Chronology of Montana's glacial Lake Missoula: Current Status

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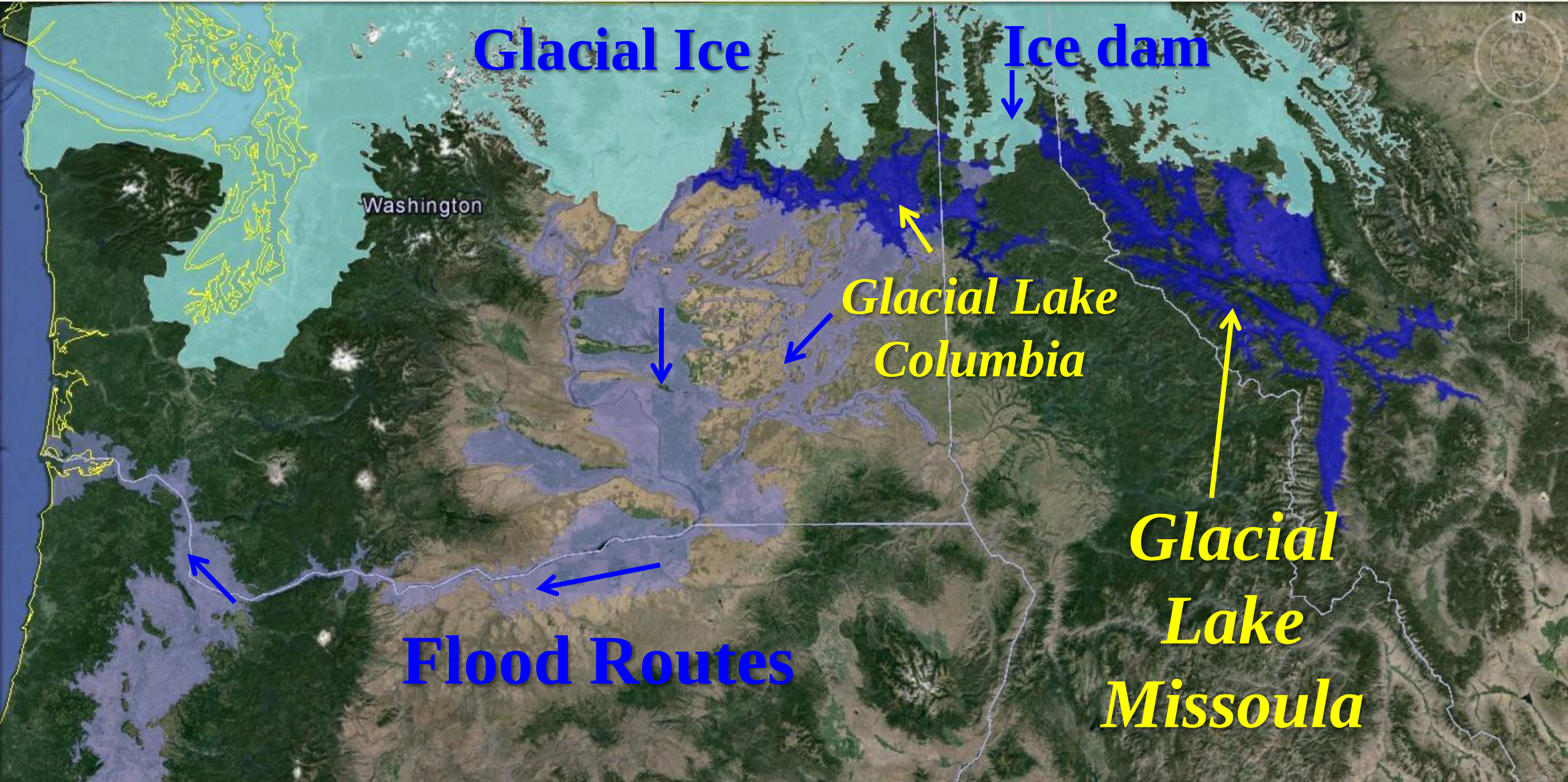
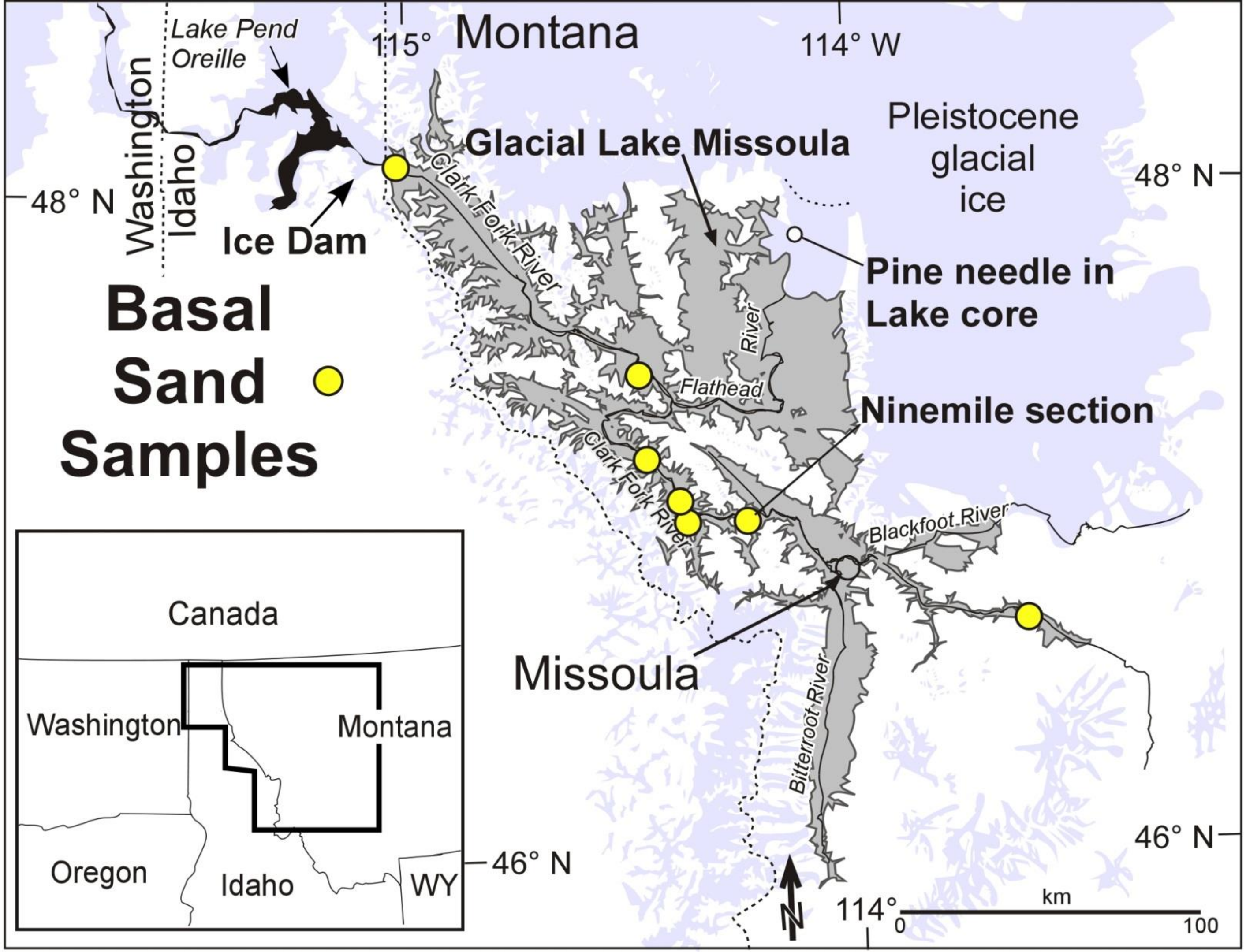
Lakes, Ice, and Scabland System



Glacial Lake Missoula

- Recognized for >105 years, no tephra or fossils documented
- Previous work on geochronology
  - Ice dam: 19-21 ka to ~14 ka (poorly constrained)
  - Lake drained prior to Glacier Peak "G" tephra (13.7-13.4 cal. ka B.P.)
  - ^{14}C in uppermost lake 14.13 ± 0.18 cal ka B.P. (Hofmann & Hendrix, 2010)
  - Optical dating of quartz
    - Three published ages, one on basal sand
- **16 new *preliminary* ages from quartz at 7 basal sand sites**

Sample Locations



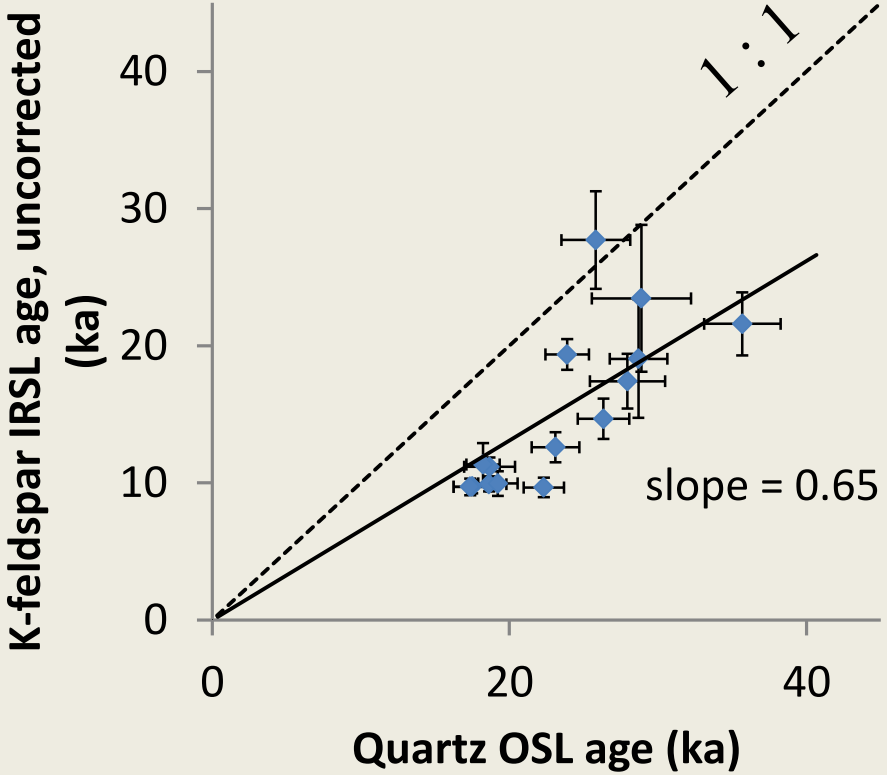
Multi-grain OSL measurements

- 180-250 μ; 10% HCL & H_2O_2 treatment
- Heavy liquid separation (2.58 g cm^{-1})
- 40% HF - Quartz purity tested using OSL IR depletion ratio
  - If failed purity screen, some quartz samples etched again with 40% HF
- SAR protocol: post-IR OSL signal from quartz
- Large aliquots, 5-8 mm stainless steel cups*

* Murray et al. (2015) Radiation Measurements; Thomsen et al. (2016) Quaternary Geochronology

Test for Quartz bleaching

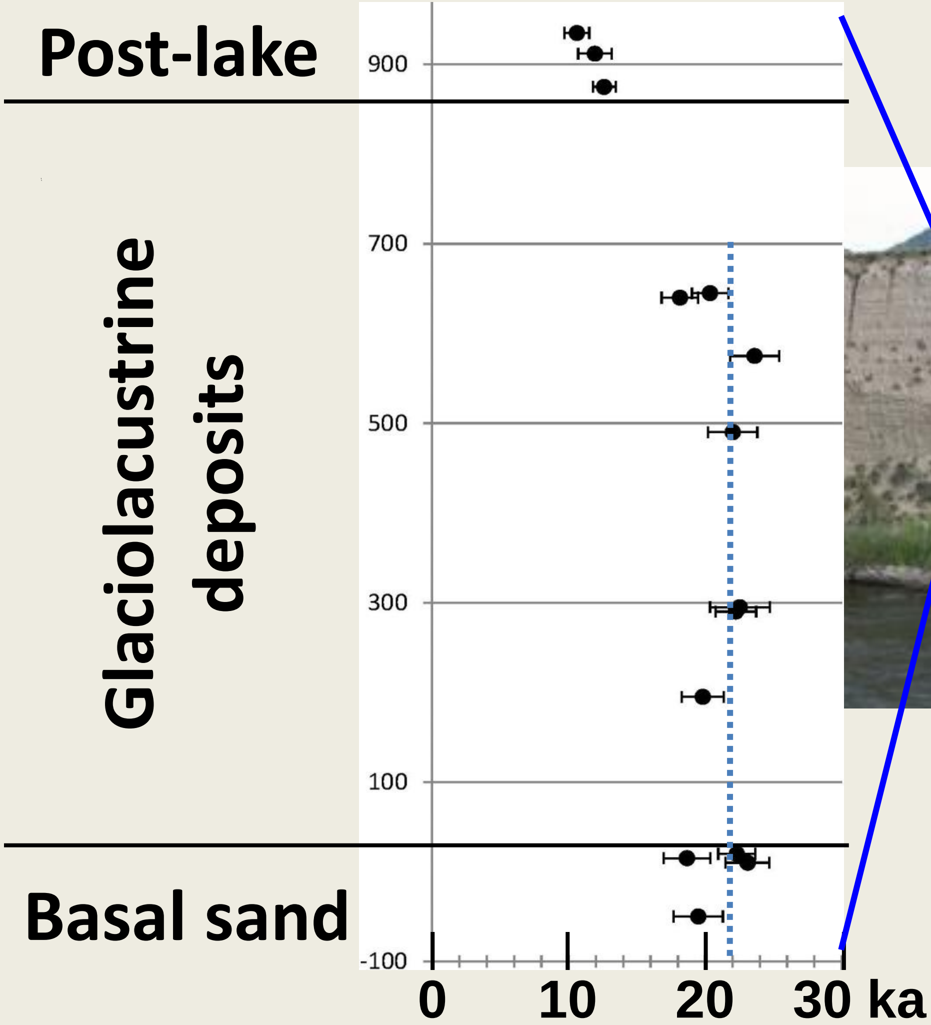
- Quartz bleaches in sunlight much more readily
- Compare Quartz ages to K-Feldspar ages (uncorrected for fading)
- Expected lower uncorrected Feldspar ages show that **Quartz is likely well bleached**



Dose rate measurements

- Two dose rate samples were prepared for each sample
  - Material in tube
  - From ~30 cm around tube
- 100-250 g sample cast in wax cups
- High-precision gamma spectroscopy with conversion factors of Guerin et al. (2011)
- Estimated water content
  - Average of *in situ* and saturated for each sample: 13—27%

Garden Gulch



Lake filled to >1,180 m (>65% of capacity) at least 11 times by ~20.9 ± 1.3 ka

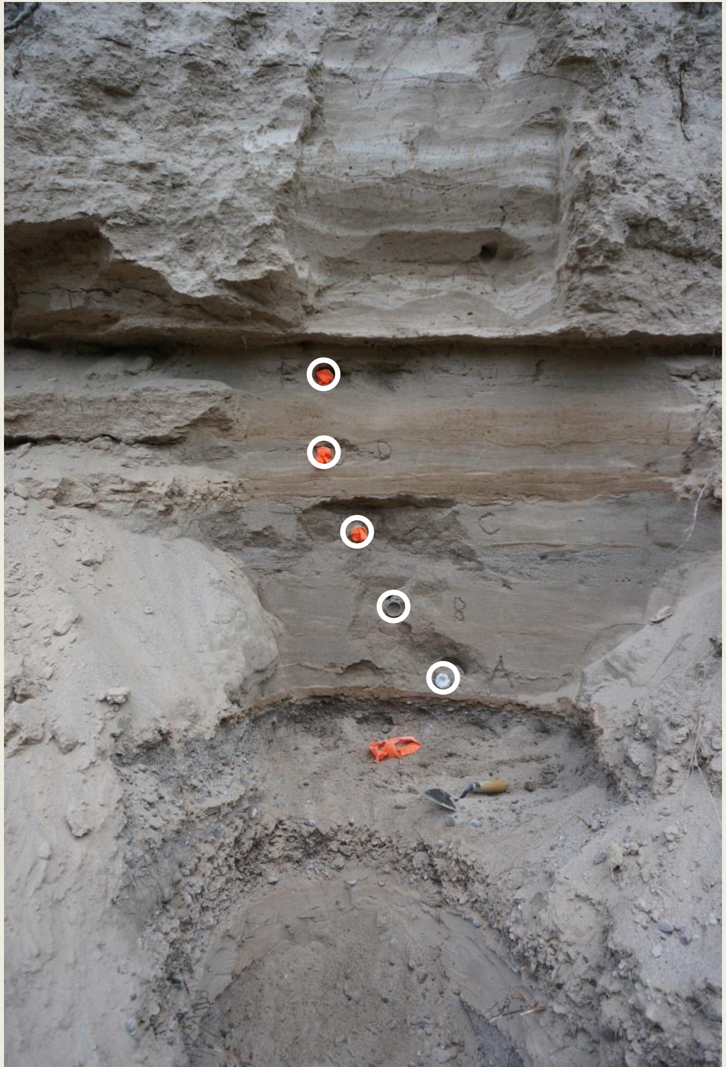
Basal sand at Cyr

- Five samples
- Nine dose rate samples
- Range:

  17.36 ± 1.13 ka–19.23 ± 1.32 ka

- **Average:**

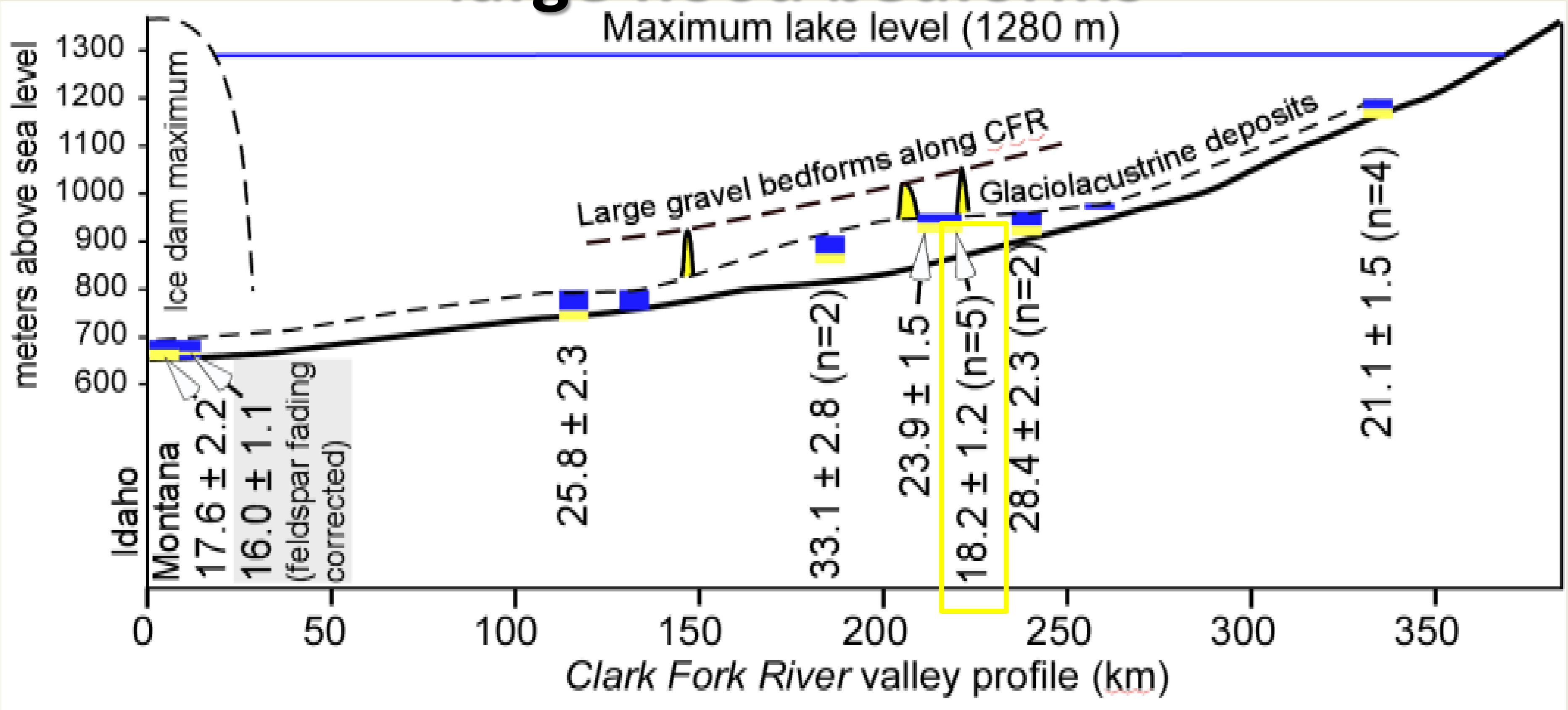
  18.15 ± 1.17 ka



Basal Sand with gravel at Tarkio

23.9 ± 1.5 ka

Mix of younger and older ages near large flood bedforms



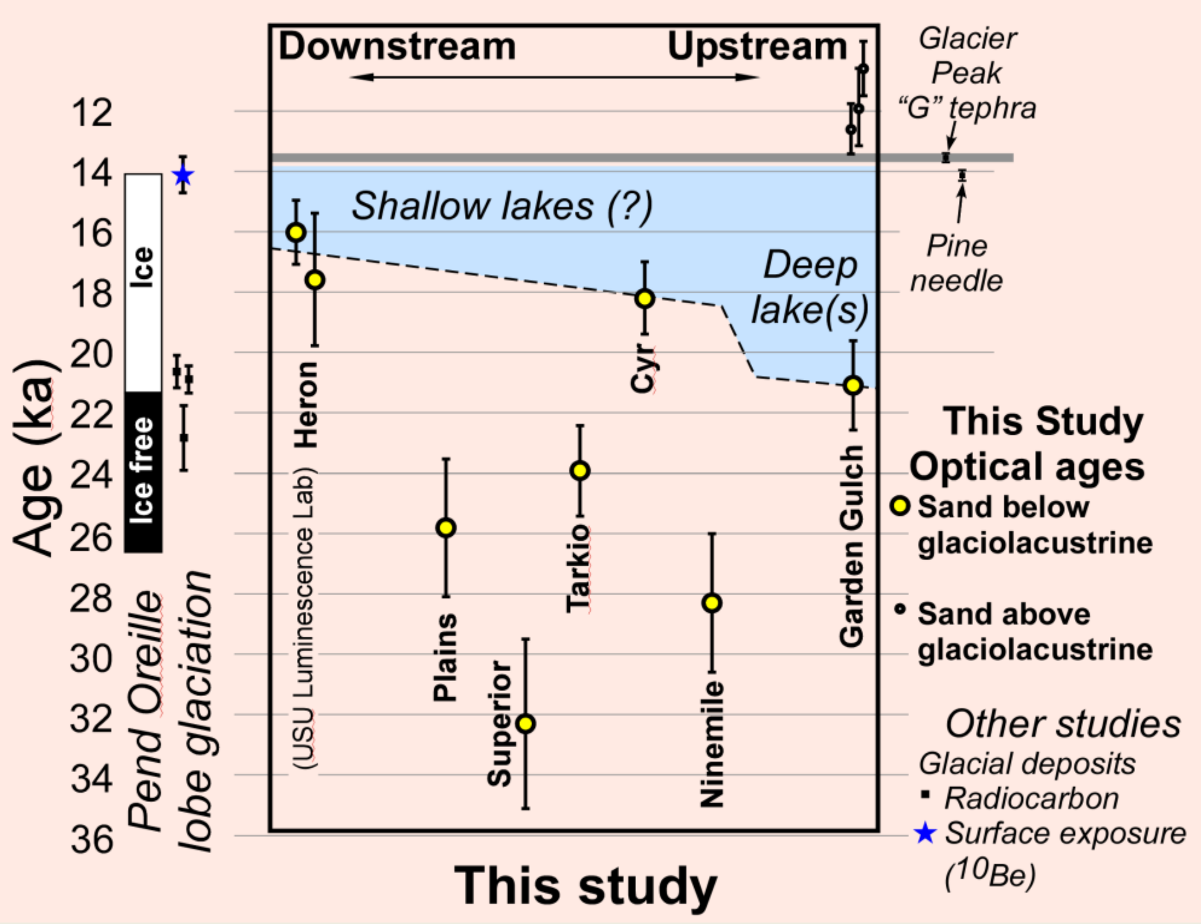
1) Deep lakes filled ~11 times ~20.9 ± 1.3 ka

2) Basal sand at Cyr & Heron possibly represent ~15% of lake capacity

3) Sediment preservation shows last lake drained non-catastrophically

4) Sediments preserved near giant gravel bars suggest large floods may be pre-last glacial

5) More work to be done with future M.S. grad students



Summary

- Sparse interlayering of basal sand with glaciolacustrine sediment suggest age ranges caused by hiatuses in record
- Glacier Peak G tephra (13.4-13.6 ^{14}C yr BP) sets minimum age for the lake
- At highest altitude (deepest lake) site, the lake rose and fell >6 times between 20.4±1.4 (n=4) to 19.3±1.1ka (n=2)
- Basal sand ages of 17.6±2.2–18.2±0.4ka (n=5), possibly representing as little as 15% of lake capacity
- Preservation of 32.3±3.4ka fluvial sediments below glaciolacustrine deposits at Superior suggest large floods that formed giant gravel bars may be older than the last glacial
- The lake did not drain catastrophically from its last stand