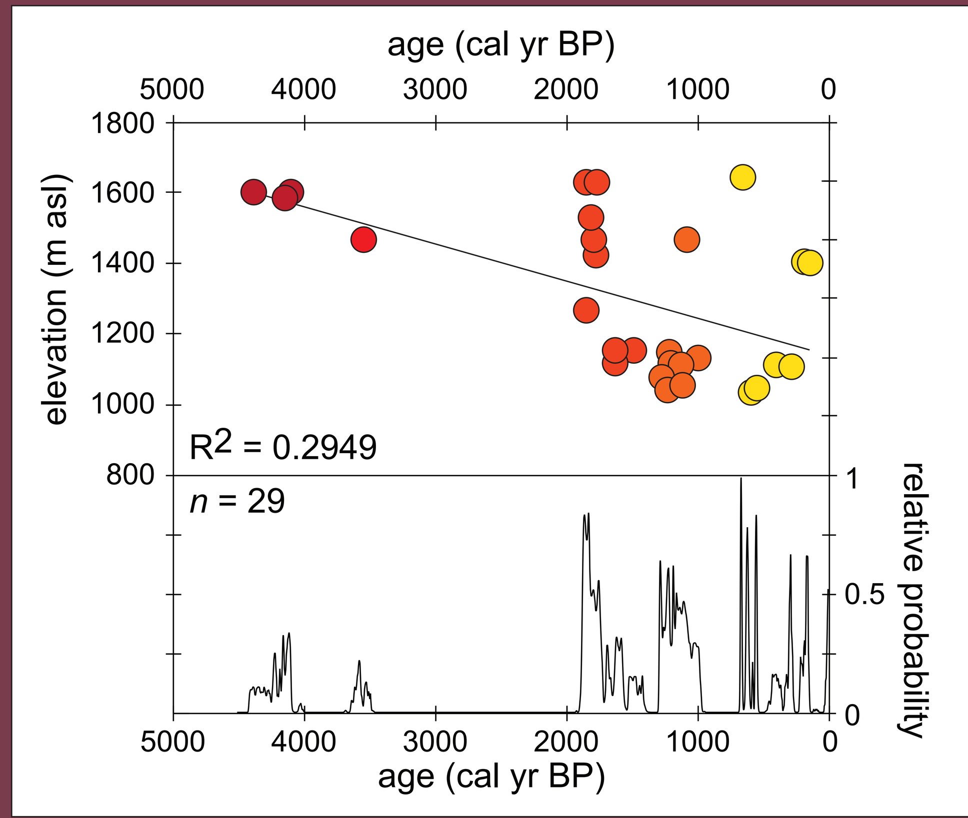
STUDY AREA



METHOD 2: ^{14}C moss chronology

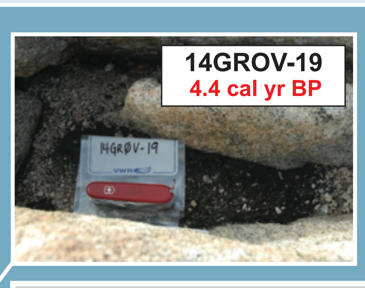
→ ^{14}C ages of rooted mosses precisely define the timing of past ice cap expansion and net snowline depression across the field area.

- Radiocarbon ages (n=29) of rooted mosses reflect the onset of snowline lowering at ~4.5-4.0 cal kyr BP followed by episodic snowline lowering after ~2.0 cal kyr BP.
- The majority (86%) of ^{14}C ages occur within the past 2 kyr, clustering between ~1.9-1.5, ~1.3-1.0 and ~0.7-0.2 cal kyr BP, suggesting an intensification of summer cooling and snowline lowering at this time.
- A lack of ^{14}C ages occurs between ~4.0-2.0 cal kyr BP with the exception of a single ^{14}C age at ~3.6 cal kyr BP. This may reflect little or no sustained snowline depression during this interval, or is an artifact of a small dataset.



METHOD 3: *in-situ* ^{14}C exposure/burial dating

→ Combining ^{14}C ages of rooted mosses with *in-situ* ^{14}C exposure ages of adjacent bedrock helps constrain the total duration of Holocene ice cover and provides insight on the history of ice expansion during the Holocene.



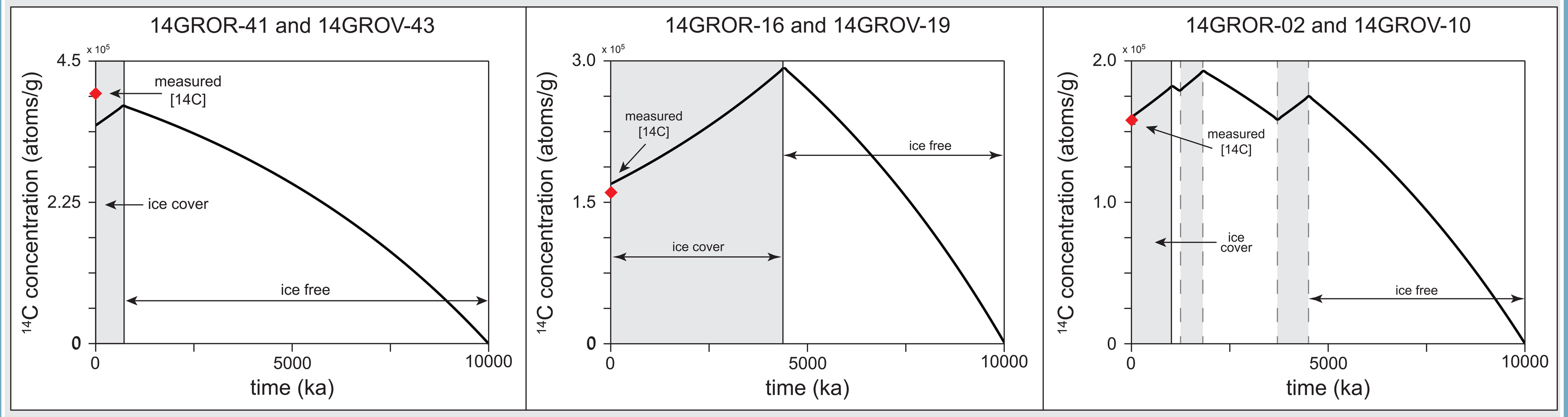
rock-moss pairs

in-situ ^{14}C exposure age & sample ID	moss ^{14}C age & sample ID
4.9±0.3 ky (14GROR-02) *4.9±0.3 ka (14GROR-02r; replicate)*	**1.0±0.1 cal yr BP** (14GROV-10)
2.4±0.1 ky (14GROR-15)	**3.6±0.1 cal yr BP** (14GROV-15)
2.7±0.1 ky (14GROR-16)	**4.4±0.1 cal yr BP** (14GROV-19)
10.4±0.9 ky (14GROR-41)	**0.7±0.1 cal yr BP** (14GROV-43)

In situ ^{14}C ages calculated with a production rate of 13.0±0.5 atoms g^{-1} yr^{-1} (Borchers et al., 2016; Phillips et al., 2016).

Possible burial scenarios: When did ice cover the site during the Holocene?

→ In order to model the exposure history, constraints on periods of ice cover (or lack thereof) are incorporated from moss and lake core ^{14}C dates, and other regional climate proxies.



→ Differences in the measured [14C] versus the modeled [14C] may be due to the effects of thin ice shielding (Miller et al., 2006; Anderson et al., 2008) and/or production pathways.

CONCLUSIONS

- ^{10}Be-dated erratics constrain local deglaciation to 10.1±0.4 ka (n=9).
- A prominent peak in Crash Lake downcore data at ~9 ka punctuates the early Holocene and may reflect glacier advance correlative with nearby ice sheet moraines (Lesnek et al., *in prep*).
- Crash Lake PC1 scores suggest that local ice expanded at ~1.8 cal yr BP, which is synchronous with increased mineral-rich input in Gnat Lake at ~1.8 cal yr BP, and with ^{14}C ages in the moss chronology.
- *In situ* ^{14}C ages indicate that moss ^{14}C ages only represent the most recent period of ice cover at a particular site, and that additional periods of burial occurred in this region during the Holocene.

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