Spatio-temporal patterns of Late-Pleistocene mountain glaciation in the western United States

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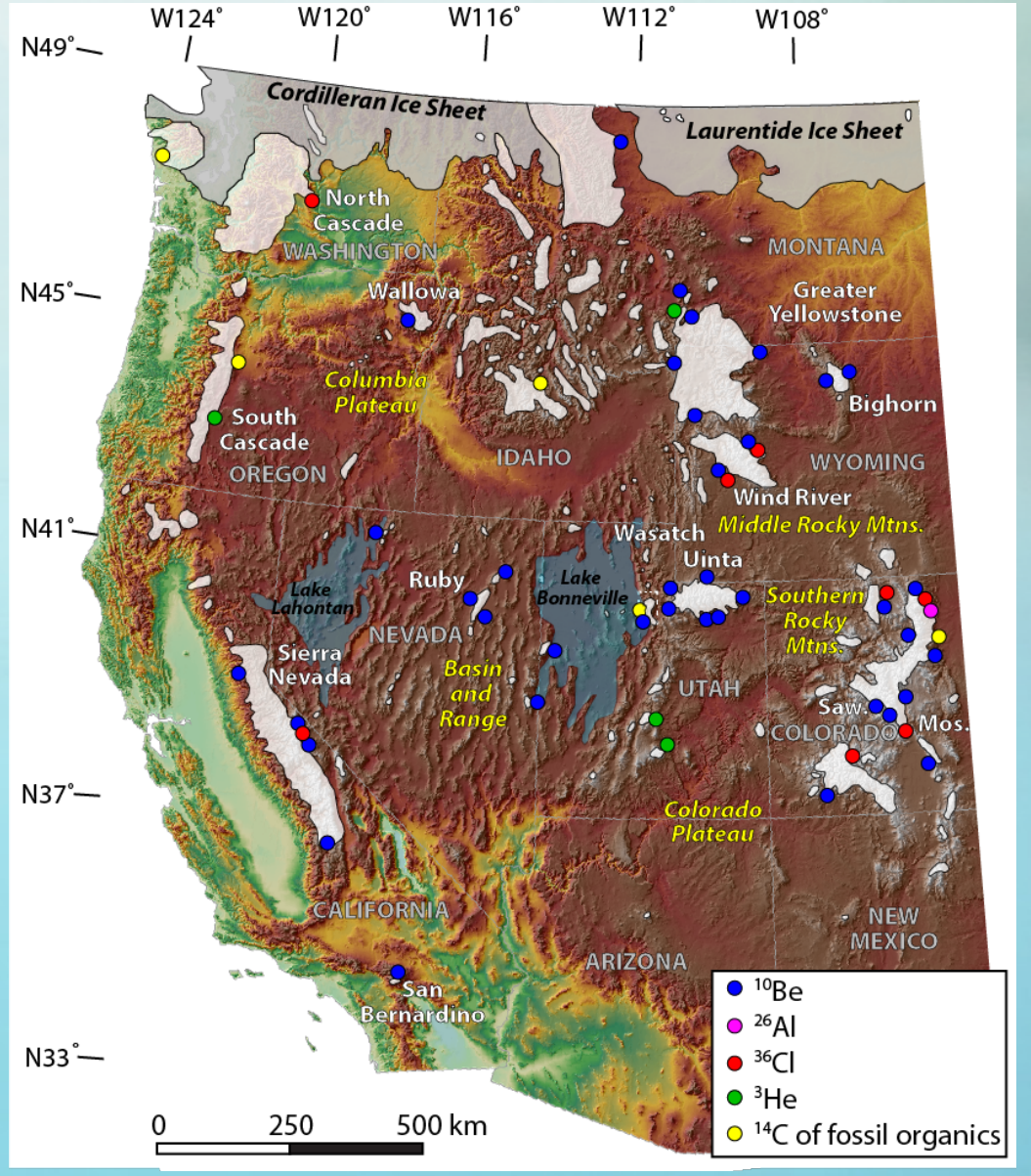
Cosmogenic chronologies of glacial deposits

- Majority of direct ages of Pleistocene moraines are from cosmogenic nuclides
- Exposure ages of 200+ moraines in conterminous western U.S.
- Valuable proxy for Quaternary climate change
- Cosmogenic nuclide data available in ICE-D Alpine



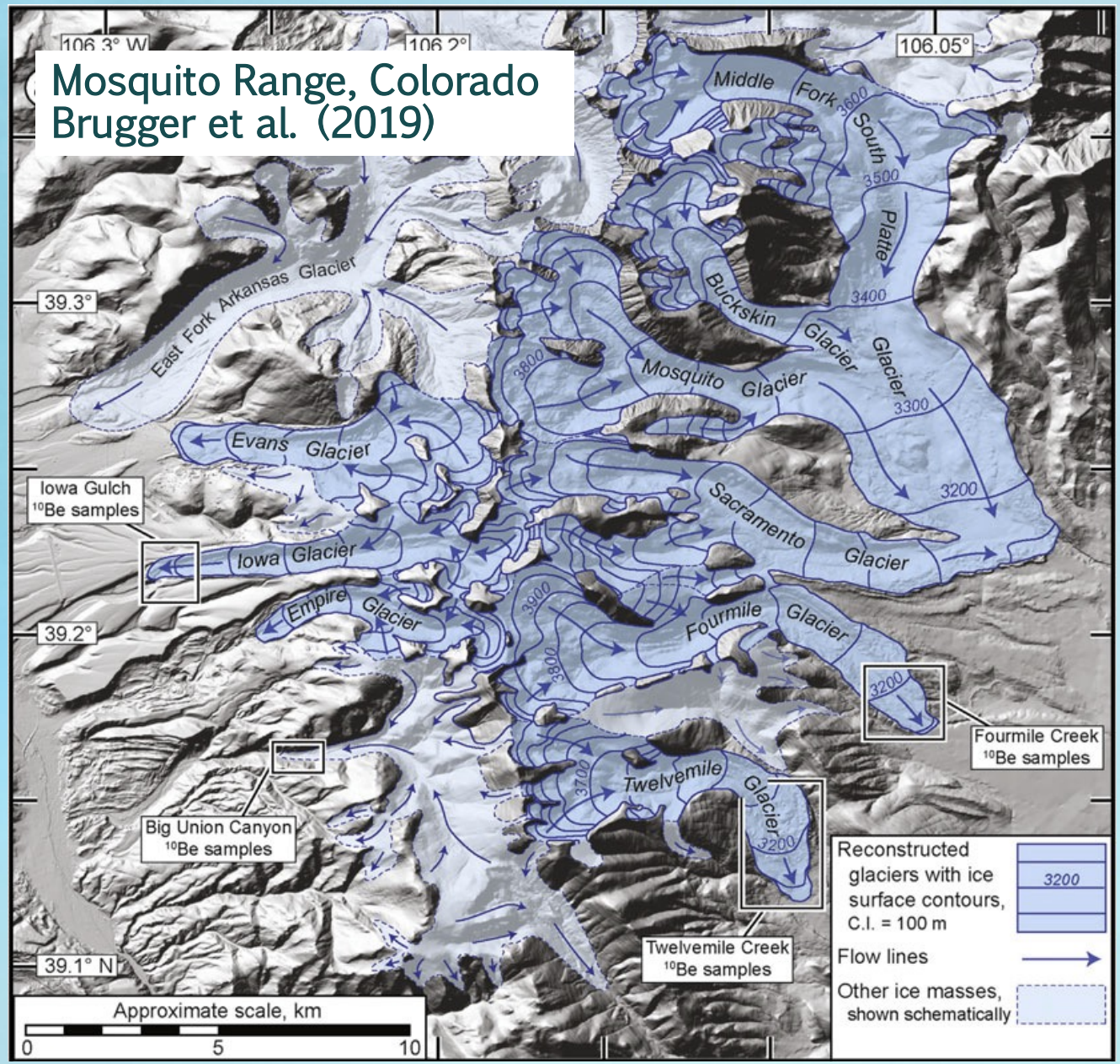
Laabs et al. (2020, QSR)

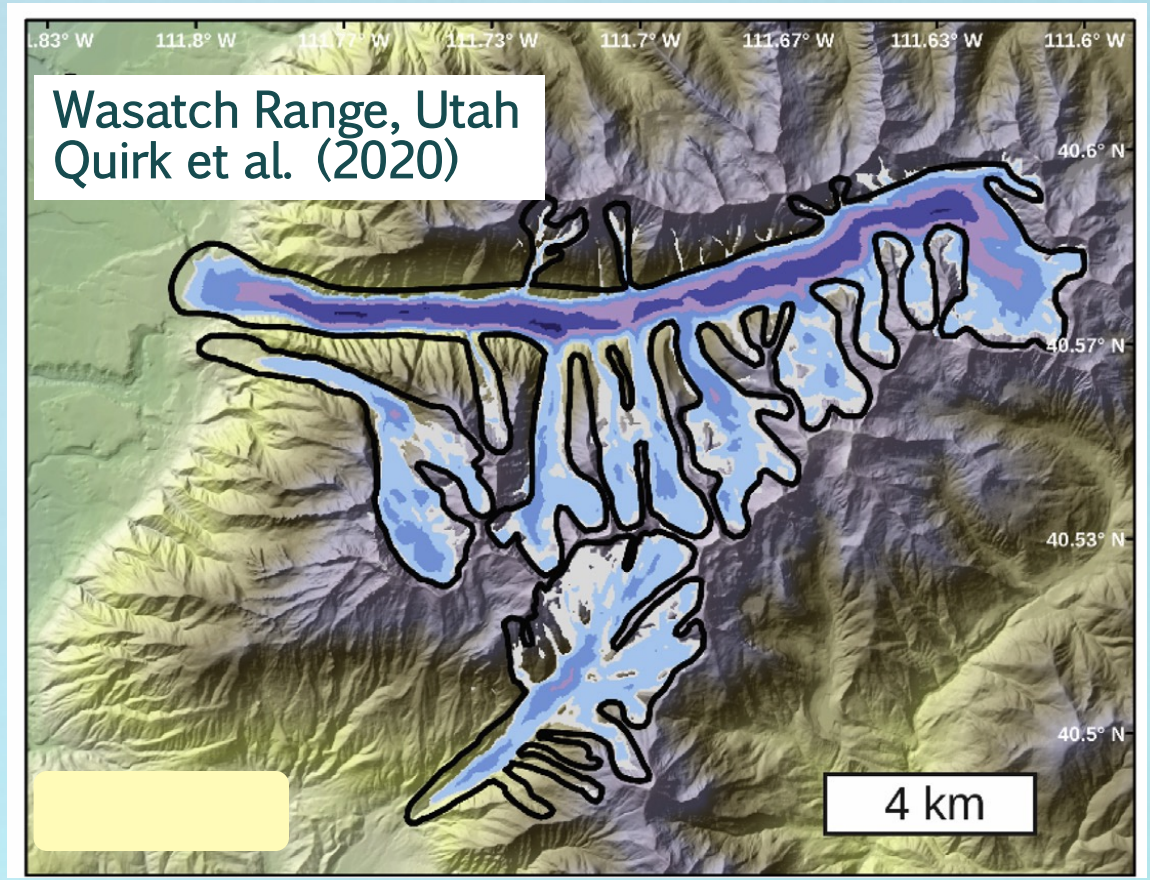
Spatial pattern of Pleistocene glaciation

- Most glacial reconstructions have focused on regional and local scales
- Mapping-based glacier shapes, thickness, hypsometry, ELAs
- Available mapping, paleoglacier reconstructions vary spatially

S. Porter et al. (1983), K. Pierce (2003)

Reconstructions of Late Pleistocene glaciers



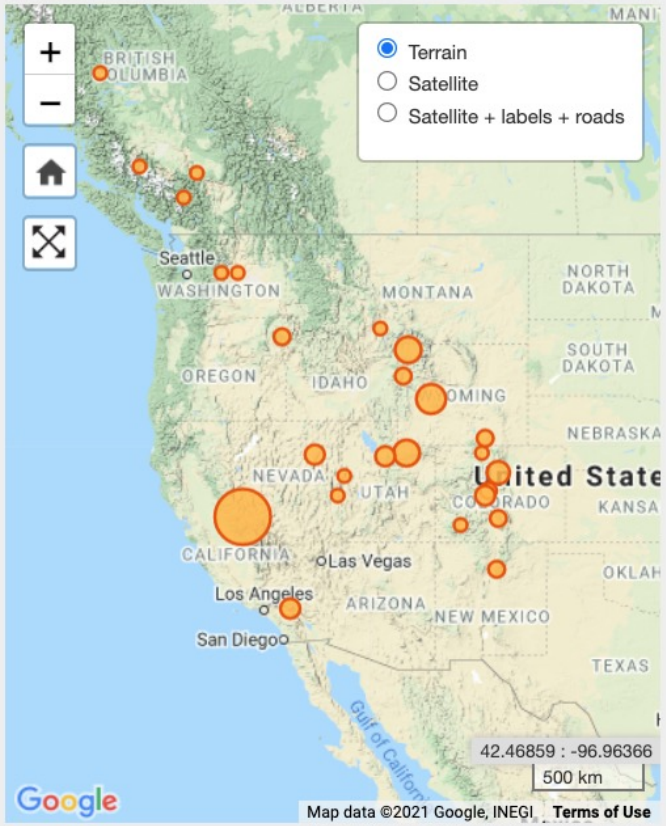


Reconstructing spatio-temporal patterns

- Cosmogenic exposure ages of Late Pleistocene valley glaciers
- Outliers among exposure ages identified statistically or by authors
- Assume arithmetic mean of moraine exposure ages = depositional age
- Represent moraine exposure ages in a spatial context
- Construct regional ELA surface from new and existing reconstructions

ICE-D informal cosmogenic-nuclide exposure-age database ALPINE

Randomly selected area: Yukon-Tanana D



Browse by site:

- **North America**
- **South America**
- **Europe**
- **Asia**
- **Africa**
- **Oceania**
- **Greenland**

For Antarctica you want **this** instead.

Browse by publication year

KML file of all samples (open in Google Earth)

Recent discussion

Thanks to **Jakob Heyman** for compiling most of these data so we could easily ingest them to get this project started.

ICE-D Alpine (alpine.ice-d.org)

Global geochemical database for cosmogenic exposure dating of glacial landforms

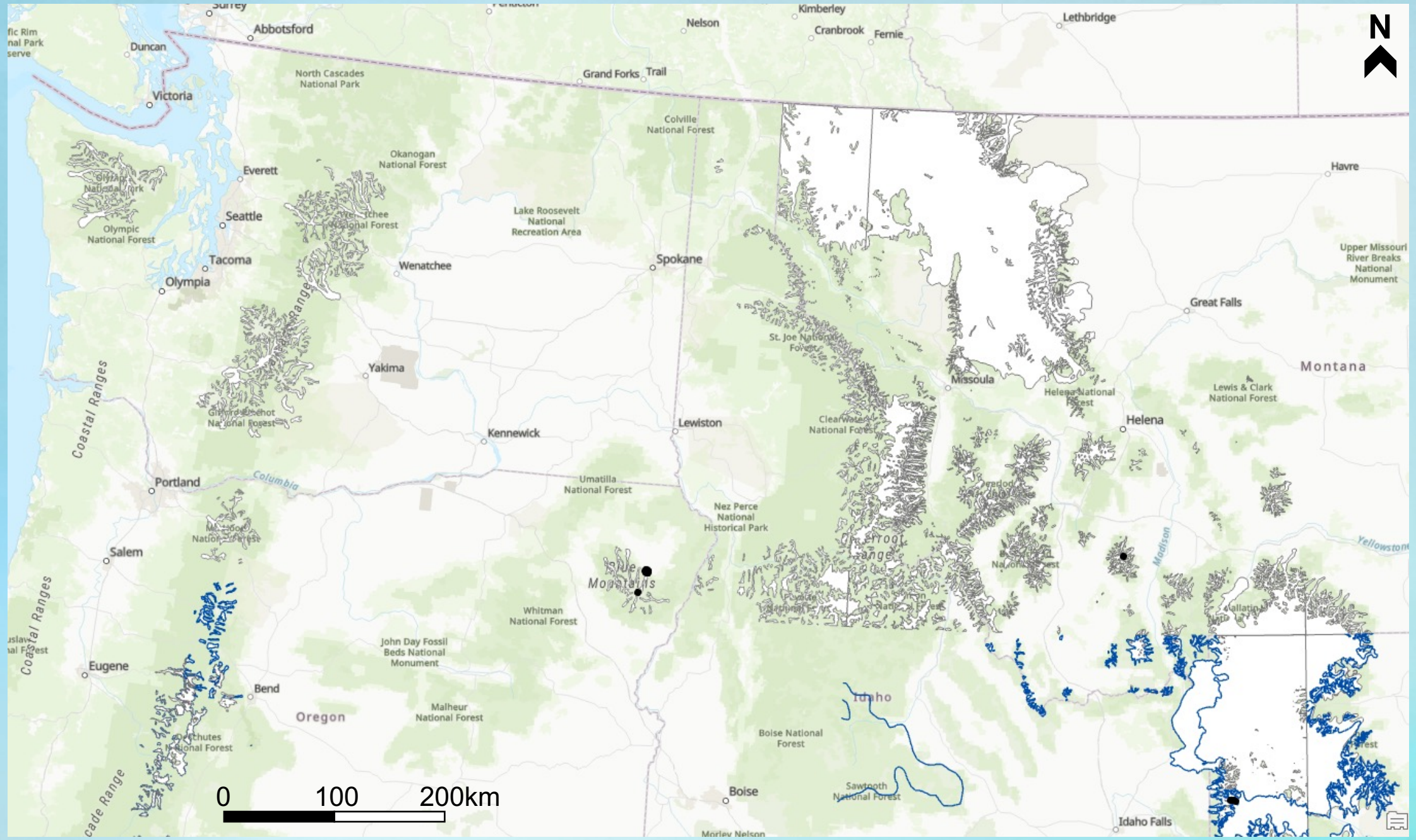
Includes computational infrastructure for Version 3 online exposure-age calculators, updated from Balco et al. (2008)

Geochemical data and sample metadata permit synoptic analysis of glacial chronologies

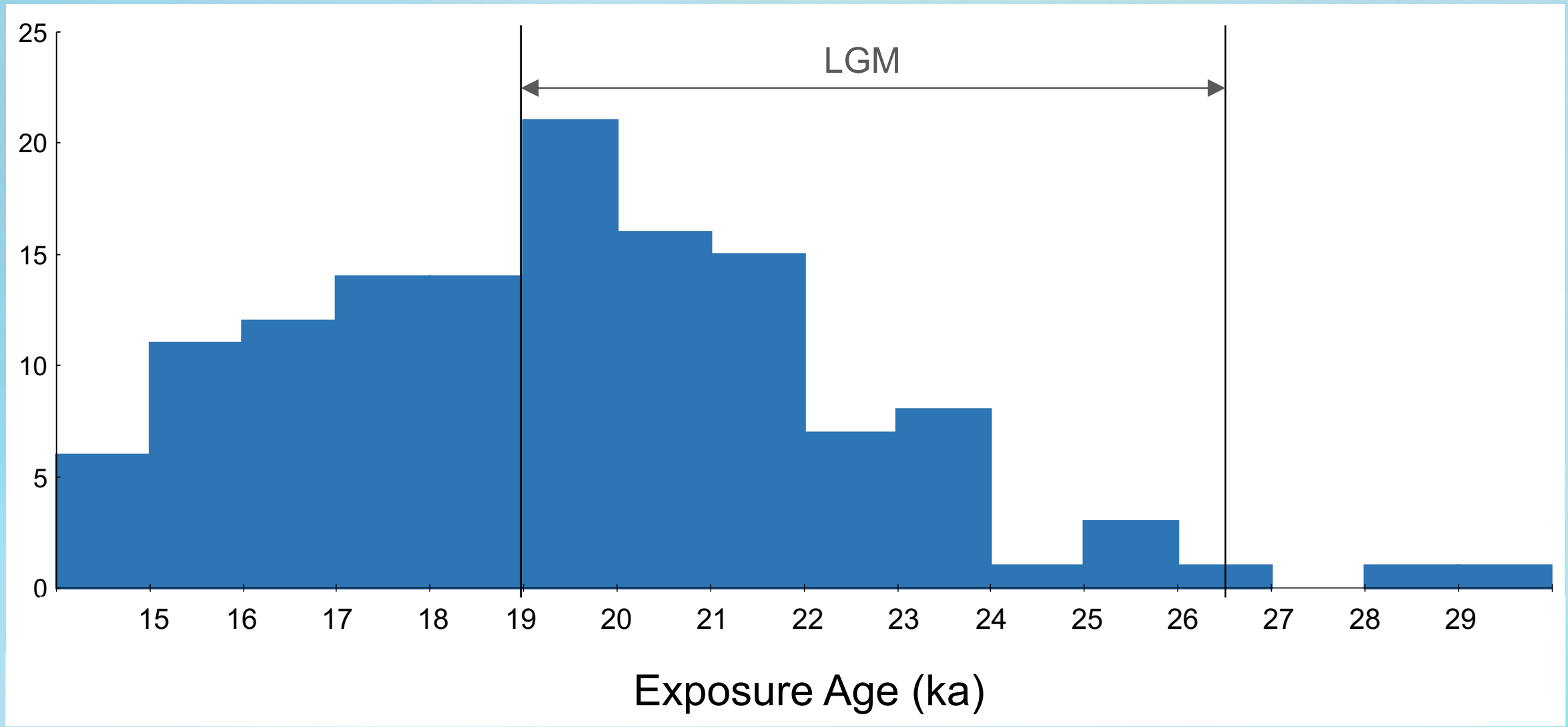
Reconstructing spatio-temporal patterns

- ELAs compiled from previous reports and paleoglacier polygons
- Accumulation-area ratio and toe-headwall altitude ratio for Pleistocene maximum ice extent
- Polygons sourced from Quaternary Glaciations: Extent and Chronology, Developments in Quaternary Science, vol 15., J. Ehlers, P.L. Gibbard, P.E. Hughes, (2011)
- Availability and precision of polygons varies

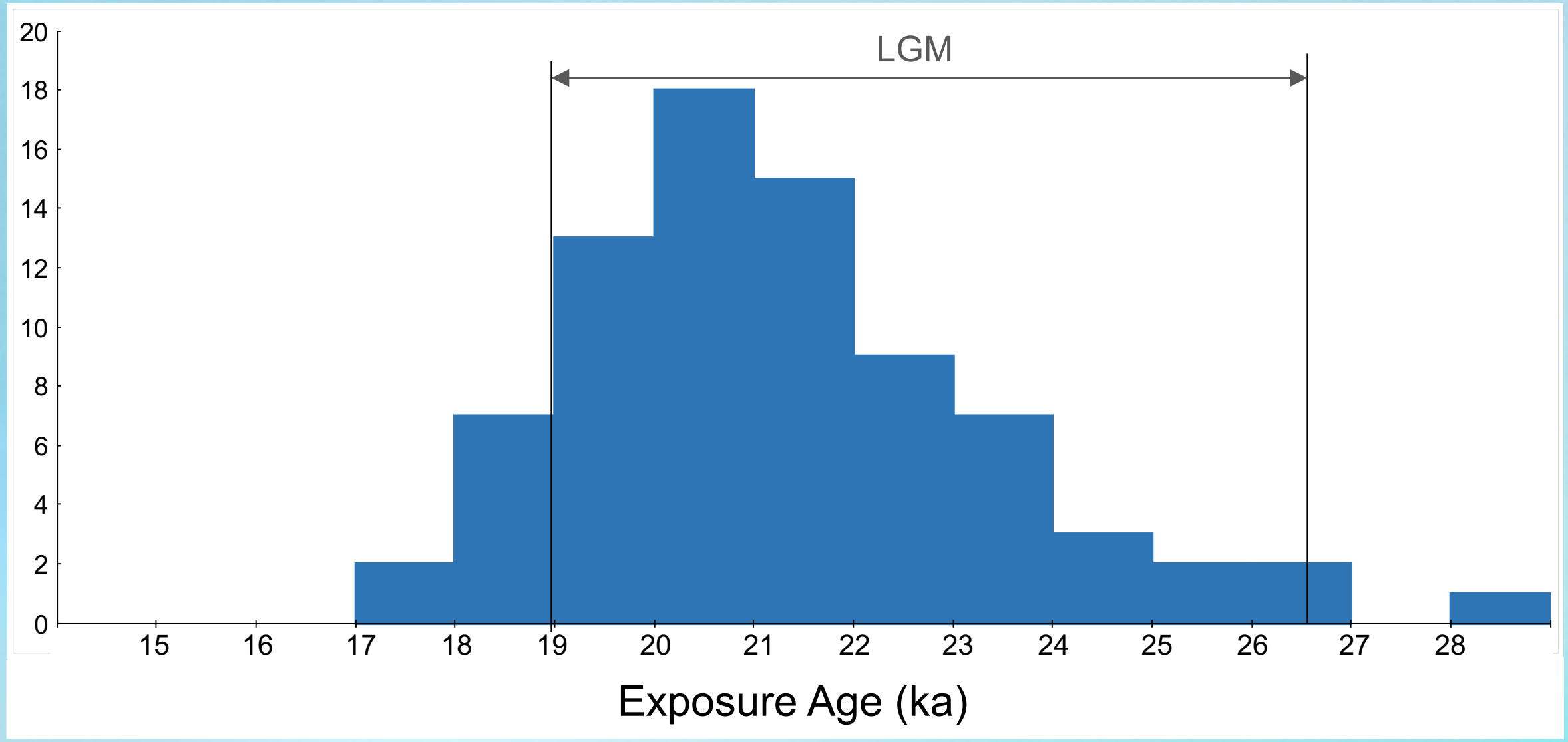
Late Pleistocene mountain glaciers in the northwestern U.S.



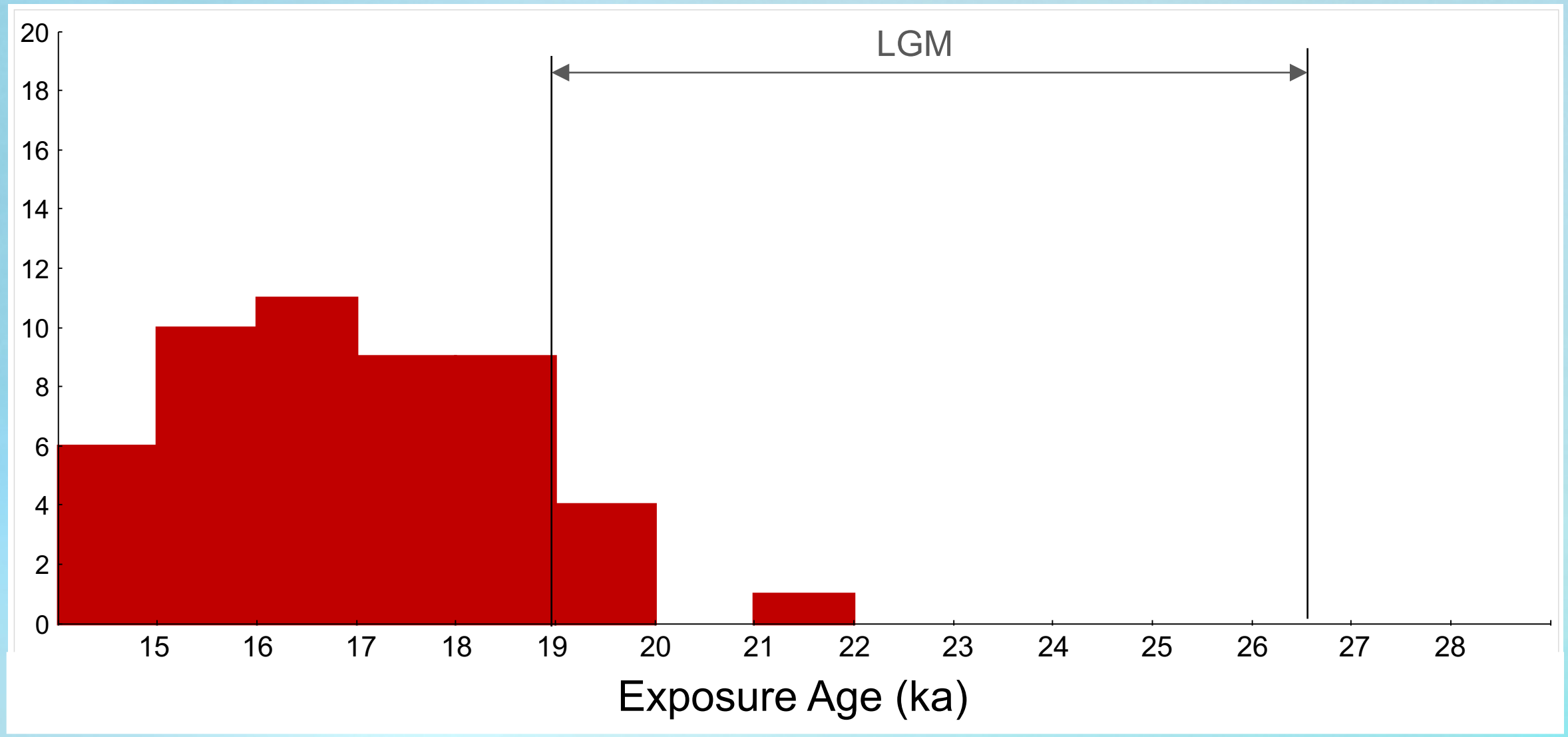
Mean exposure ages of all moraines deposited by valley glaciers (n = 132)



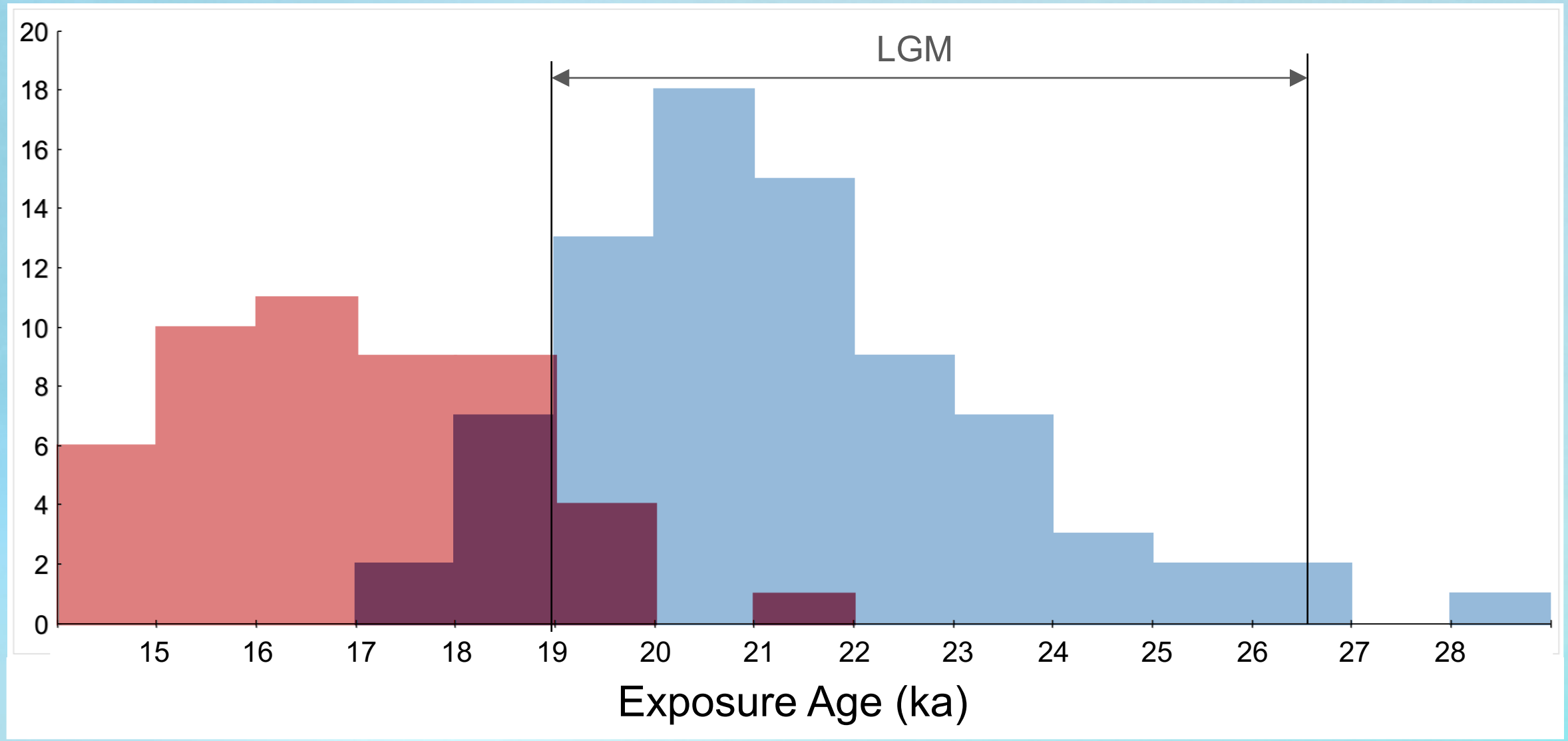
Mean exposure ages of terminal moraines (n = 80)



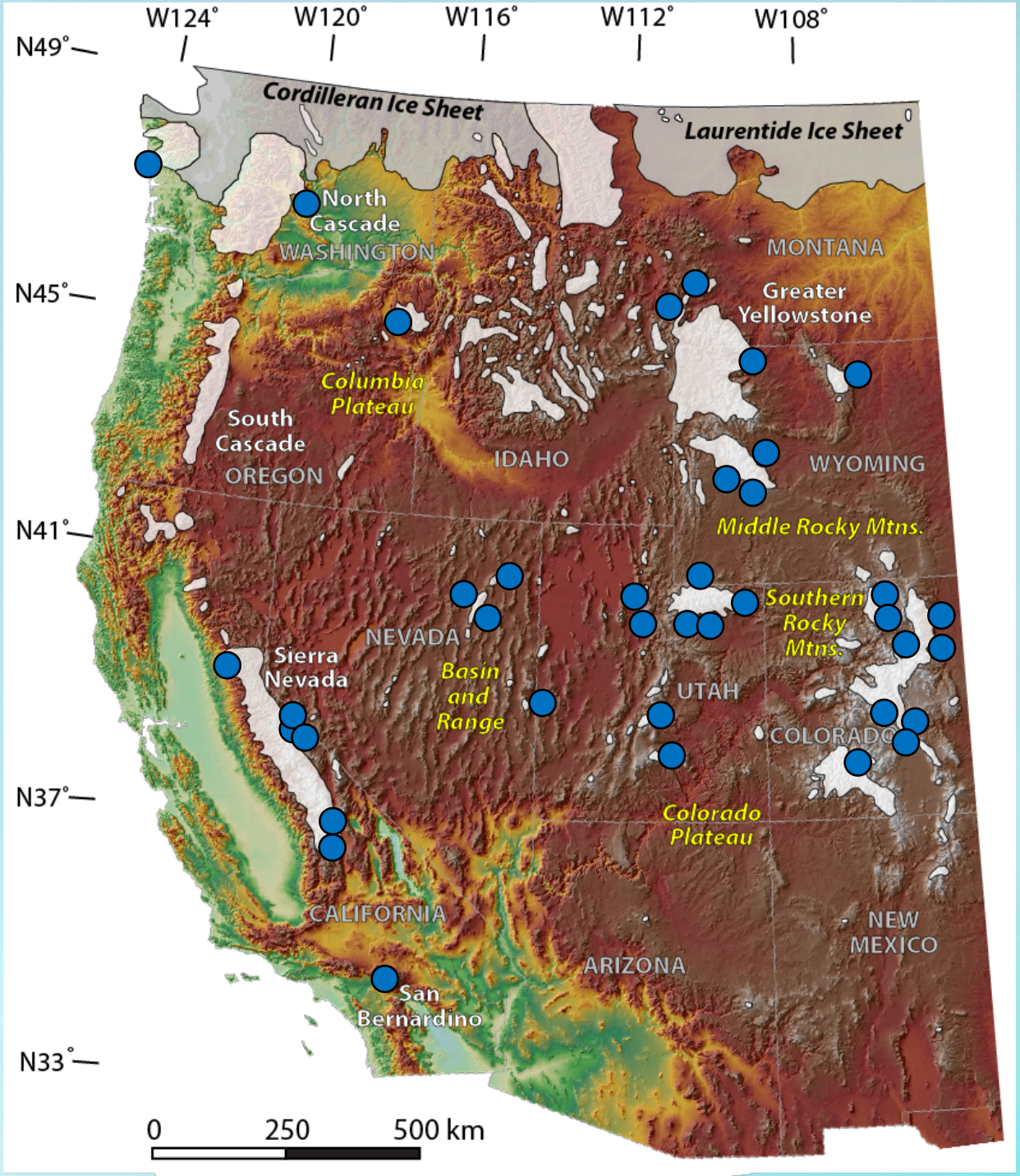
Mean exposure ages of recessional moraines (n = 52)



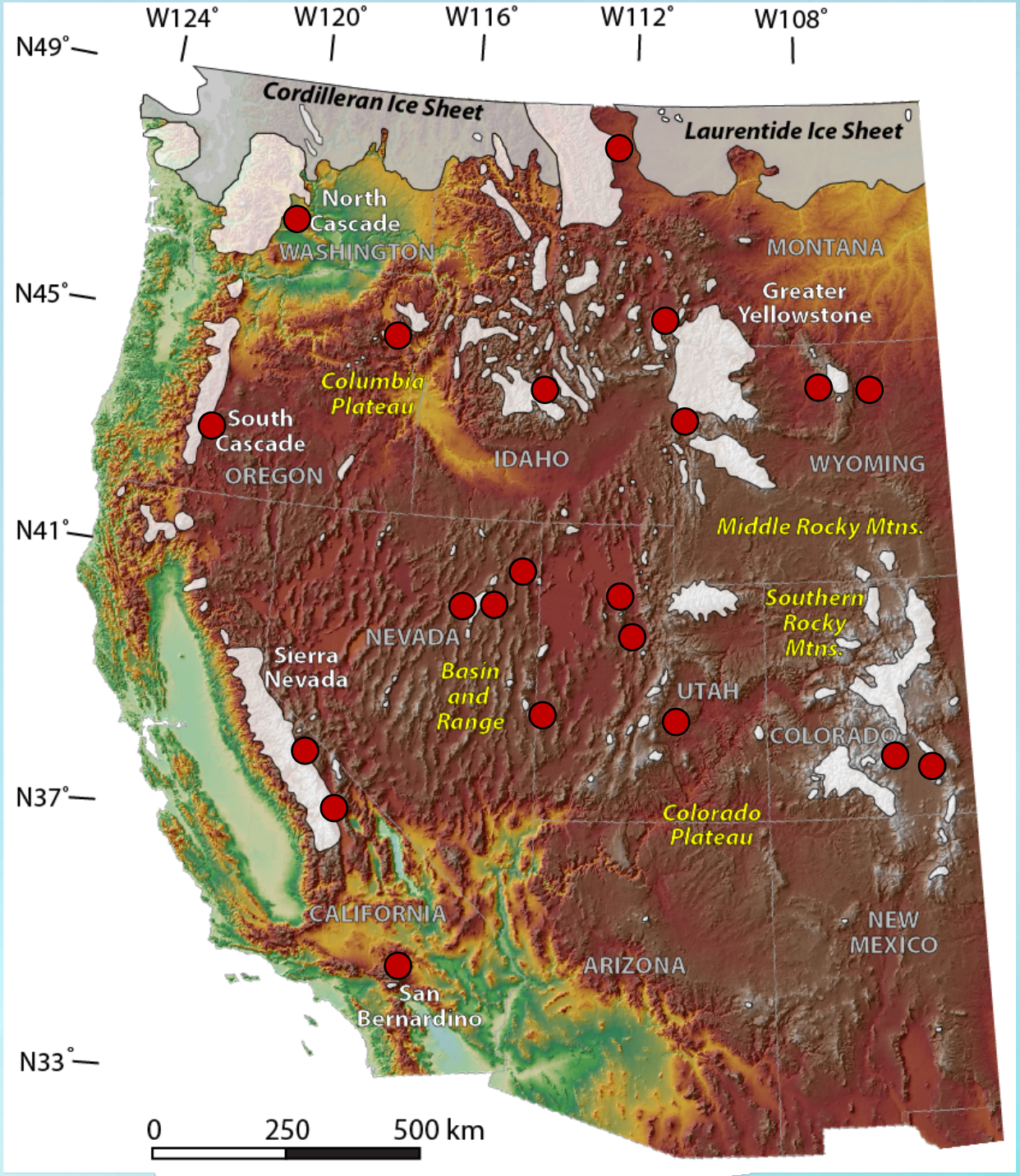
Mean exposure ages of terminal and recessional moraines



LGM terminal moraines

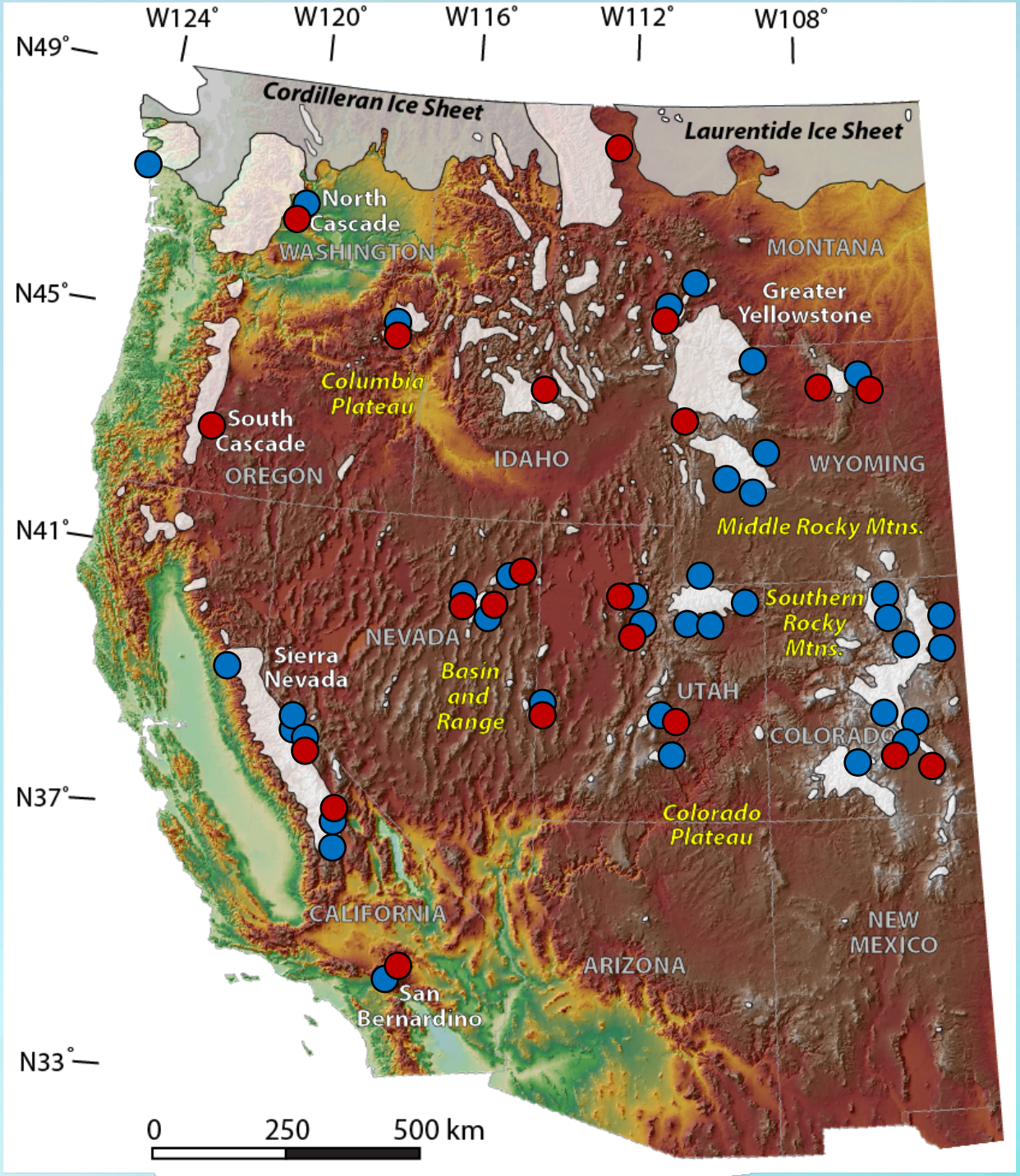


Post LGM downvalley moraines

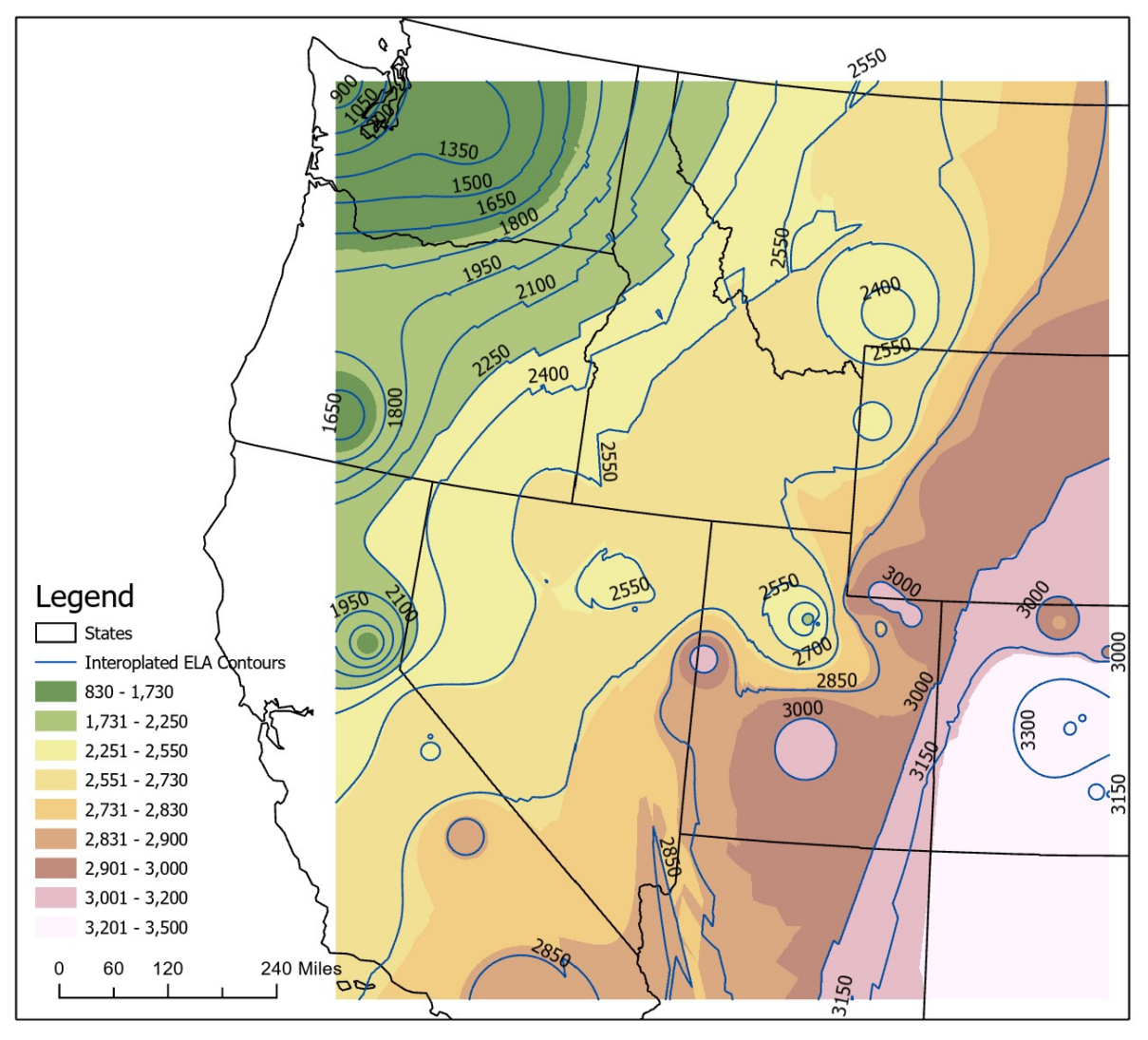


LGM terminal moraines

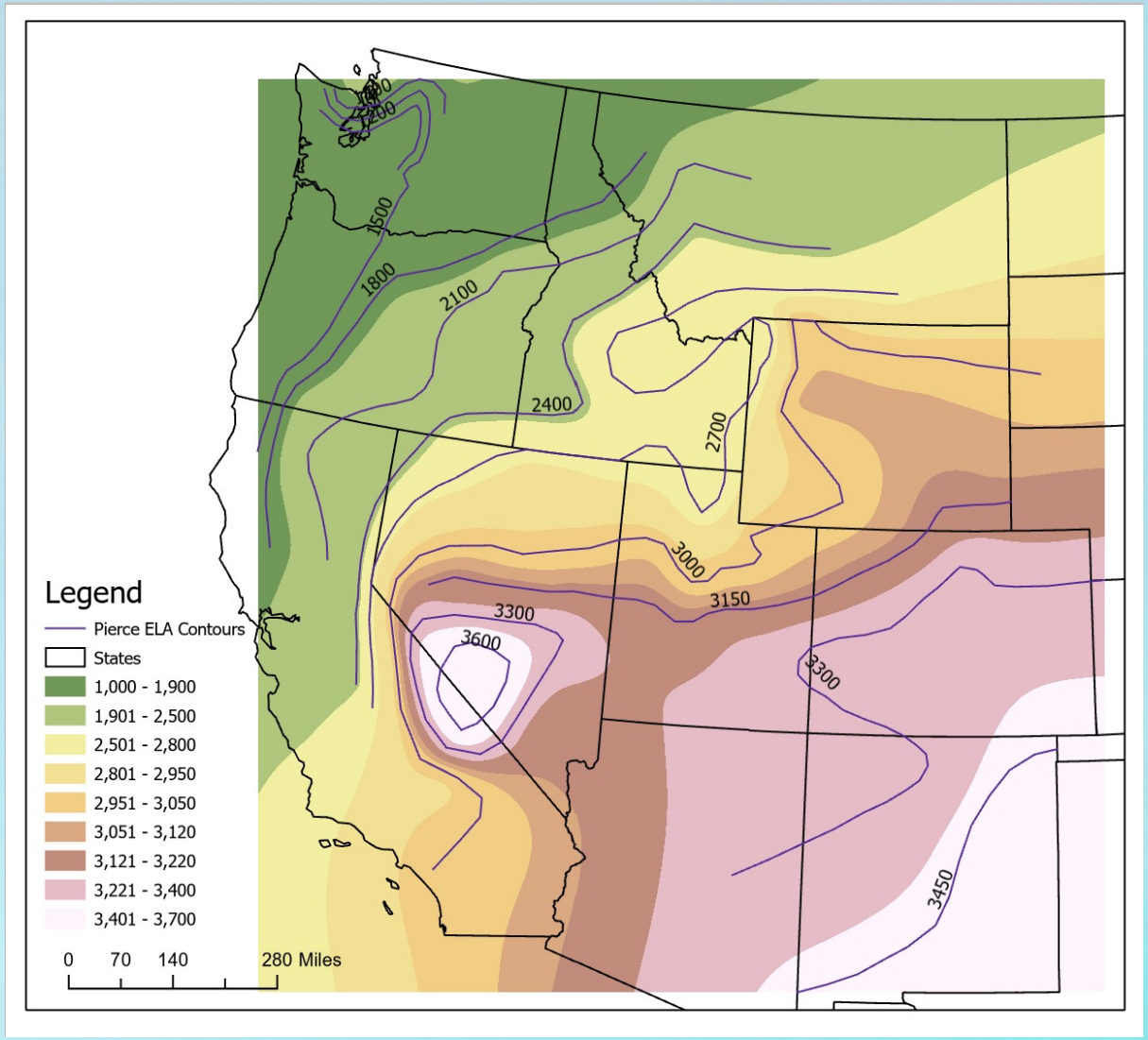
Post LGM downvalley moraines



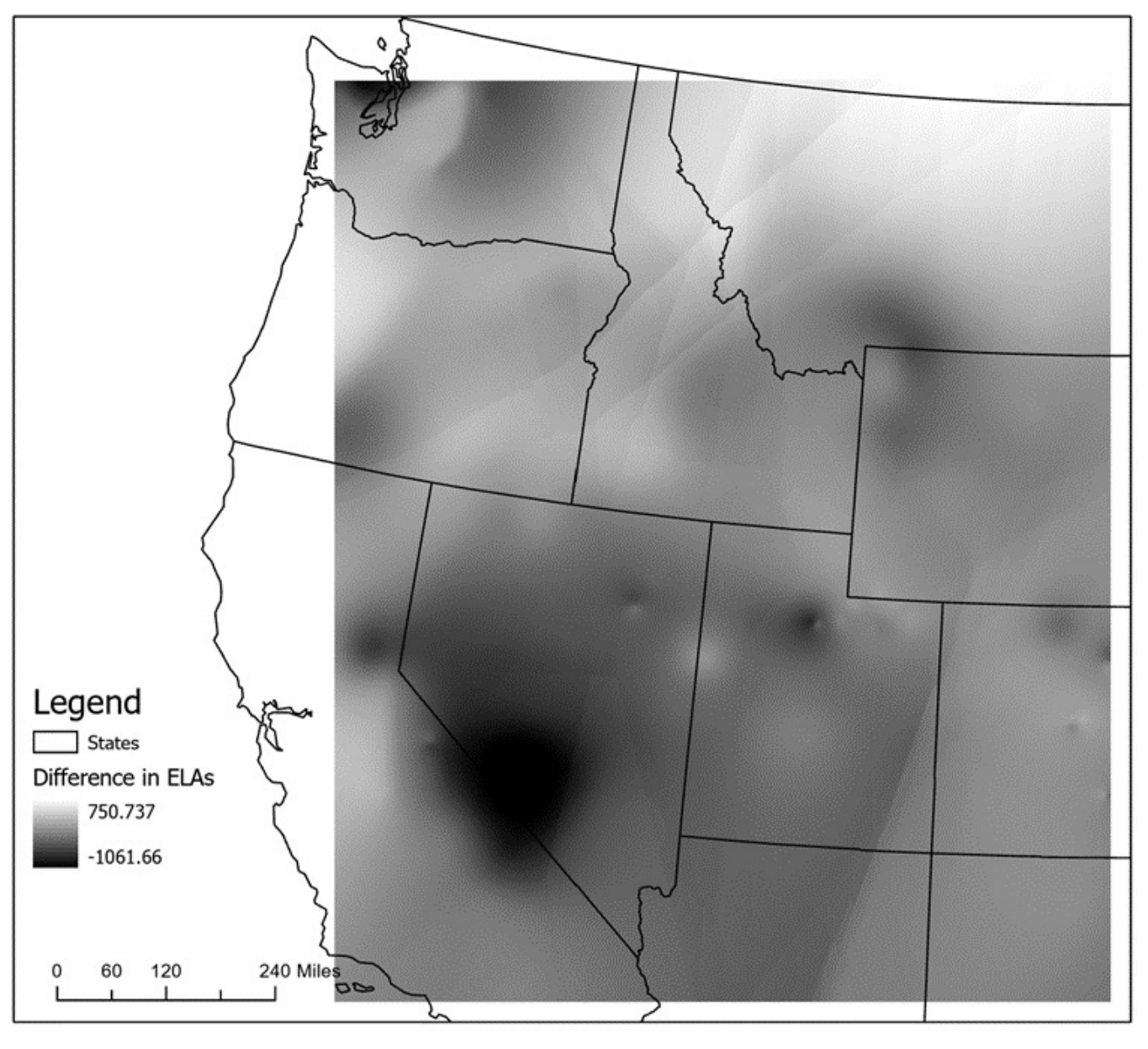
LGM ELA surface for valleys w/cosmo chronologies based on AAR, THAR



Late Pleistocene ELA surface from Porter et al. (1983), Pierce (2004) based on cirque floor elevations



LGM ELAs minus Porter/Pierce ELAs



Summary

- Terminal moraines of Pleistocene valley glaciers correspond to the latter part of the Last Glacial Maximum, 21-19 ka
- Recessional moraine ages vary, represent times of readvance or pauses in retreat after 19 ka
- Spatio-temporal pattern for the Sierra Nevada, Great Basin, Rocky Mountains – PNW and Northern Rockies underrepresented
- Need more chronologies of recessional moraines and updated reconstructions of Pleistocene paleoglaciers!