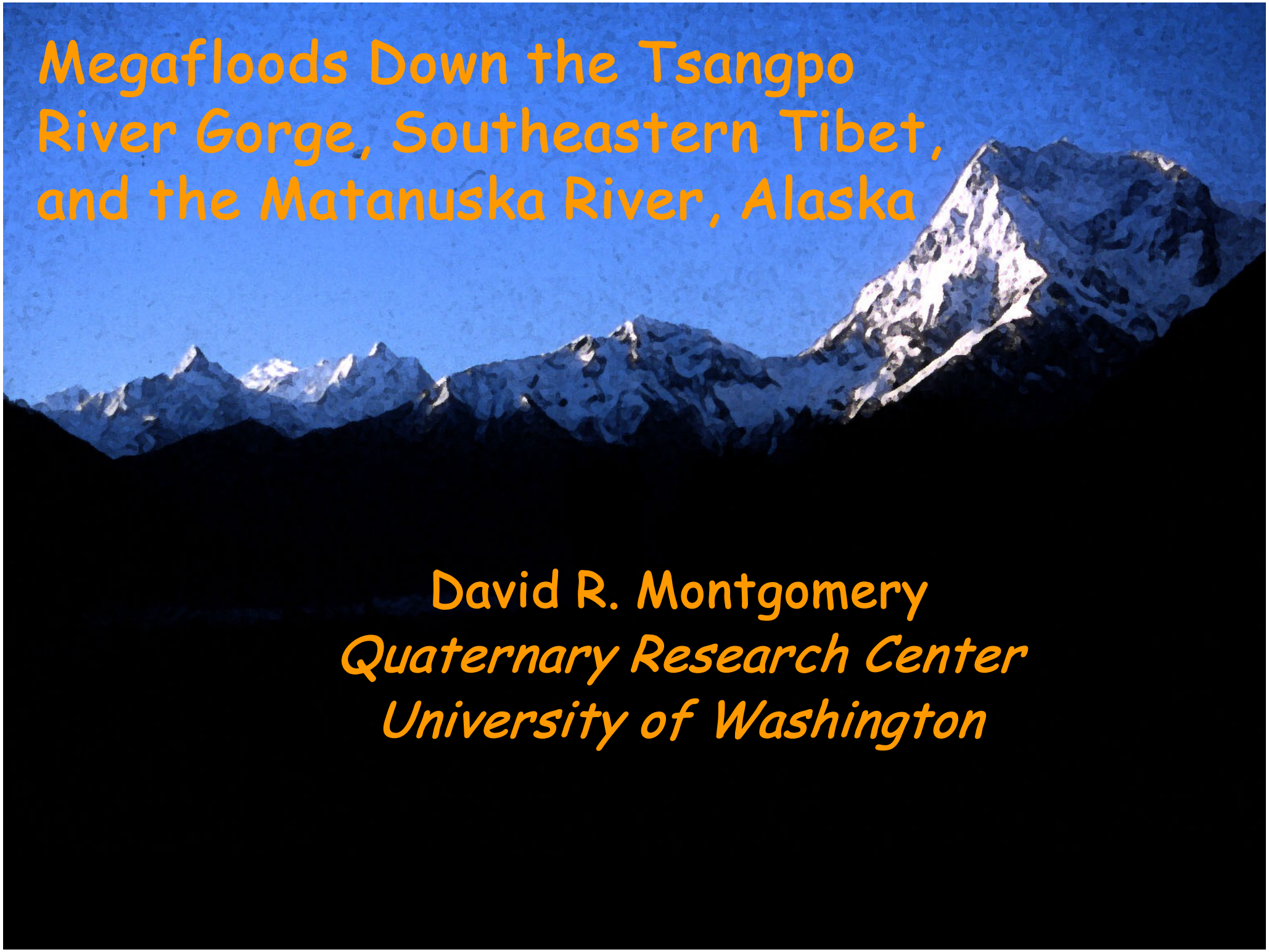
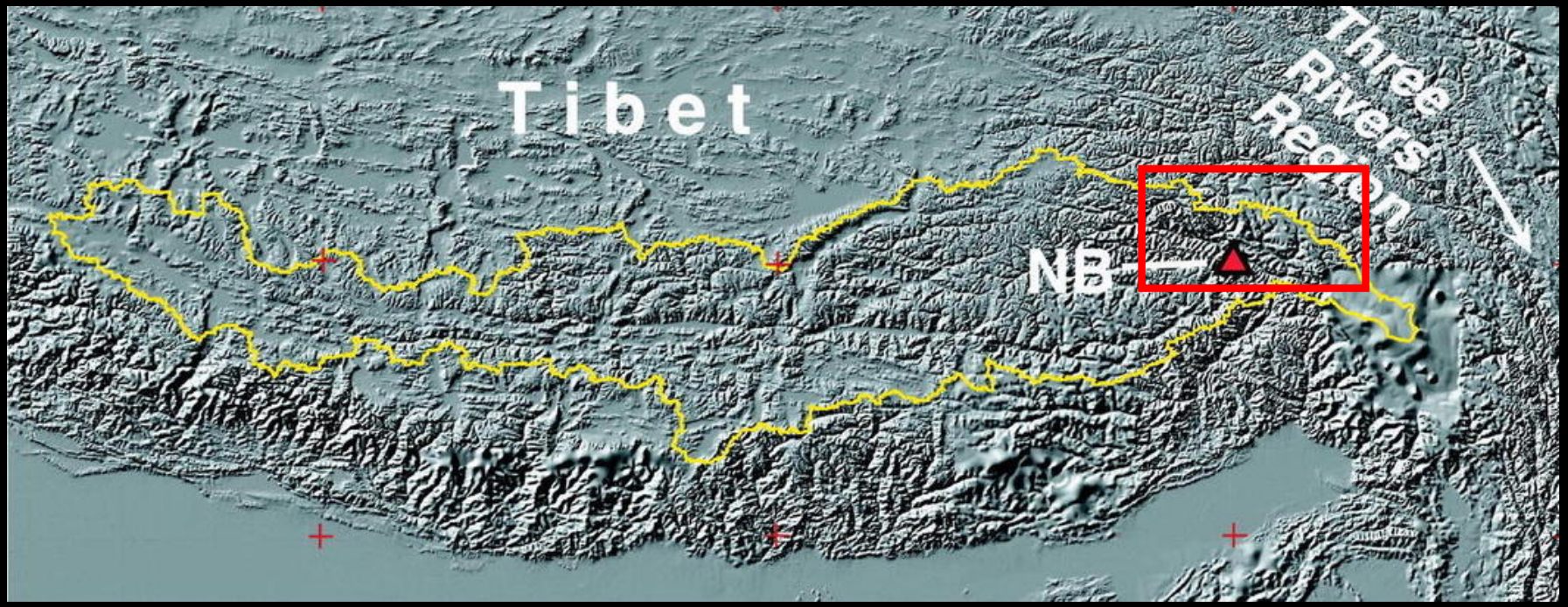
Megafloods Down the Tsangpo River Gorge, Southeastern Tibet, and the Matanuska River, Alaska

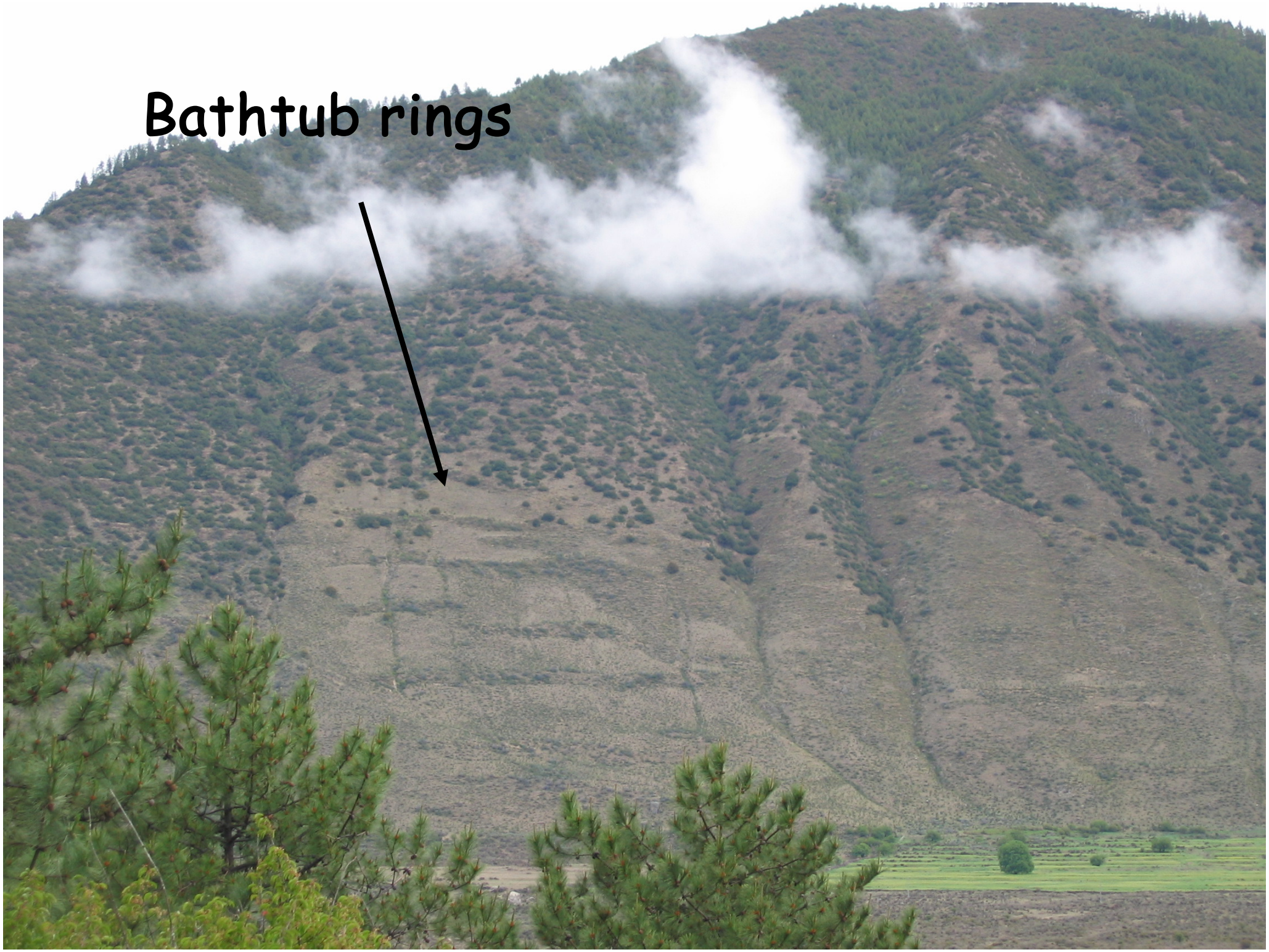


David R. Montgomery
Quaternary Research Center
University of Washington

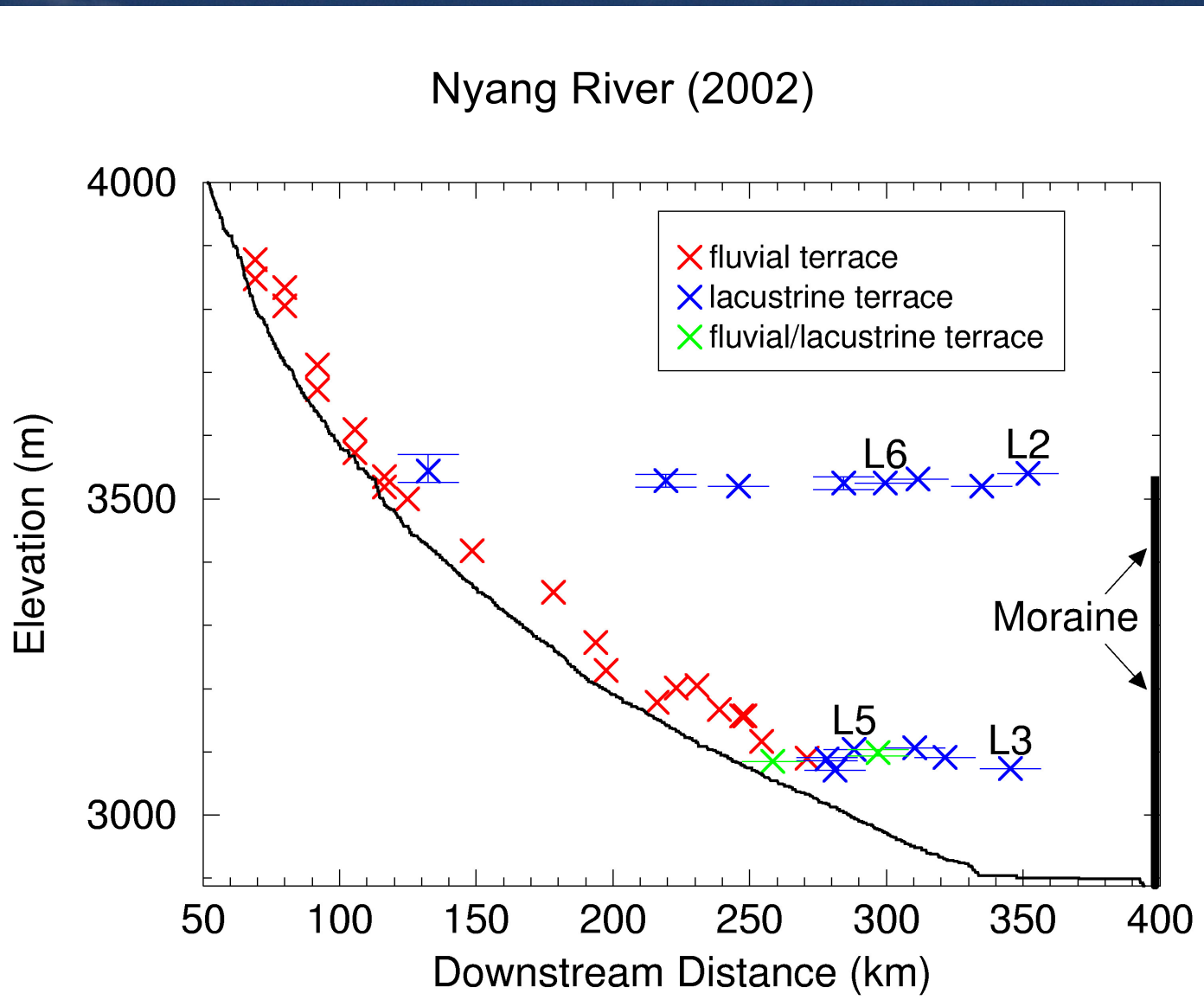
Montgomery, D. R., Hallet, B., Yuping, L., Finnegan, N., Anders, A., and Gillespie, A., Evidence for Holocene megafloods downs the Tsangpo River gorge, Southeastern Tibet, *Quaternary Research*, v., 62, p. 201-207, 2004.




Lake Sediments over fluvial gravel

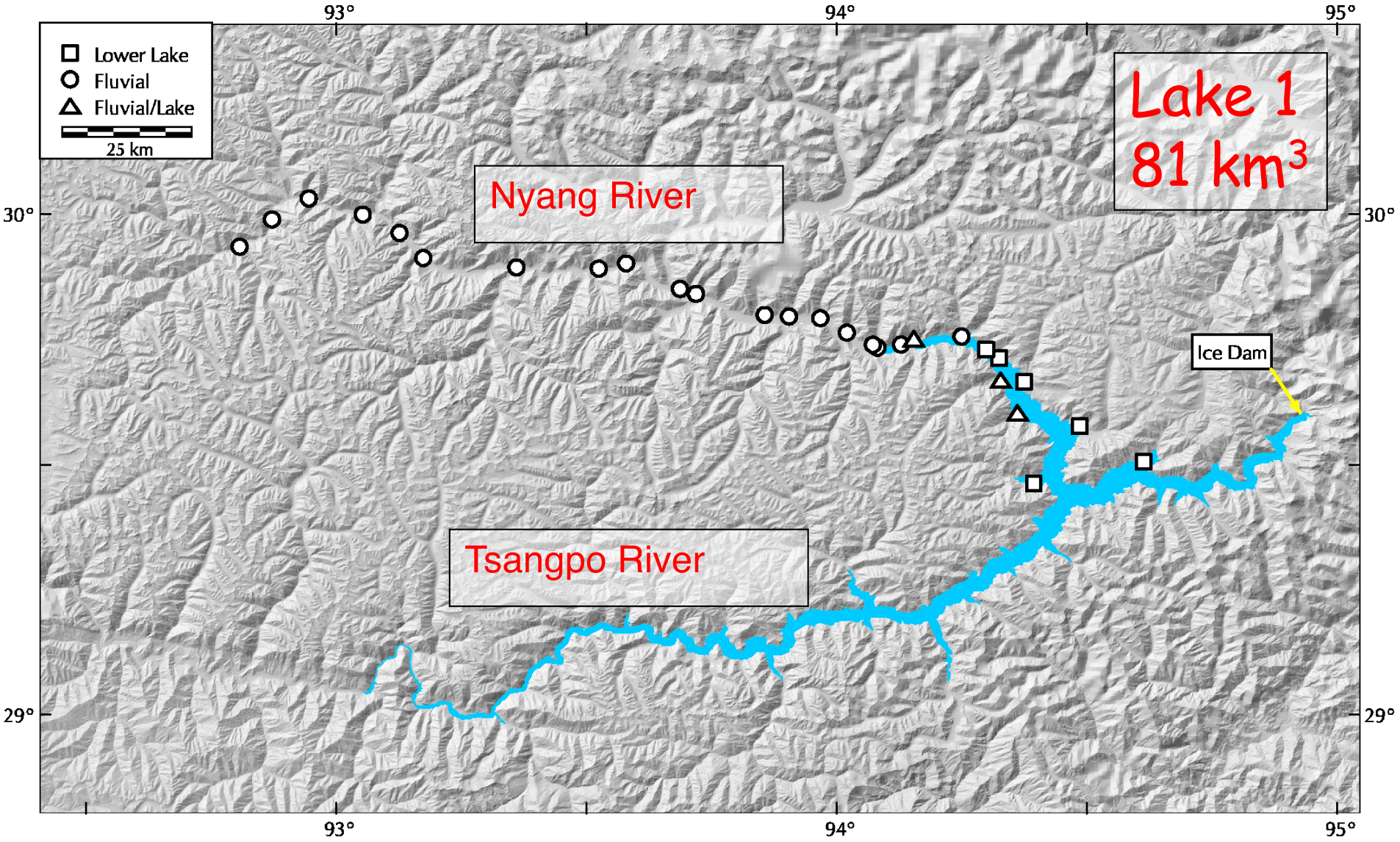

Bathtub rings

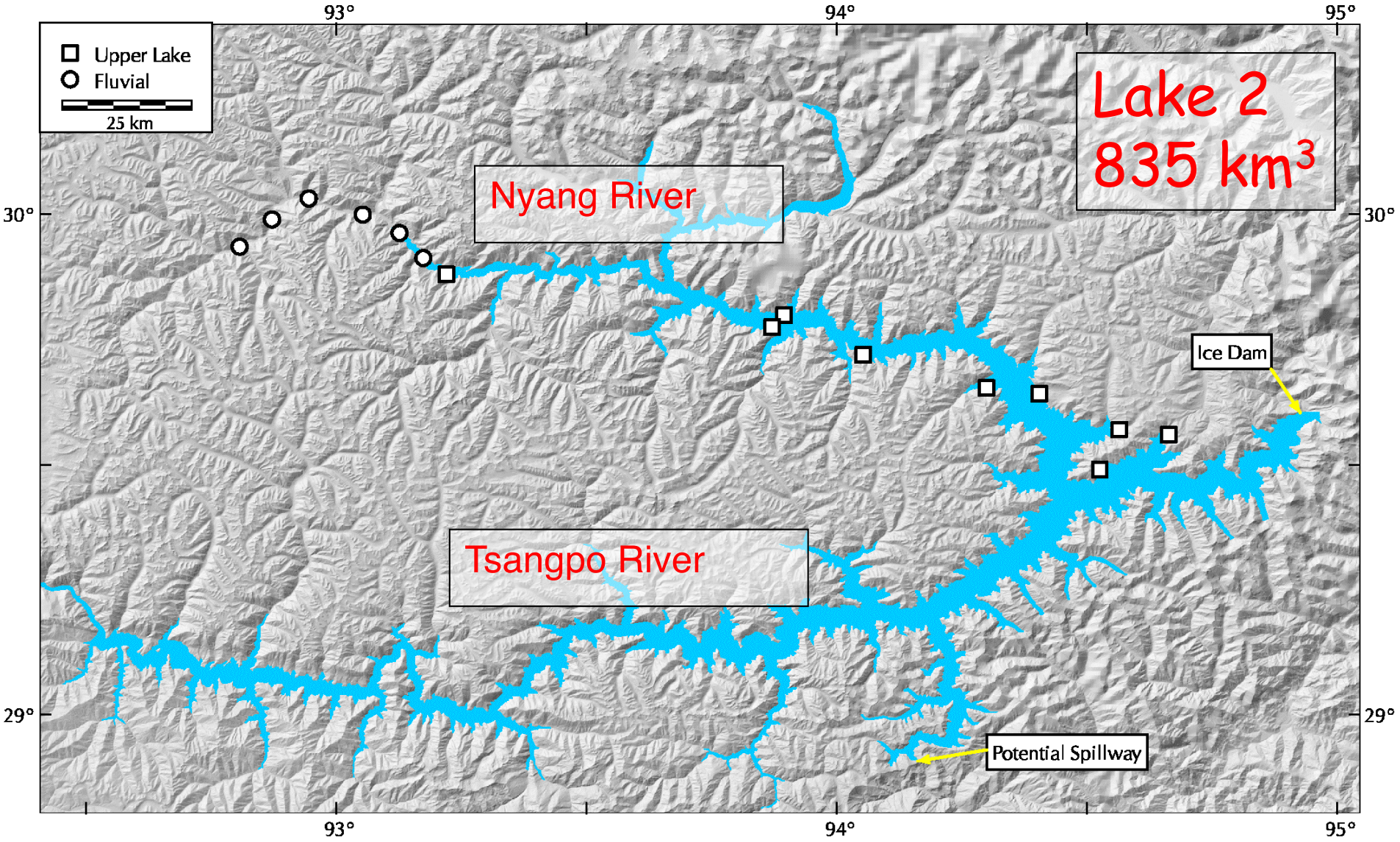
Delta terrace from tributary


Nyang River (2002)
4000
3500
3000
Elevation (m)
fluvial terrace
lacustrine terrace
fluvial/lacustrine terrace
L6
L2
Moraine
L5
L3
50
100
150
200
250
300
350
400
Downstream Distance (km)


Moraine "dam" at entrance to Tsangpo gorge
Lake 3 elevation
Lake 2 elevation


Moraine "plug" at entrance to Tsangpo gorge


Lower Lake
Fluvial
Fluvial/Lake
25 km
93°
94°
95°
30°
29°
Nyang River
Tsangpo River
Lake 1
81 km3
Ice Dam


Upper Lake
Fluvial
25 km
93°
94°
95°
30°
29°
Nyang River
Tsangpo River
Lake 2
835 km³
Ice Dam
Potential Spillway

Tsangpo Terrace ages

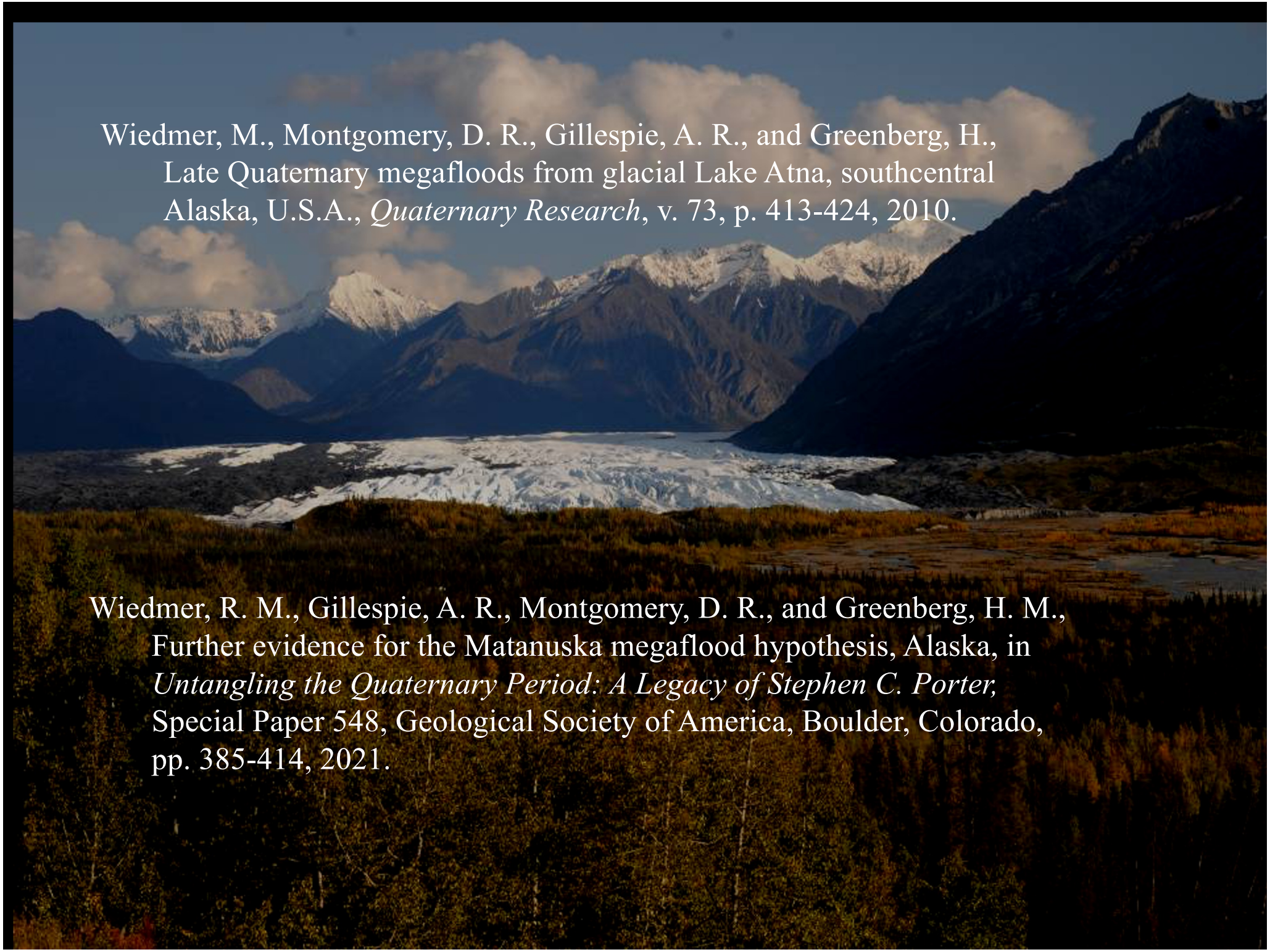
	^{14}C age	Calibrated age
Lake 1:		
L3	1220 ± 40 yr. b.p.	690 to 900 A.D.
L5	1640 ± 40 yr. b.p.	320 to 450 A.D.
Lake 2:		
L2	8860 ± 40 yr. b.p.	9760 to 10160 b.p.
L6	9870 ± 50 yr. b.p.	11300 to 11190 b.p.

Estimated paleoflood characteristics.

	Volume (km^3)	Peak Discharge ($m^3\ s^{-1}$)	Unit Stream Power ($watts/m^2$)
Tsangpo (Upper Lake)	835	5×10^6	1 to 5×10^6
Tsangpo (Lower Lake)	81	1×10^6	2×10^5 to 1×10^6
Missoula *	2184	1.7×10^7	2.5 to 3×10^5
Bonneville **	4750	1×10^6	1×10^5

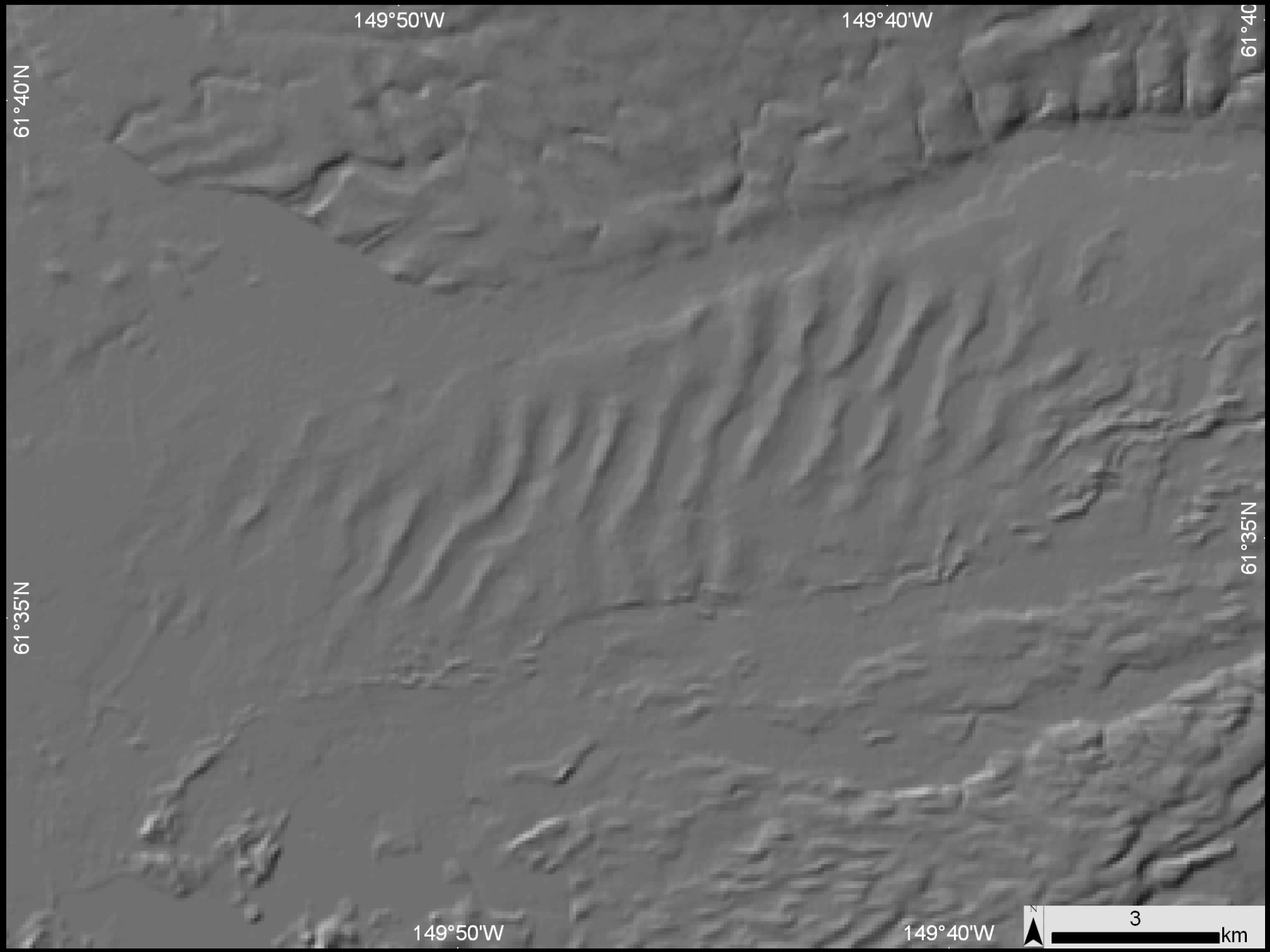
- O'Connor and Baker (1992)
- ** O'Connor (1993)

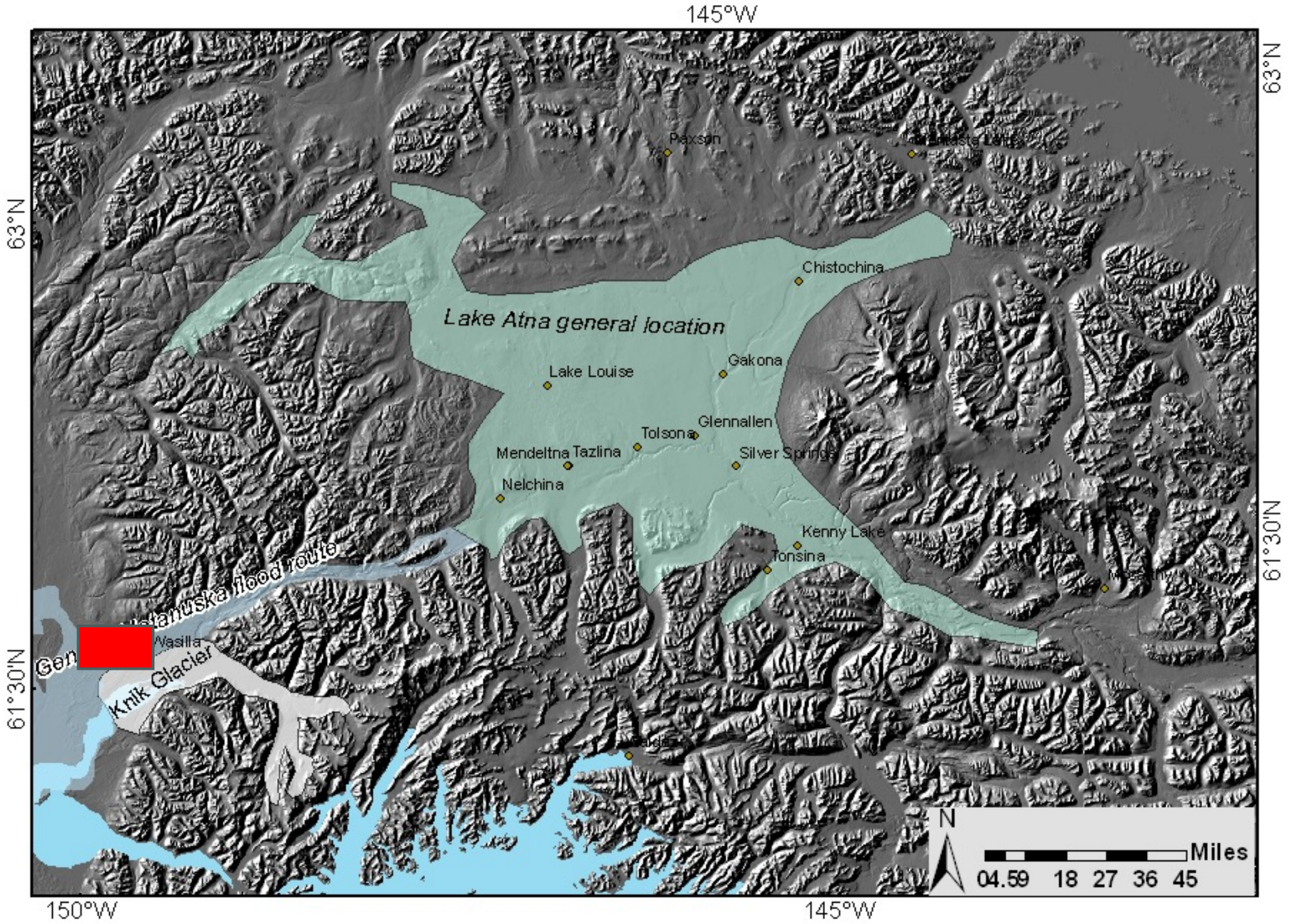
In the late 8th century, Padmasambhava brought Buddhism to Tibet. The Sutras record that he defeated the demon of the lake, thereby draining it and raising the valley's farmland from its waters.



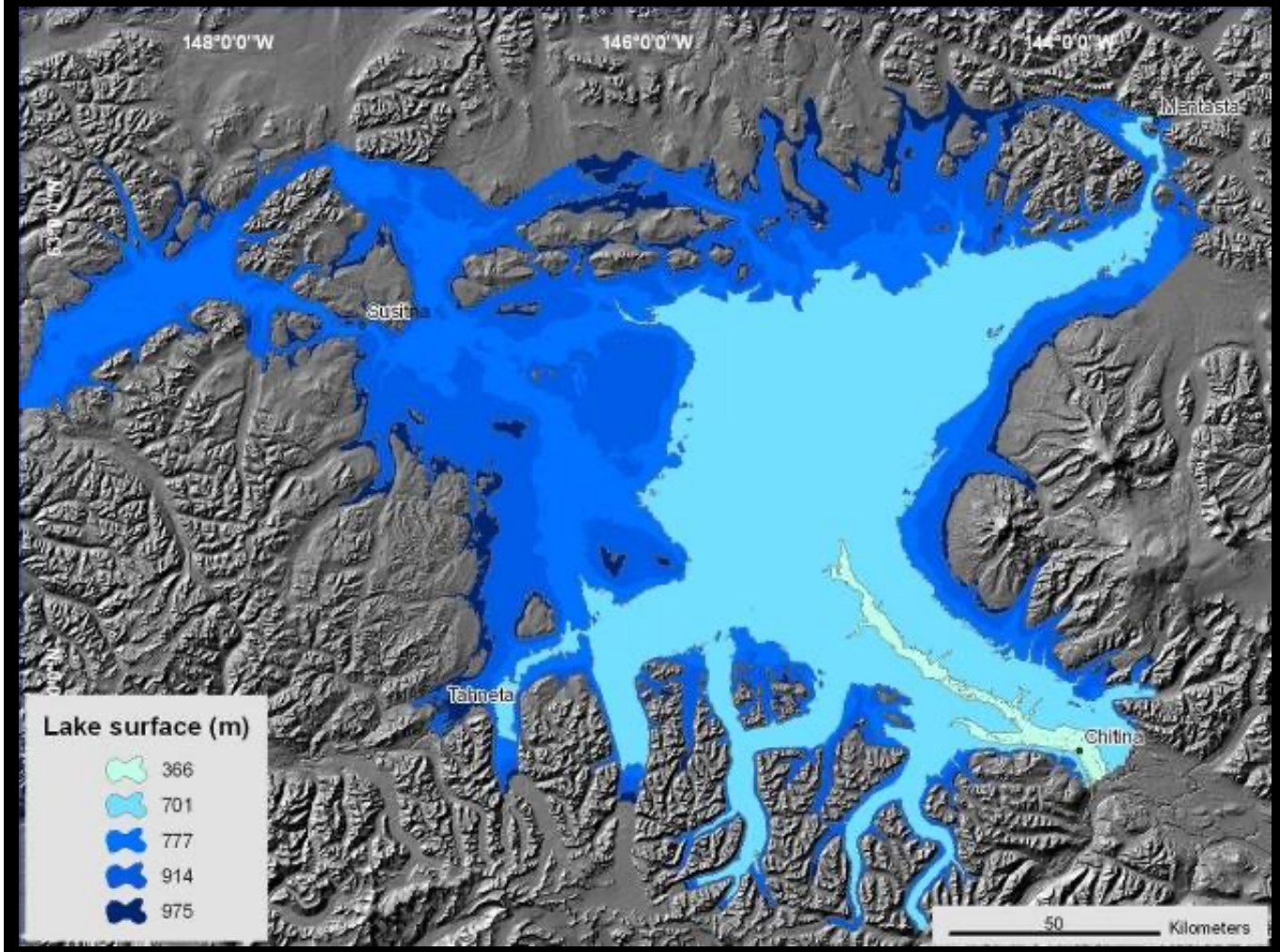
Wiedmer, M., Montgomery, D. R., Gillespie, A. R., and Greenberg, H., Late Quaternary megafloods from glacial Lake Atna, southcentral Alaska, U.S.A., *Quaternary Research*, v. 73, p. 413-424, 2010.

Wiedmer, R. M., Gillespie, A. R., Montgomery, D. R., and Greenberg, H. M., Further evidence for the Matanuska megaflood hypothesis, Alaska, in *Untangling the Quaternary Period: A Legacy of Stephen C. Porter,* Special Paper 548, Geological Society of America, Boulder, Colorado, pp. 385-414, 2021.


149°50'W
149°40'W
61°40'N
61°35'N
149°50'W
149°40'W
61°35'N
N
3
km

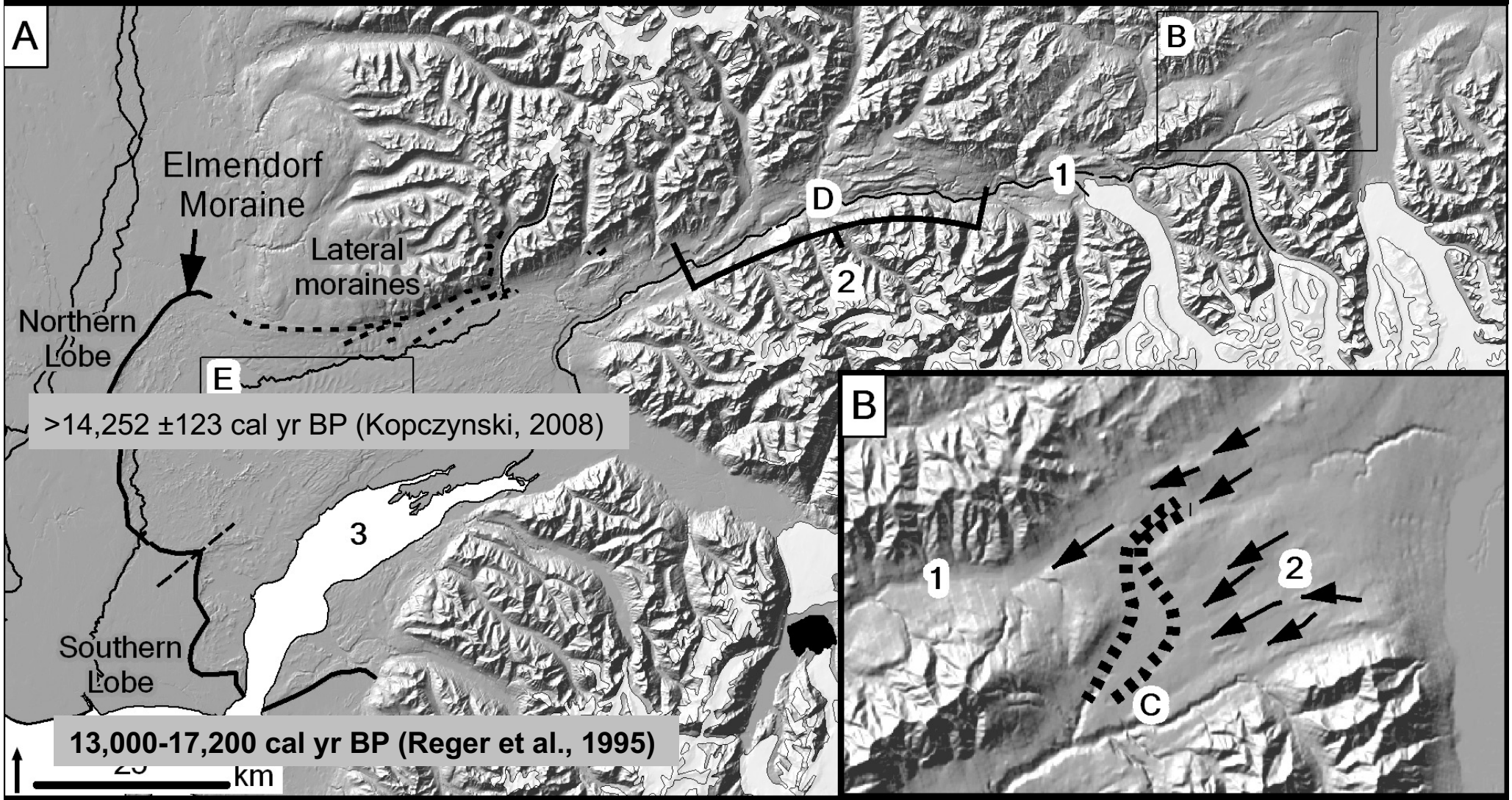

145°W
63°N
61°30'N
150°W
Paxson
Chistochina
Lake Atna general location
Gakona
Lake Louise
Glennallen
Tolsona
Mendeltna
Tazlina
Silver Springs
Nelchina
Kenny Lake
Tonsina
Knik Glacier
N
Miles
04.59 18 27 36 45

Latest Lake Atna:



- Formed >58,600±1100 ^{14}C yr BP (Ferrians, 1984)
- Extent fluctuated before finally draining >10,270-11,090 cal yr BP (Rubin and Alexander, 1960)
- Multiple dominant lake levels

Matanuska Valley flood evidence:



B: Tahneta Pass (907 m). Williams and Galloway (1986) identified an 8-km-wide flow path at ≤975 m from the CRB through Tahneta Pass to the Matanuska Valley. Within this broad path they mapped shorelines of a distinct spillway at ~914 m

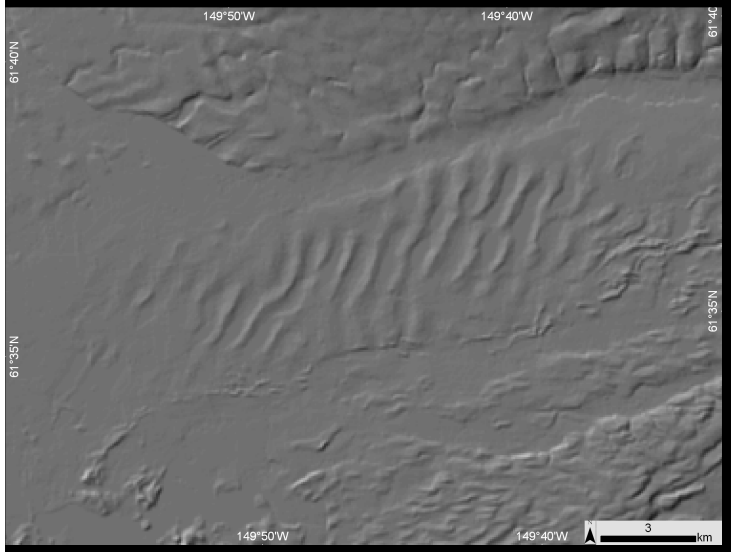
Fluvial materials deposited in dynamic environment:

Visible packet of foreset beds ~ 5 m high

Fluvial section with clean sand to cobble foresets dipping 20 degrees ~west (down valley).

Scarce boulders ≥1 m

Previous interpretations of transverse ridges:

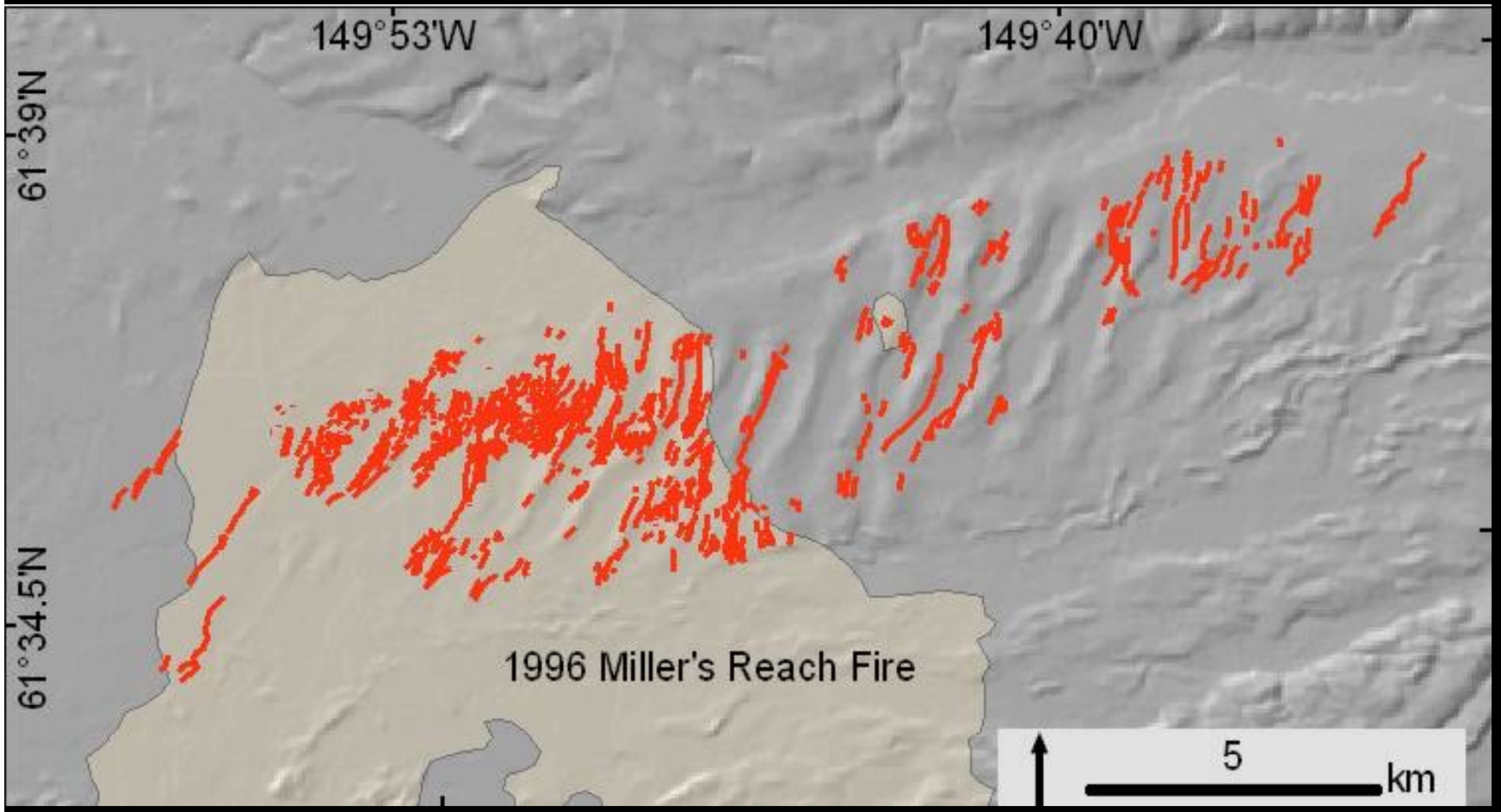


Rogen moraine (Reger and Updike, 1983)

However, not consistent with:

- Fluvial deposits
- Y-junctions
- Chord length regularity and height trends
- Lack of crescent-shaped distal margins
- Lack of fluting and/or hummocky surfaces
- Lack of terminal ridge horns

“DeGreer Moraines”?



When we mapped the DeGreer moraines we found they are restricted to the footprint of the large dunes and are oriented in concert with the larger “parent” dune.

Suggests a common genesis

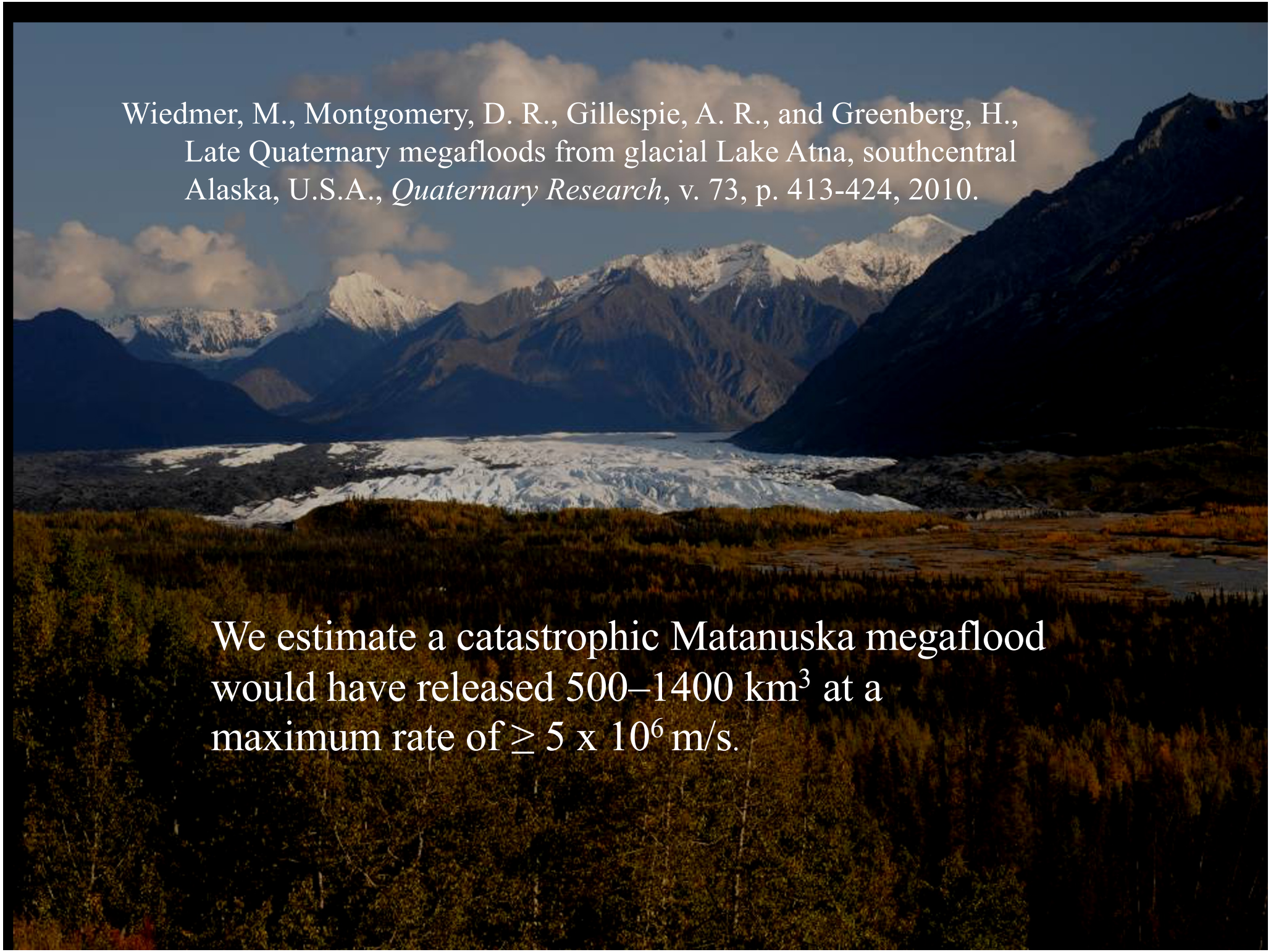
“DeGreer Moraines” superposed on large dunes

(≤3 m high) subparallel ridges, symmetrical in cross section uniform in ridge morphology. These smaller ridges are spaced <100 m apart, are constructed of well-washed poorly bedded gravelly alluvium

“DeGreer Moraines”: Smaller water formed dunes?

Analyses of modern river bedforms suggests:

- Superposed dunes are generated during rapidly decreasing discharges.
- Where 2 orders of transverse bedforms are preserved, they differ in scale by ~1 order of magnitude (Allen and Collinson, 1974).
- In height and chord length, the 2 styles of Wasilla dunes also differ by ~1 order of magnitude and are built of alluvium.



Wiedmer, M., Montgomery, D. R., Gillespie, A. R., and Greenberg, H., Late Quaternary megafloods from glacial Lake Atna, southcentral Alaska, U.S.A., *Quaternary Research*, v. 73, p. 413-424, 2010.

We estimate a catastrophic Matanuska megaflood would have released 500–1400 km^3 at a maximum rate of $\geq 5 \times 10^6$ m/s.