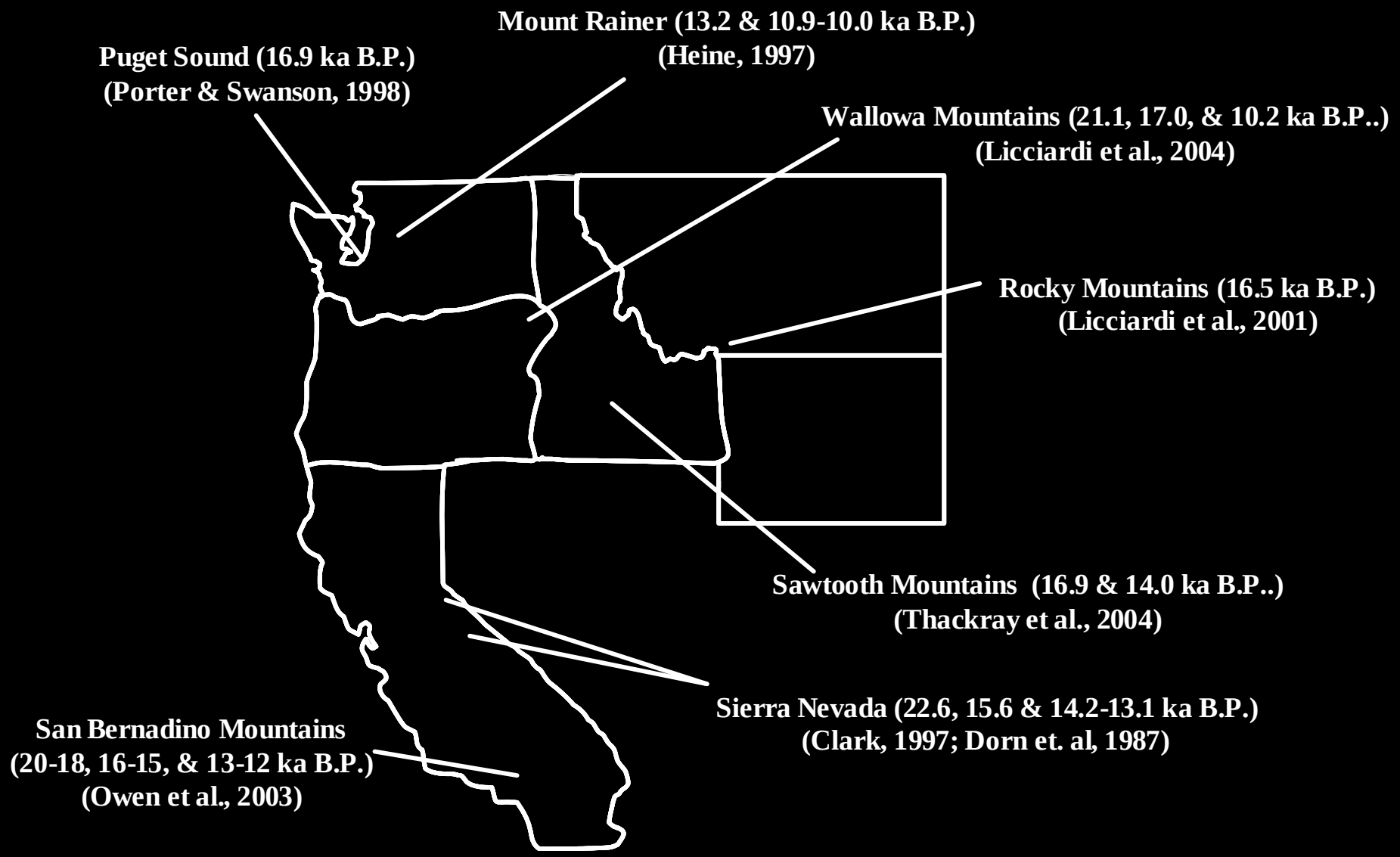
# The glacial history and paleoclimate record at Three Sisters Volcanoes, OR

A M.S. Thesis by Shaun Marcott

***South Sister from Green Lake***

# Late-Pleistocene Glacial Advances in the western United States



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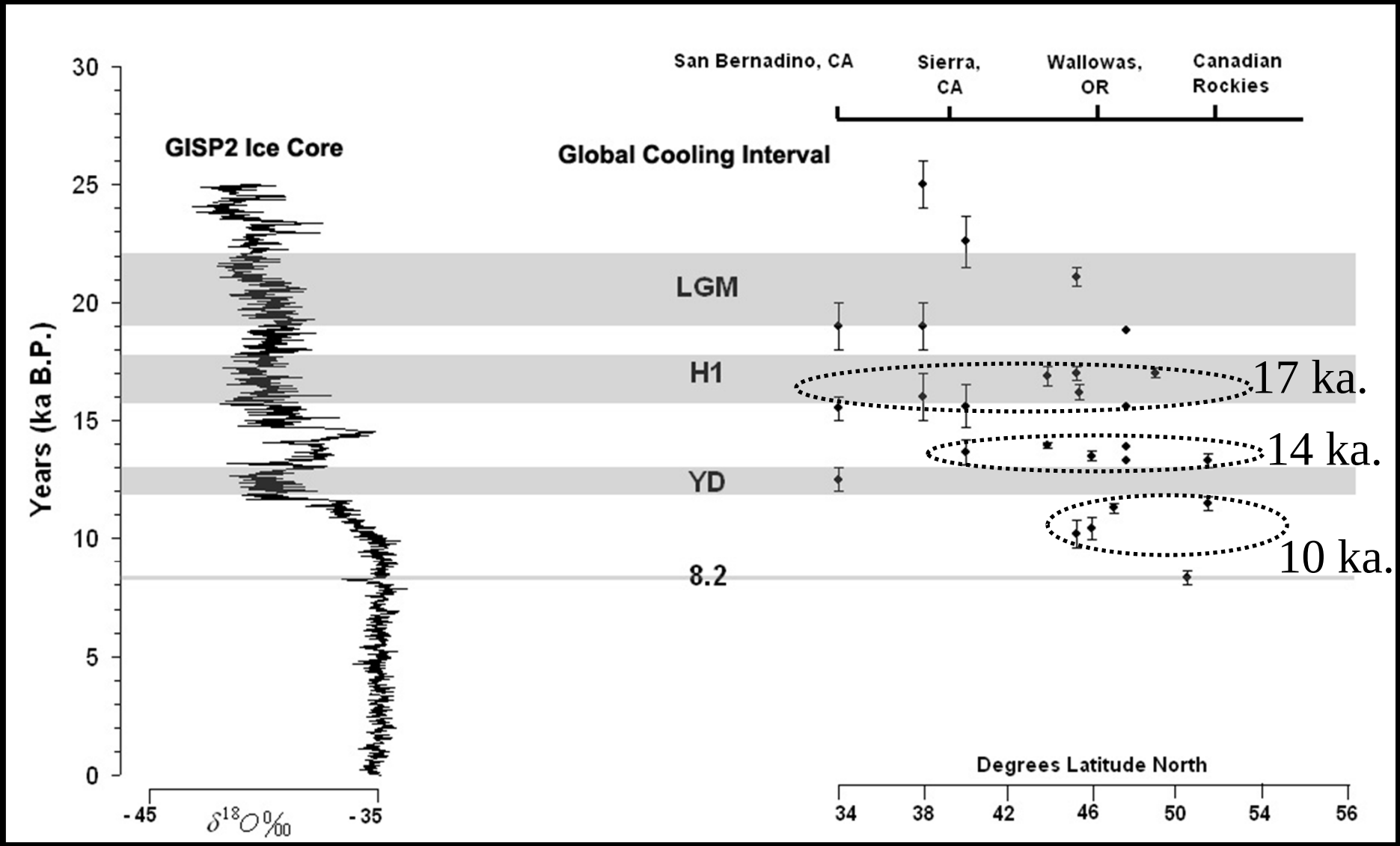

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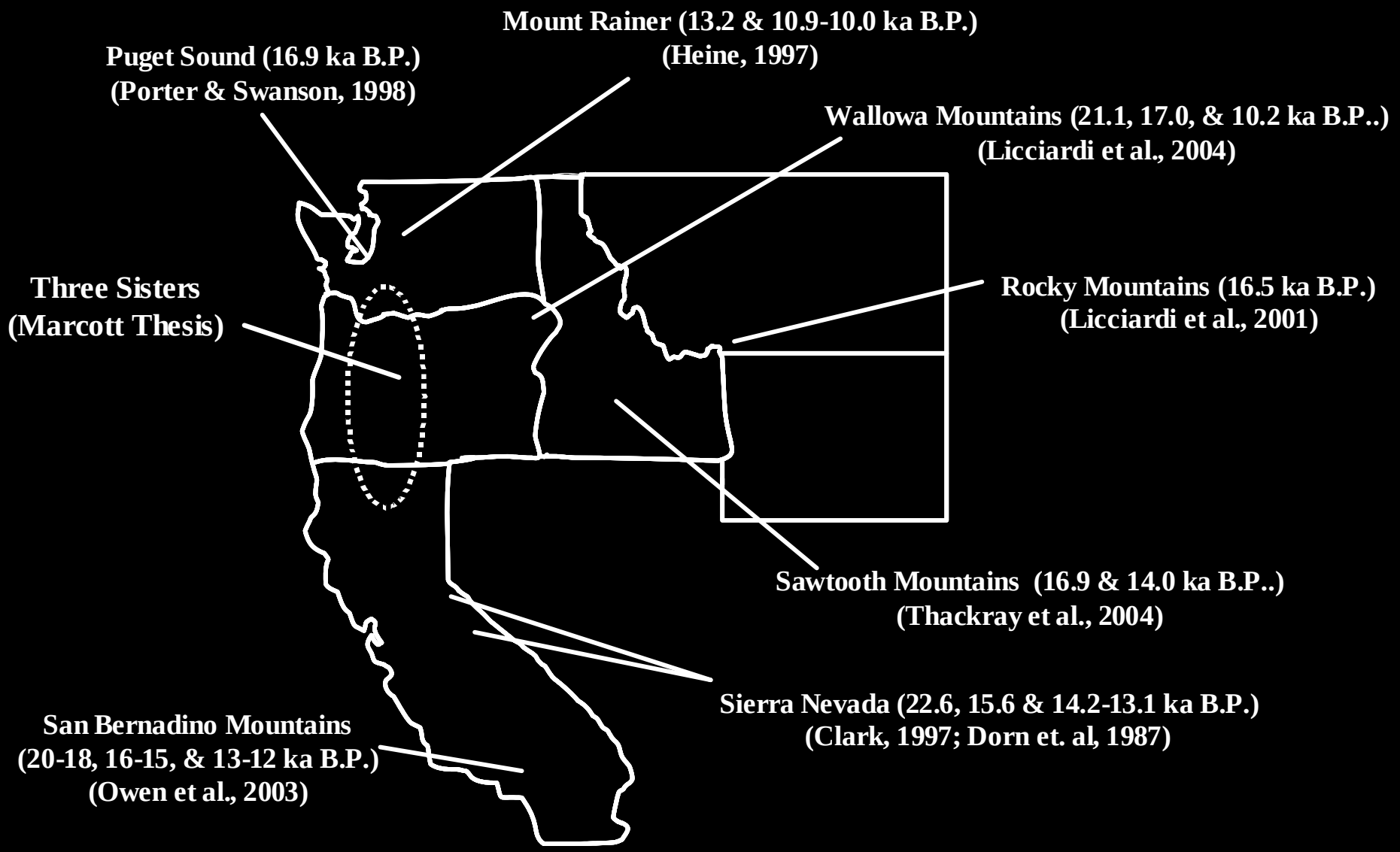
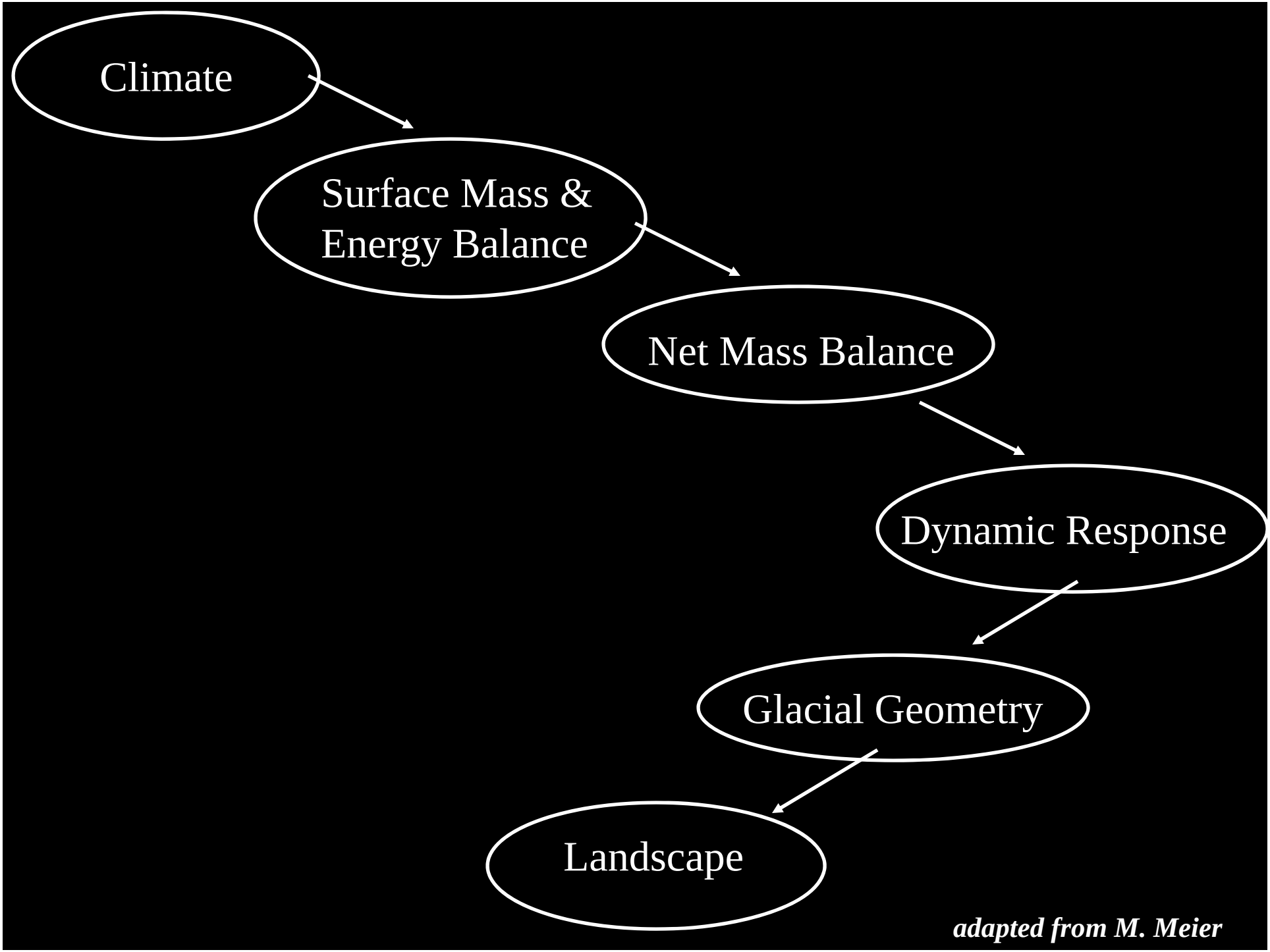
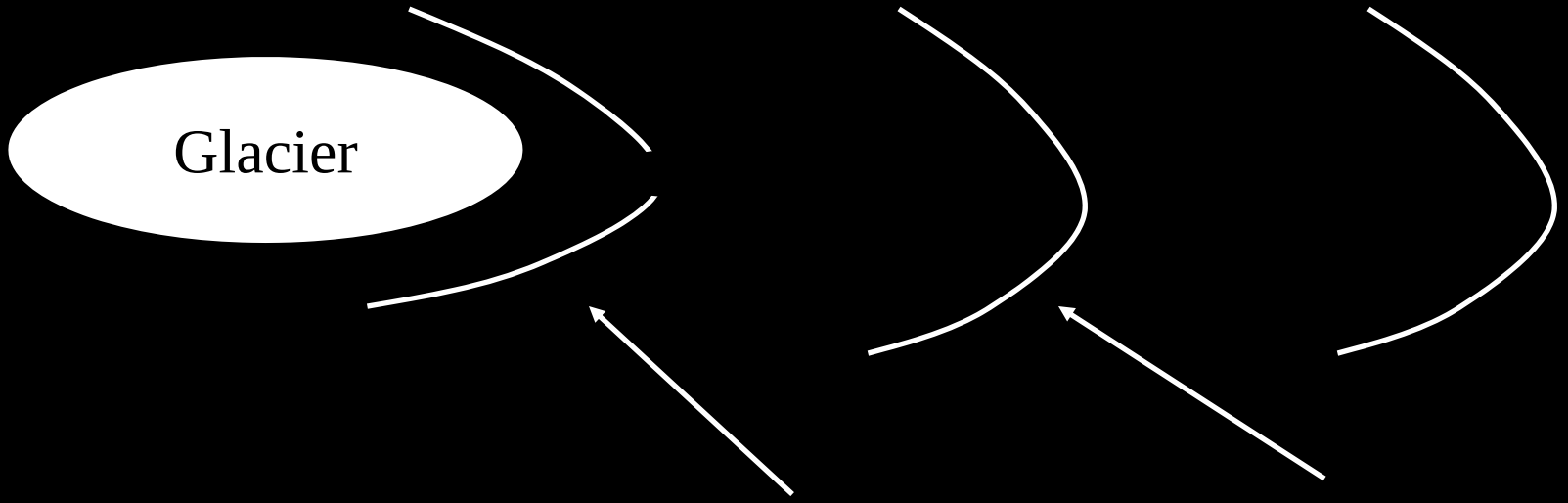


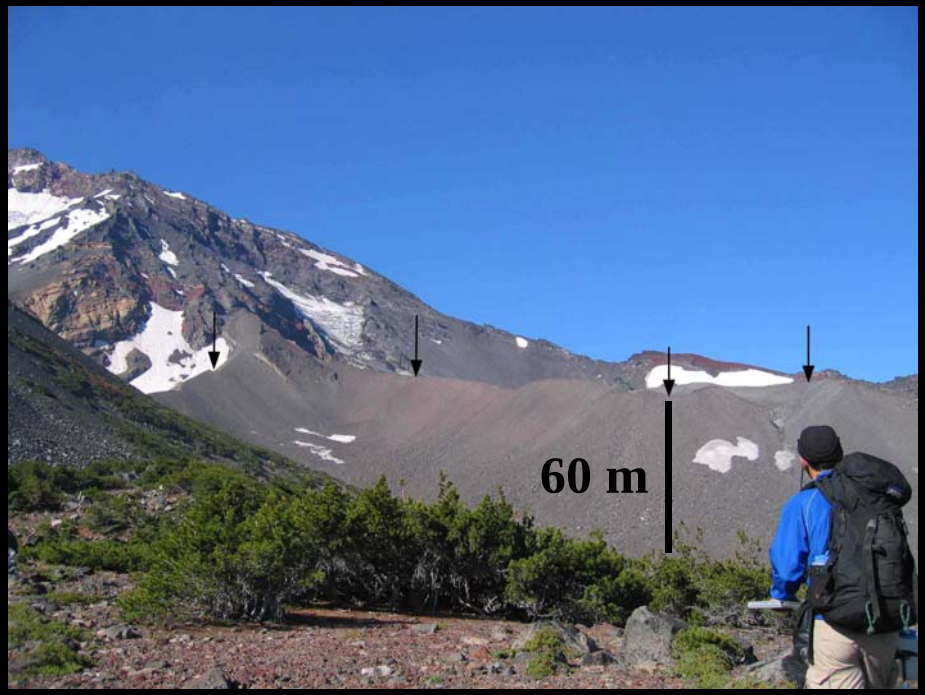
# Field Site Location


*(Scott, Iverson, Schilling, and Fisher, 2001)*

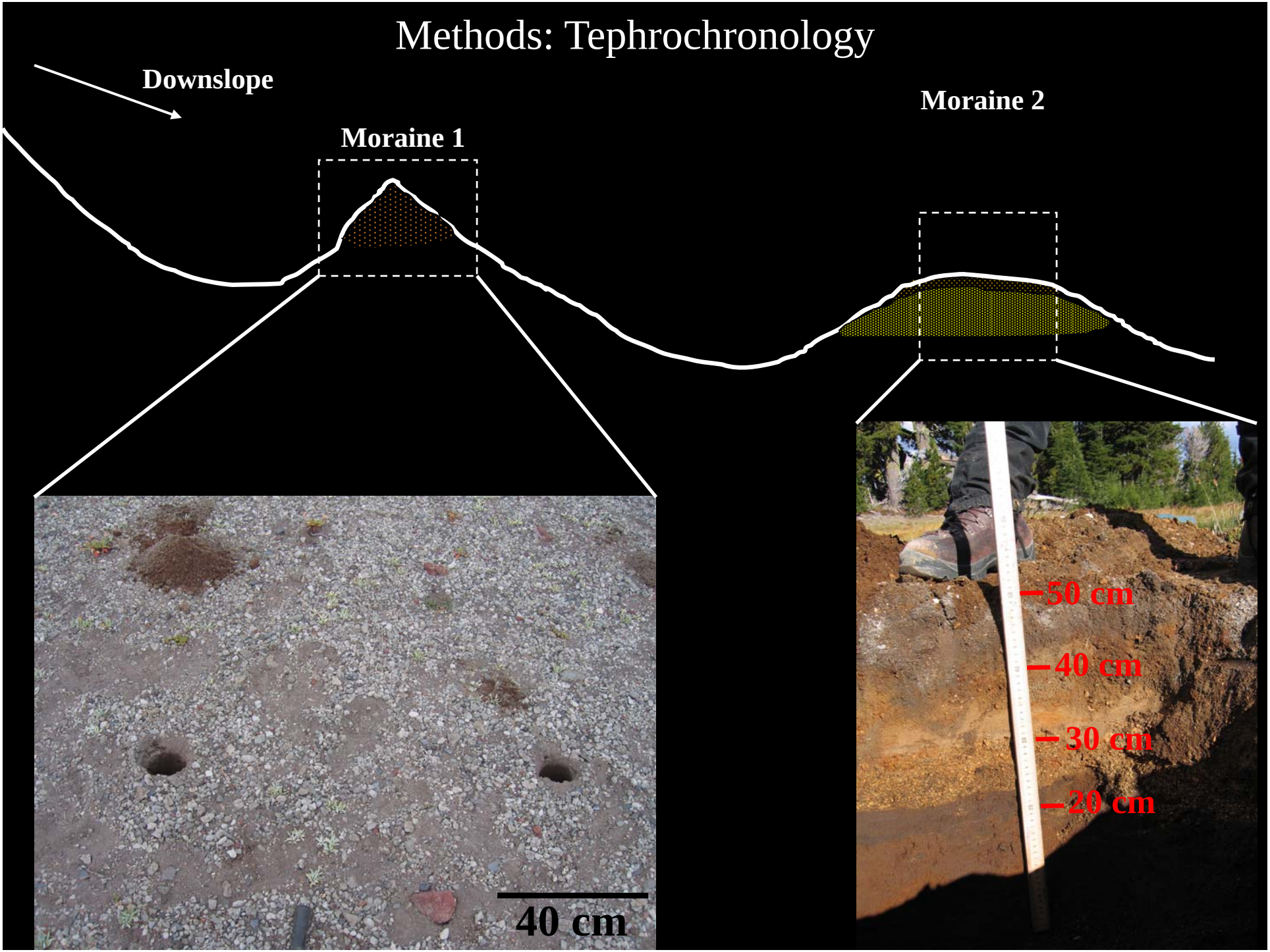

Climate
Surface Mass &
Energy Balance
Net Mass Balance
Dynamic Response
Glacial Geometry
Landscape
adapted from M. Meier

# Methods: Moraine Mapping

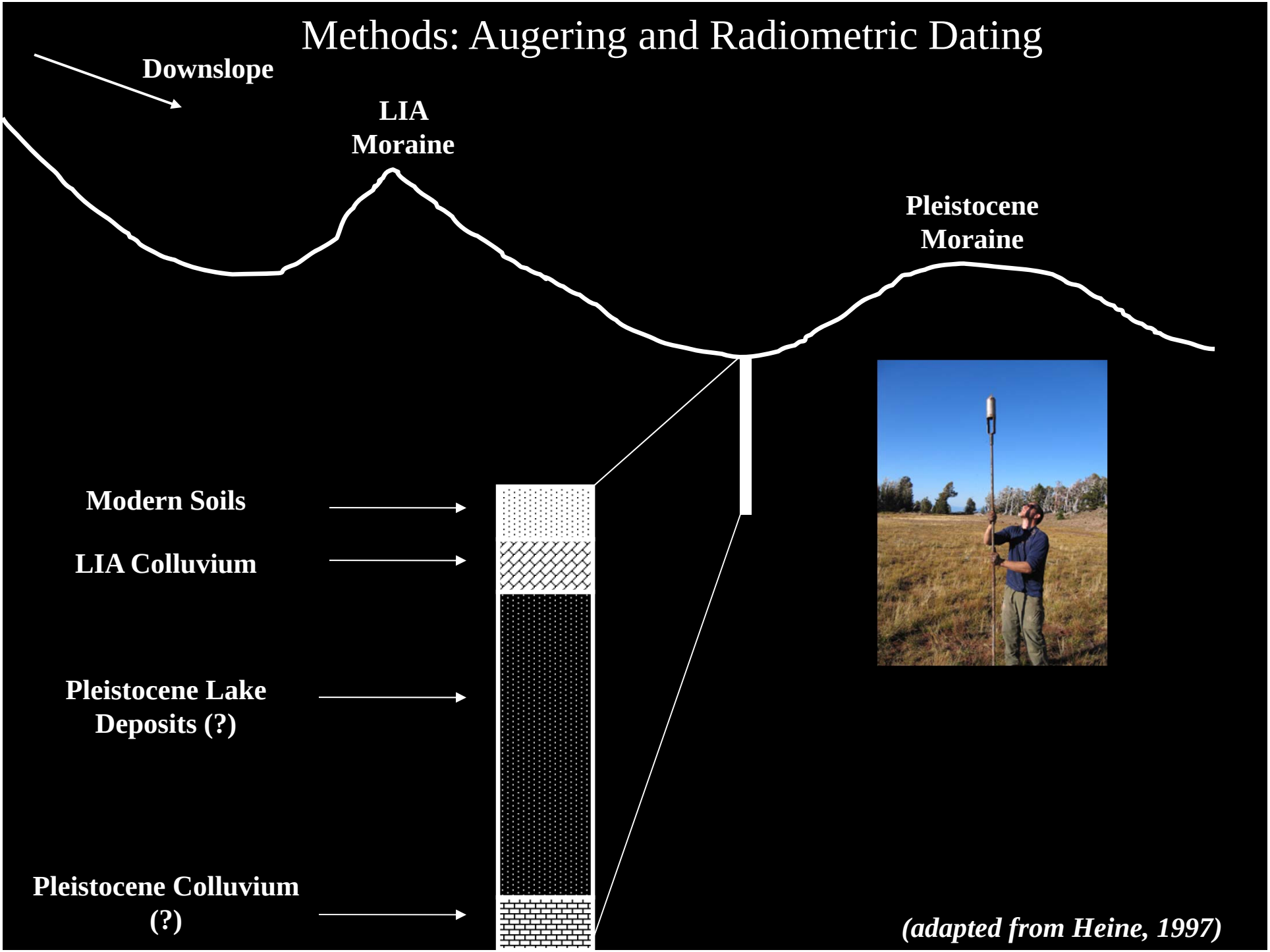



# Methods: Tephrochronology



# Methods: Augering and Radiometric Dating



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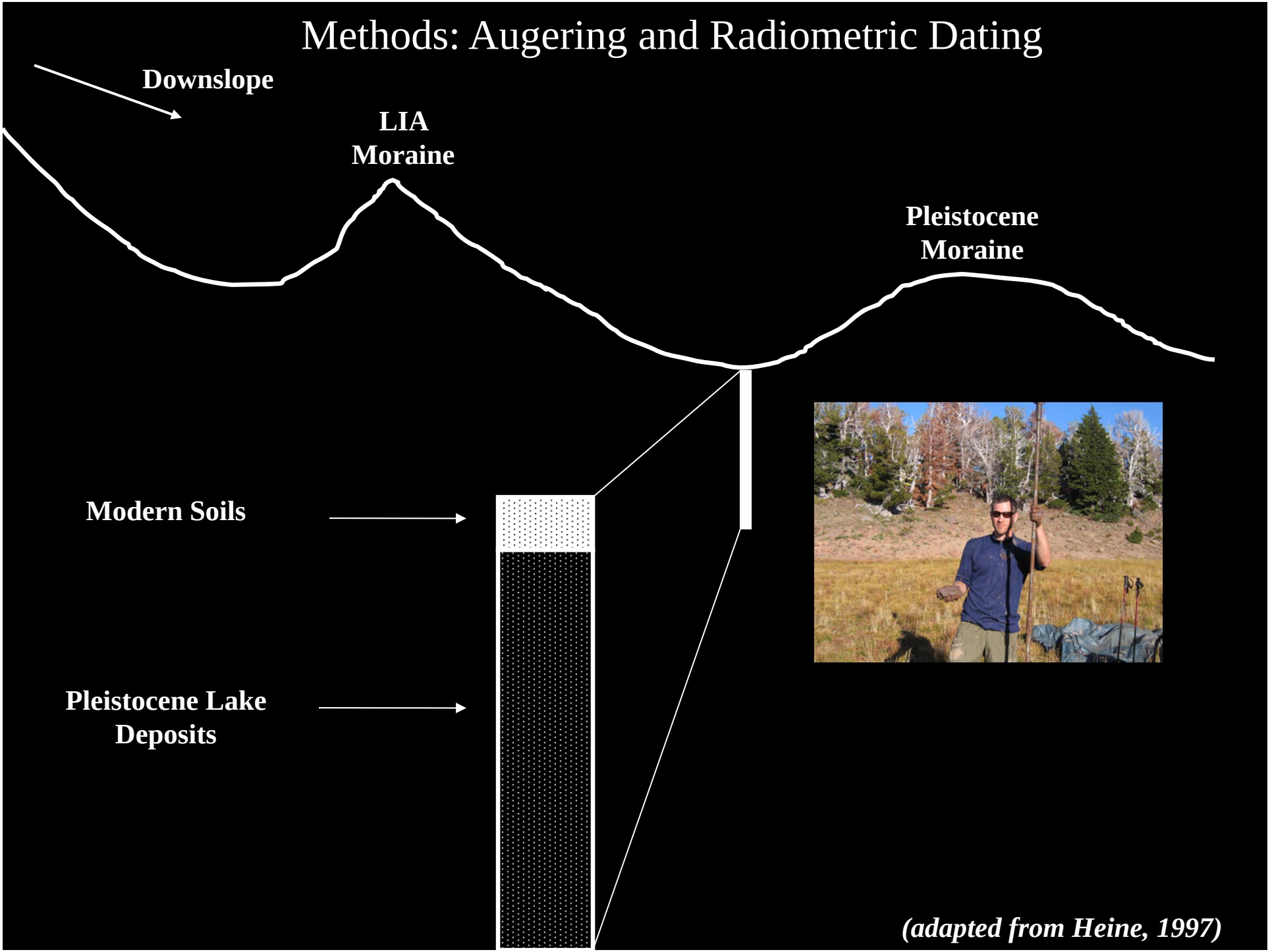
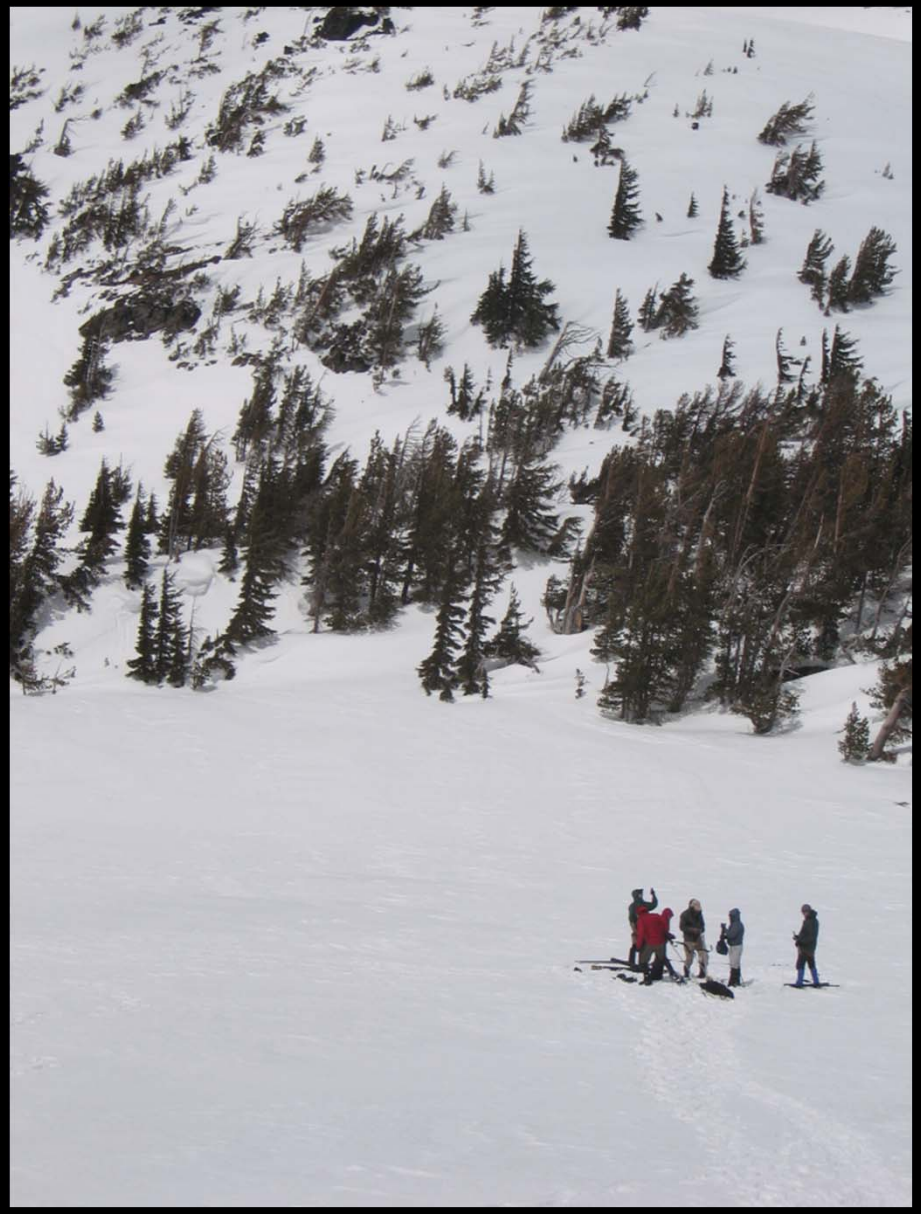


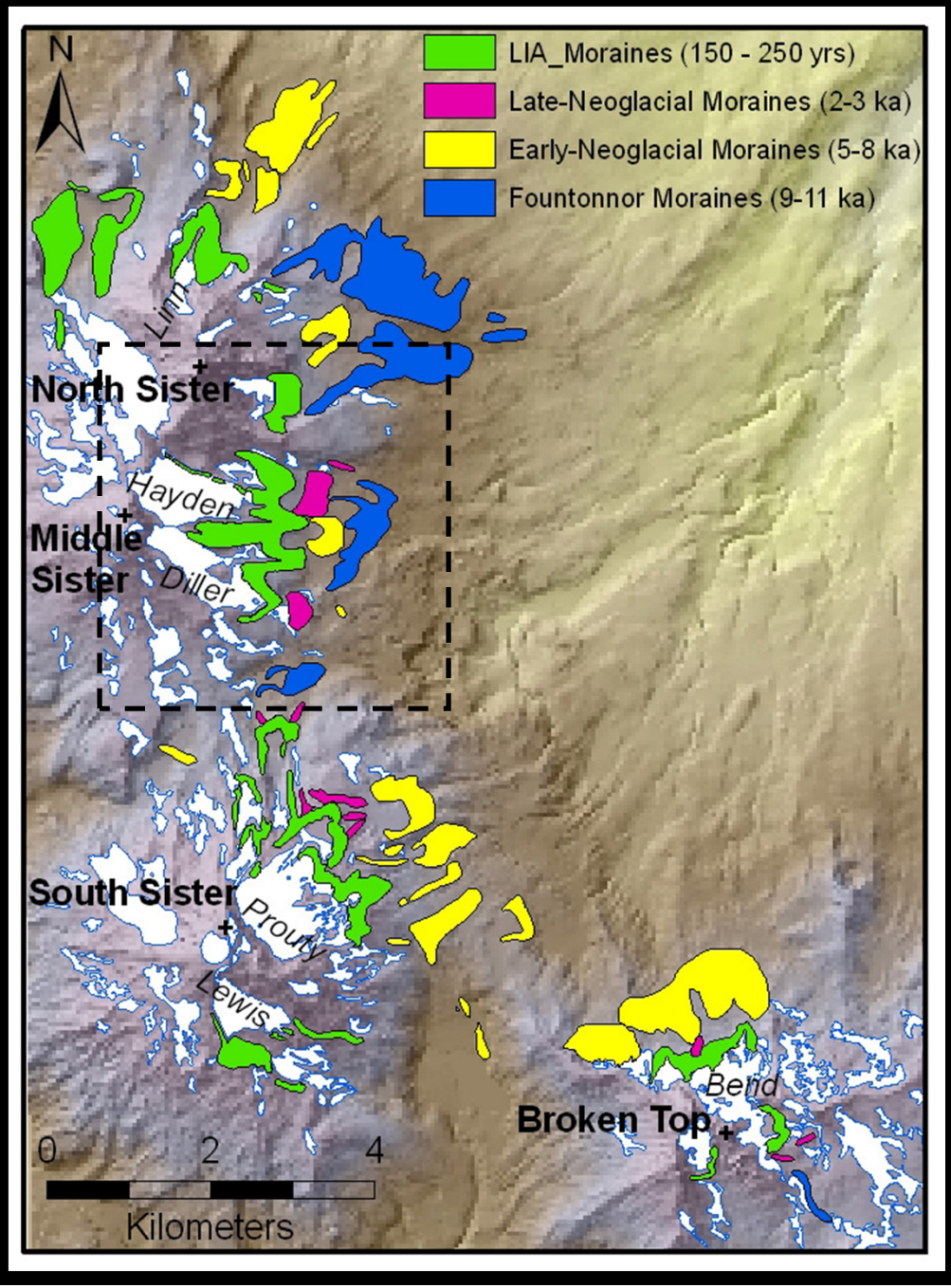
# Methods: Lake Coring



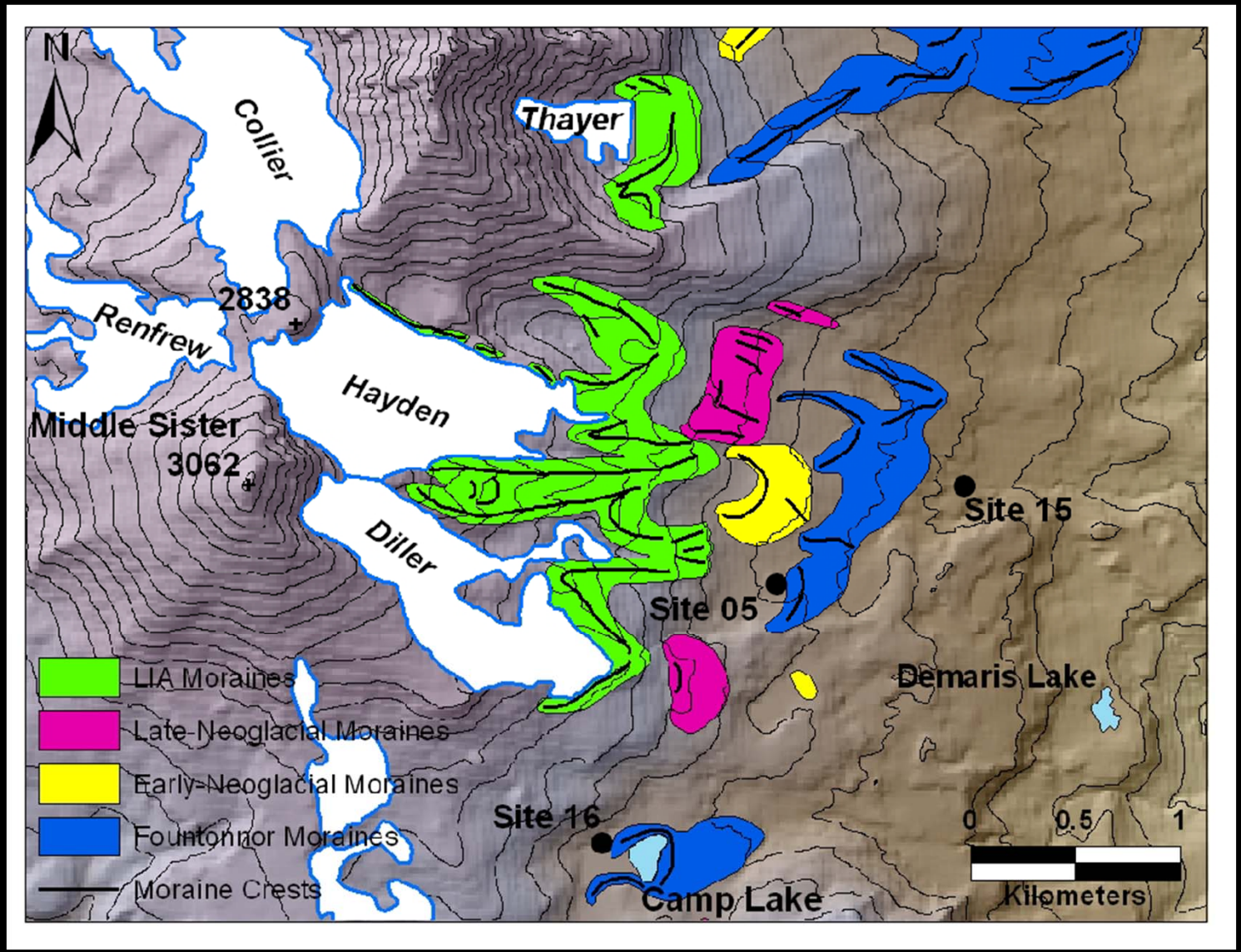
*D. Clark & N. Bowerman*

***(photos by A.Fines)***

# Results: Glacial Deposit Maps



# Results: Auger Stratigraphy



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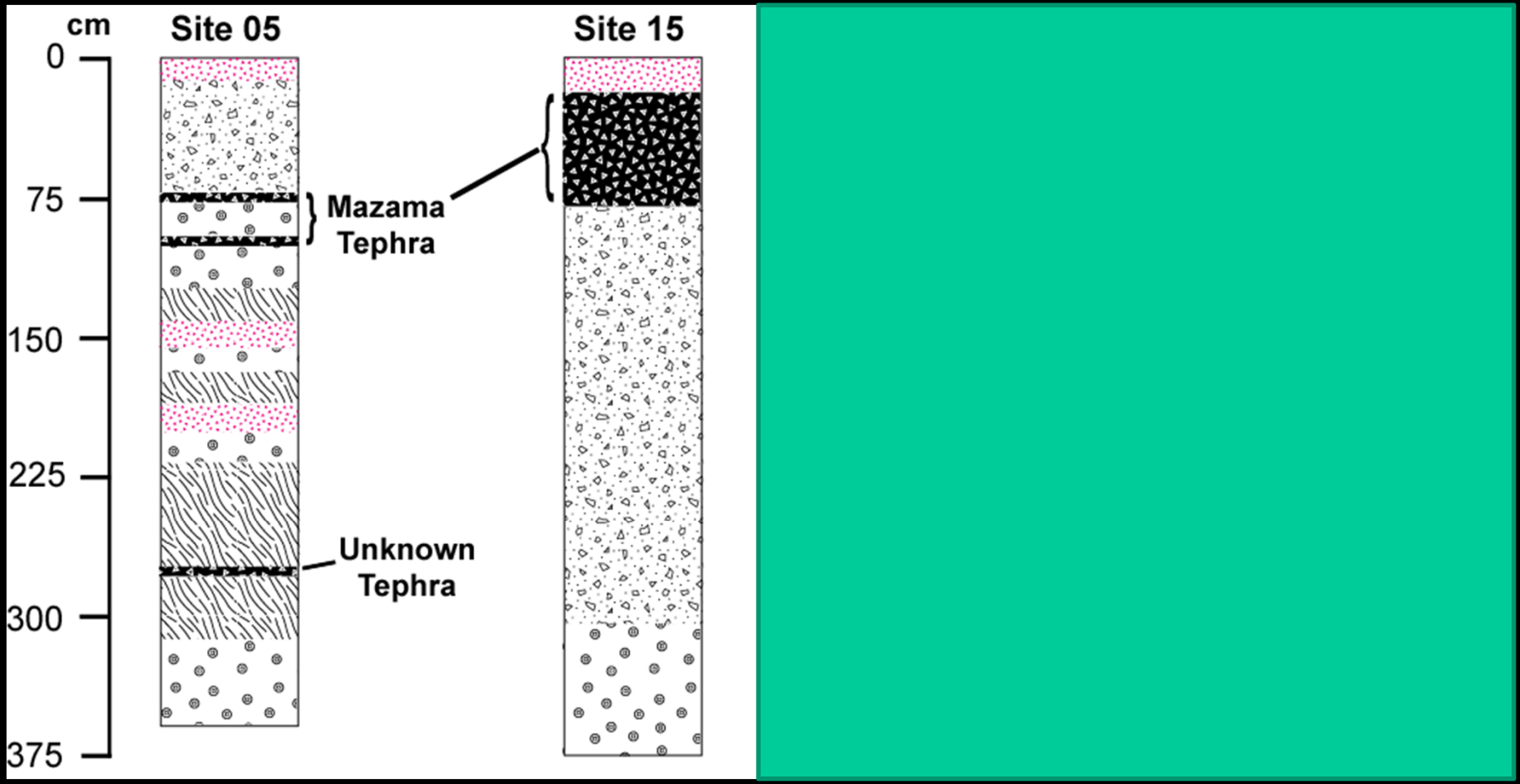
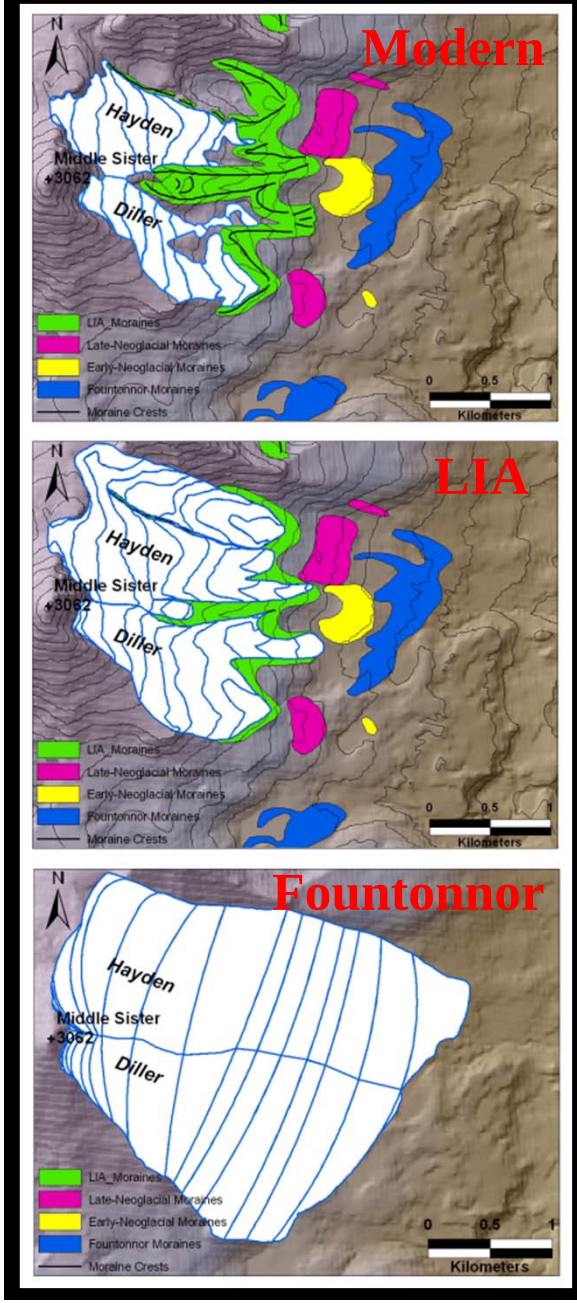


# Equilibrium Line Altitude (ELA) Calculations




## Accumulation Area Ratio Method *(Meier and Post 1962)*

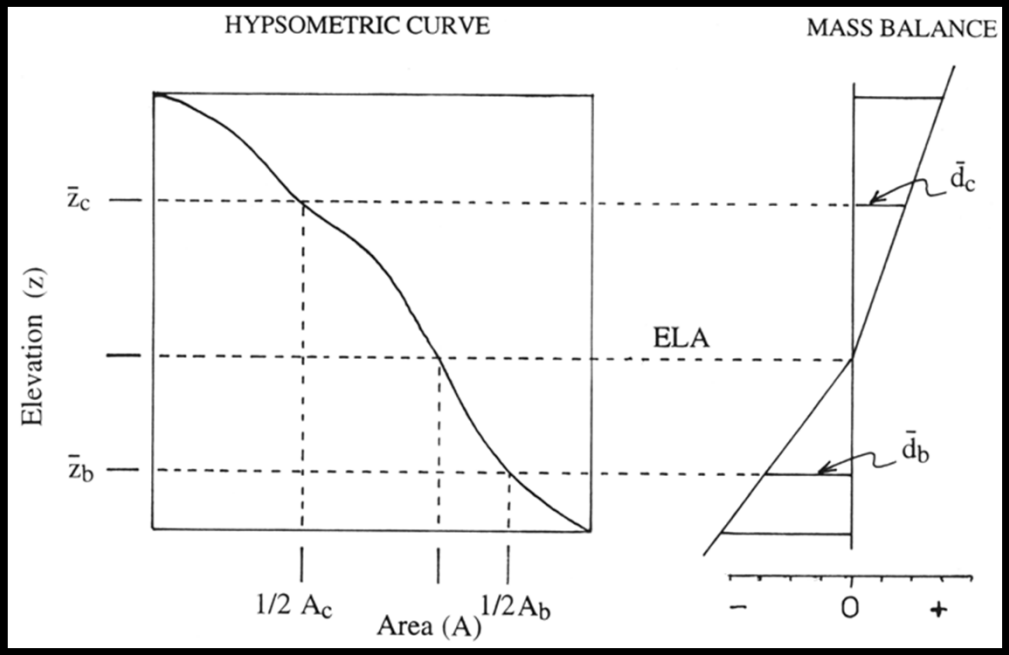
$0.65 \pm 0.1$

## Balance Ratio Method *(Furbish and Andrew, 1984)*

$$B_{nb}\, z_b A_b = B_{nc} z_c A_c$$

$$B_{nb} / B_{nc} = z_c A_c / z_b A_b$$

$$B_{nb} / B_{nc} = 2$$

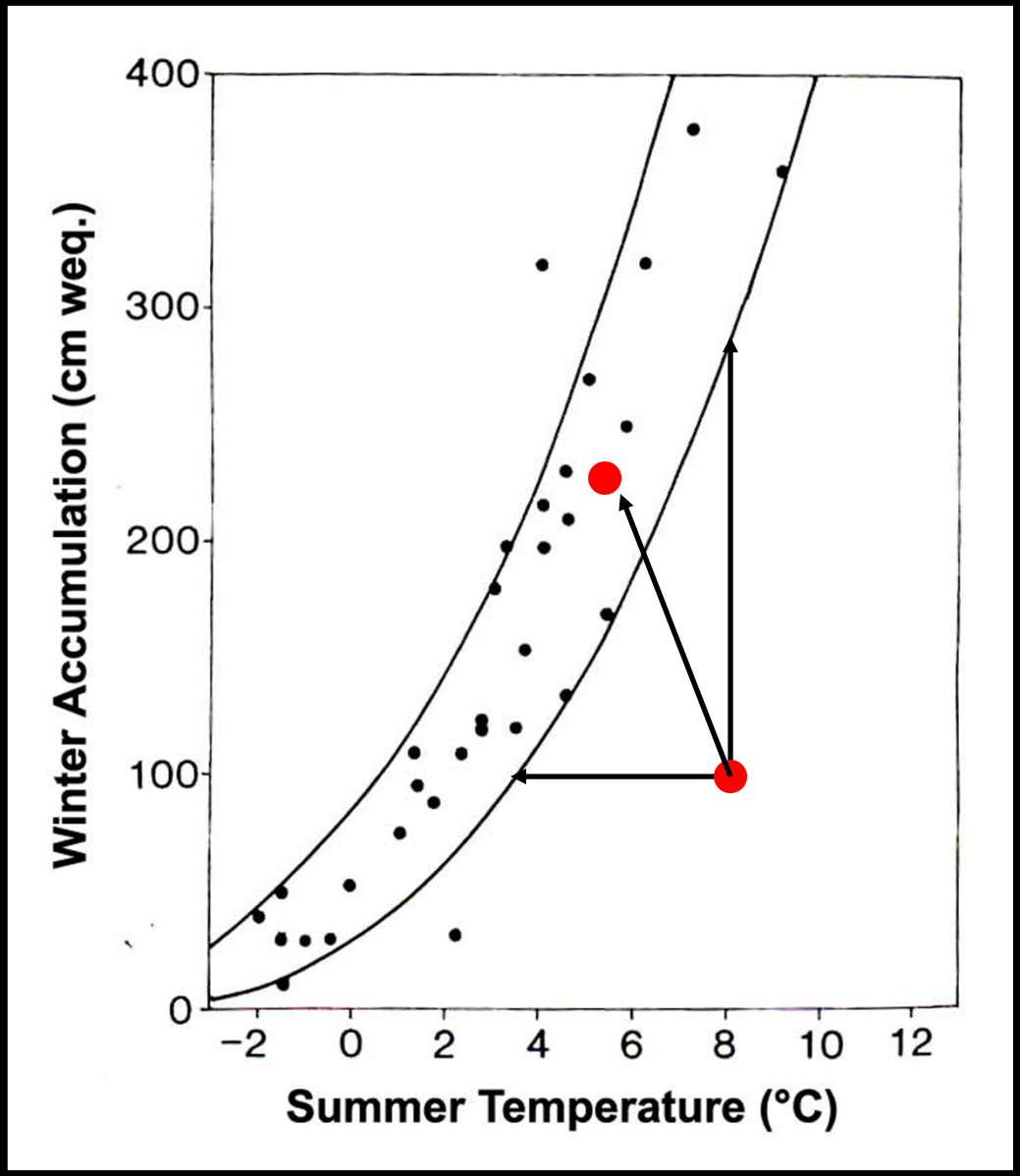


# Equilibrium Line Altitude (ELA) Results

| | AAR Method | BR Method |
|---|---|---|
| Modern | 2495 ± 30 m | 2576 m ± ?? |
| Little Ice Age | 2452 ± 40 m | 2545 m ± ?? |
| Early Neoglacial | 2285 ± 30 m | 2347 m ± ?? |
| Fountonnor | 2218 ± 80 m | 2305 m ± ?? |

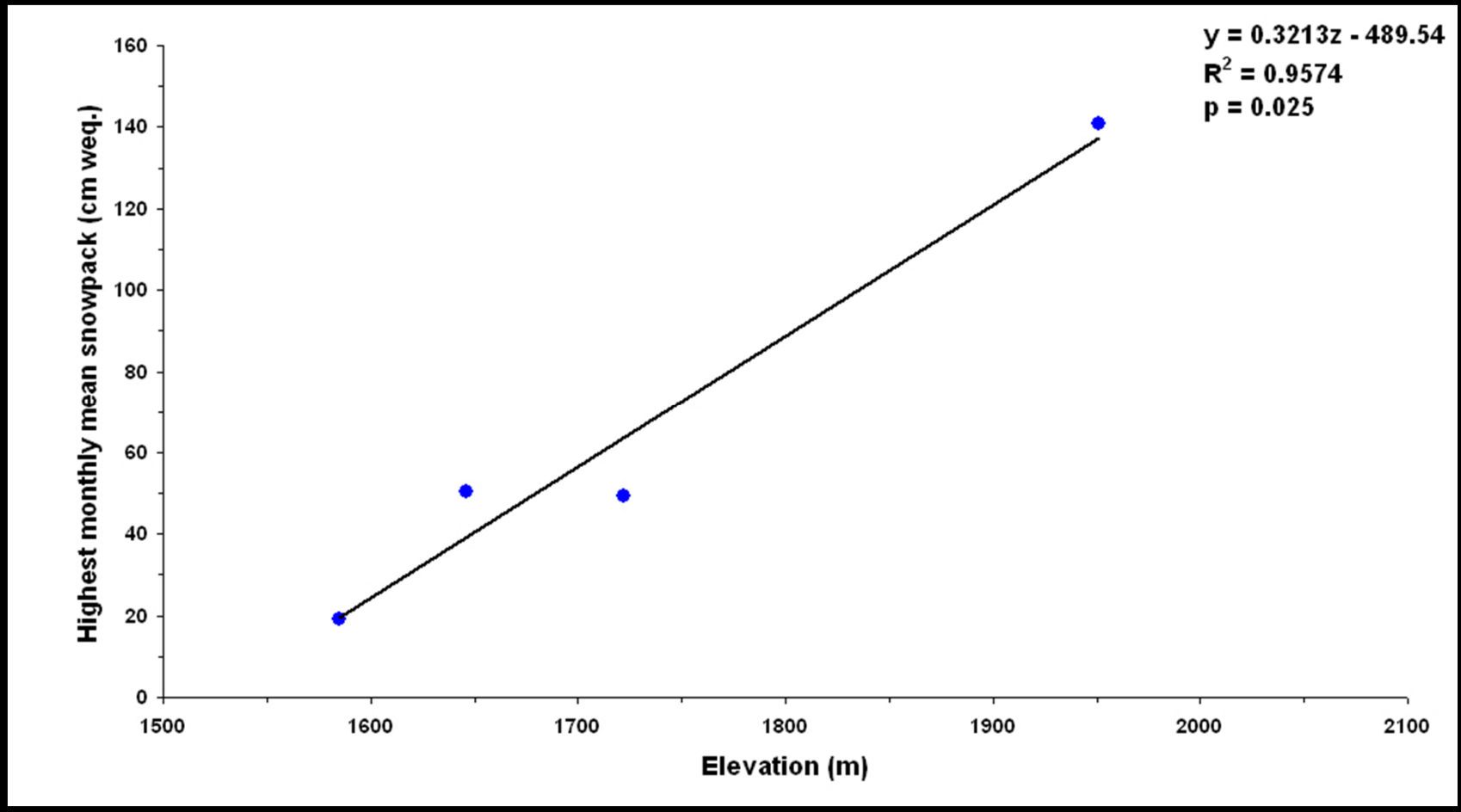
So, how do we get from the ELA to paleoclimate ?

# Modern climate at ELAs of 32 glaciers worldwide

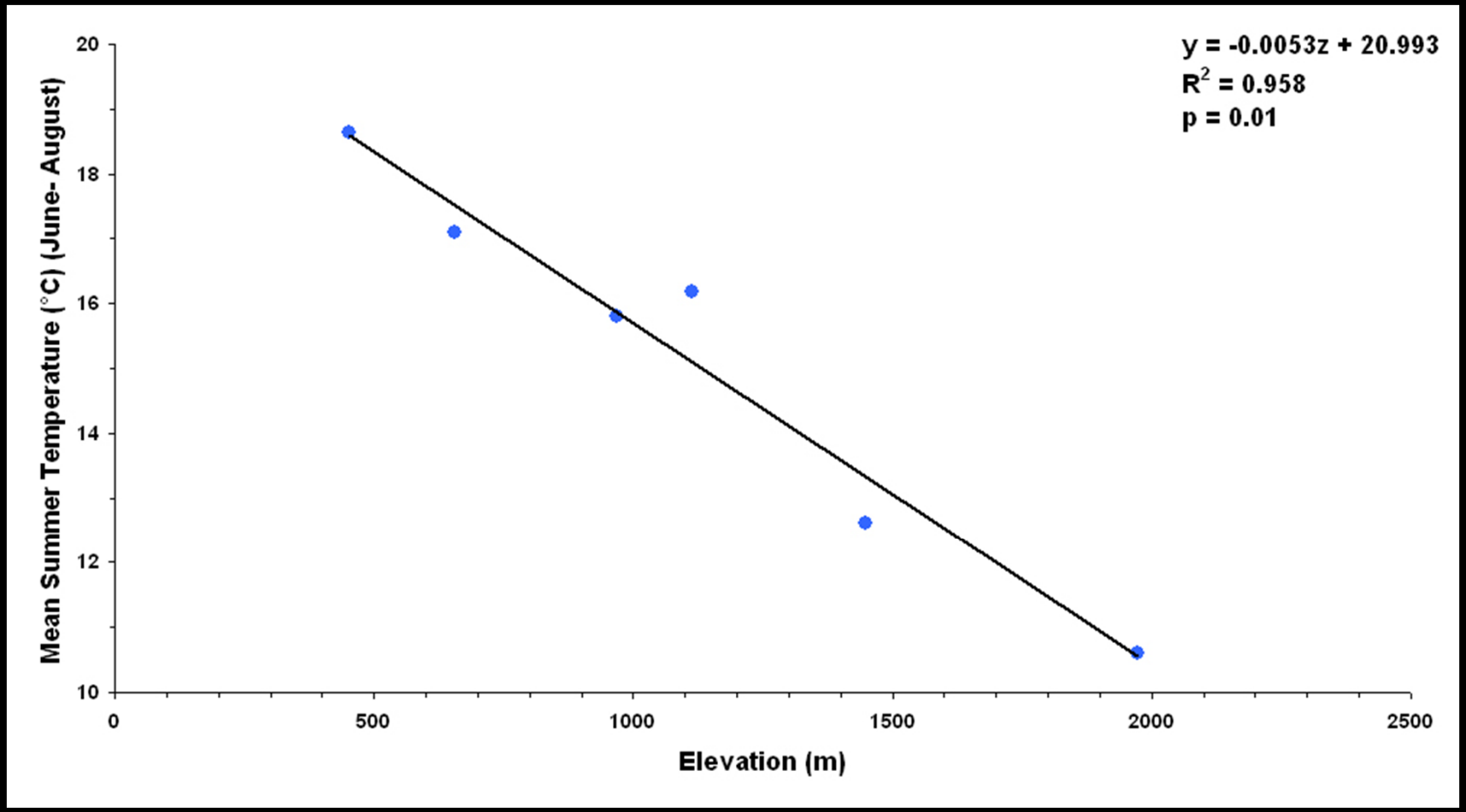



*(Leonard, 1989)*

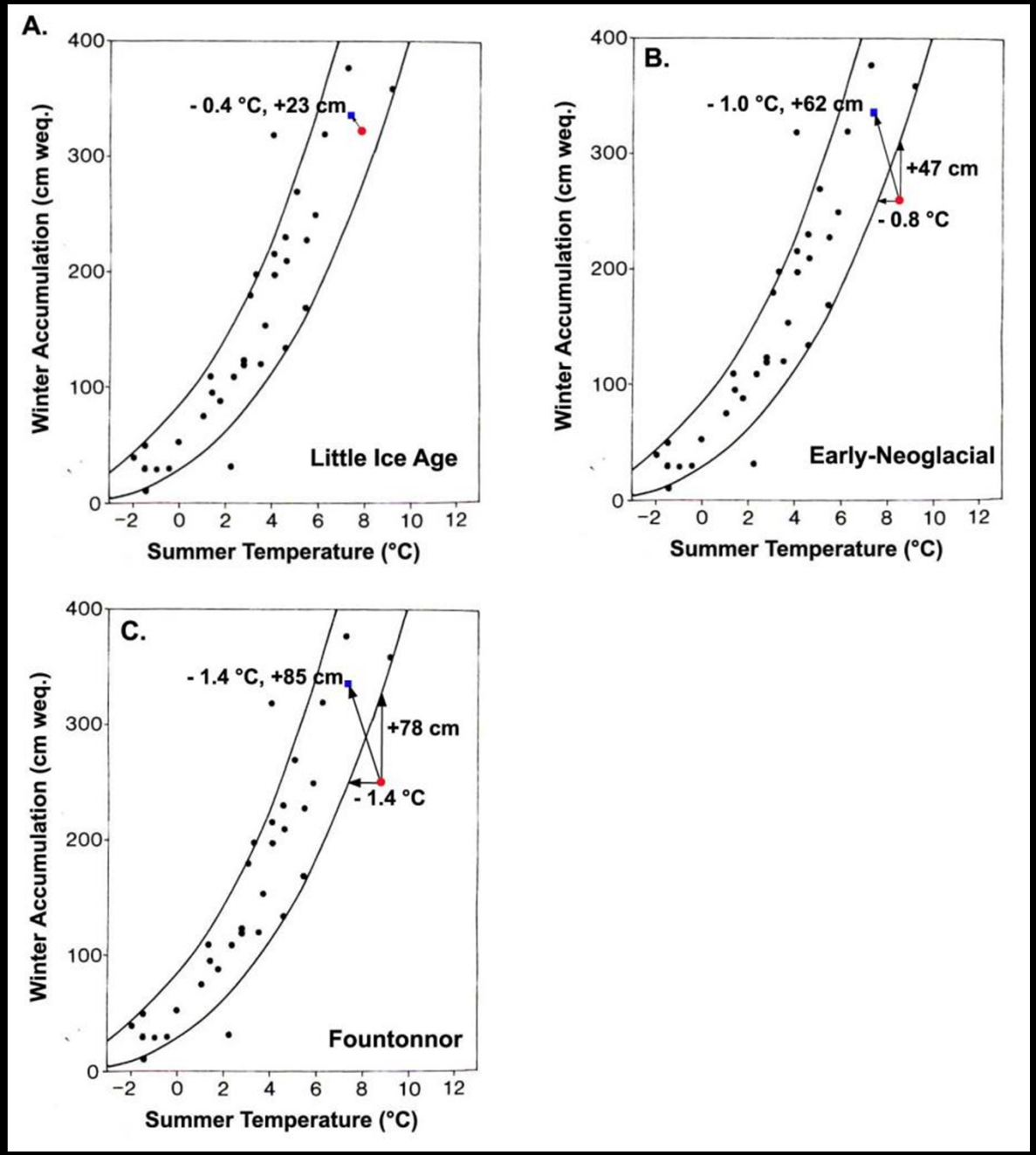
# Winter Accumulation Lapse Rate for current conditions at Three Sisters



# Summer Temperature Lapse Rate for current conditions at Three Sisters



# Modern climate at paleo ELAs



# Conclusions

LIA (150-250 yr B.P.)

**ELA depression: (30 – 40 m)**
**T/P: -0.5°C, +20 cm**

Late-Neoglacial (2-3 ka B.P.)

Early-Neoglacial (5-8 ka B.P.)

**ELA depression : (210 – 230 m)**
**T/P: -1.0°C, +60 cm**

Fountonnor (9-11 ka B.P.)

**ELA depression : (270 – 280 m)**
**T/P: -1.5°C, +85 cm**

END

*Photo by A.Fountain*

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