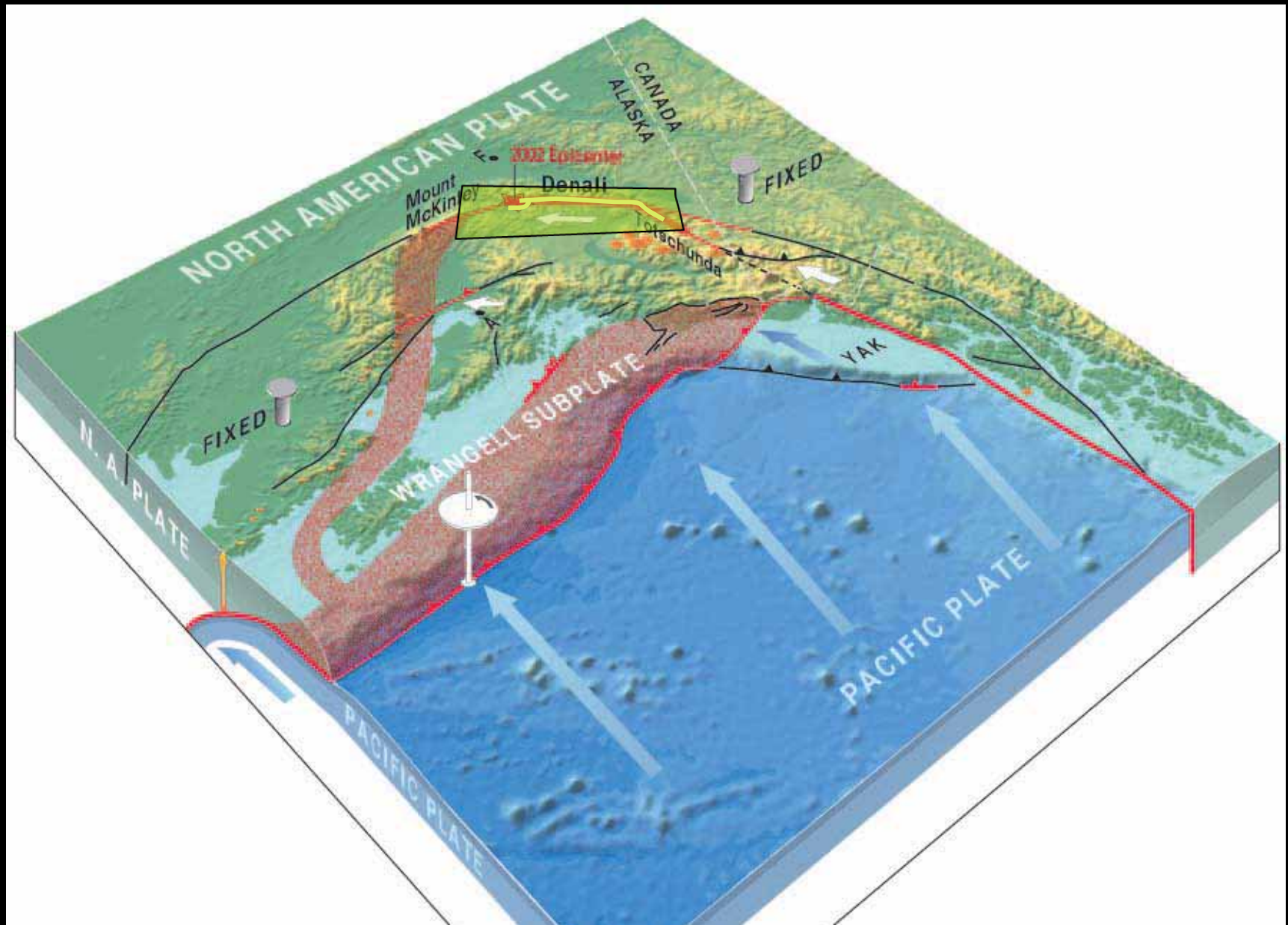
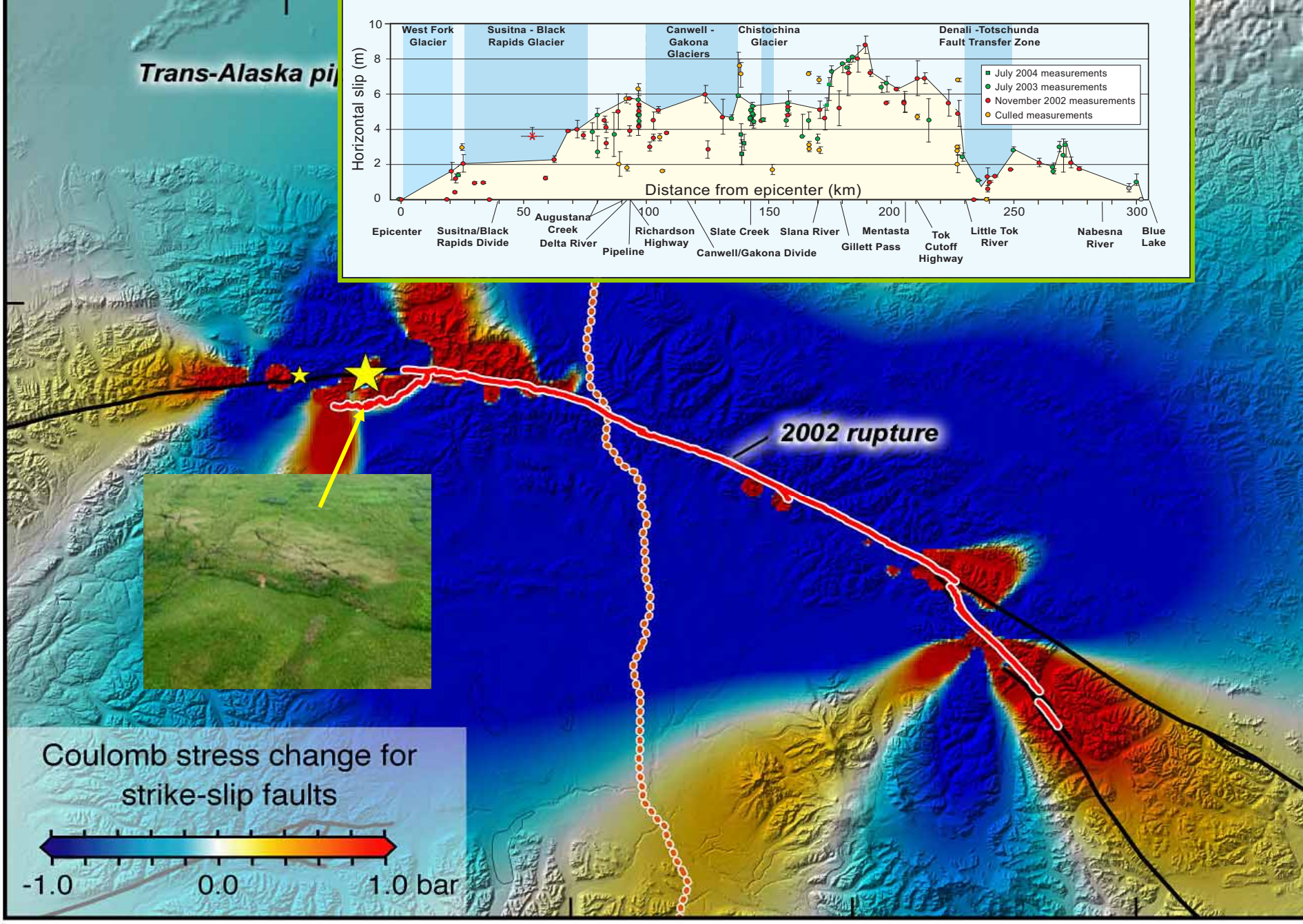
Two Very Different Surface Ruptures and Some Generalizations about the Behavior of Strike-slip Faults:

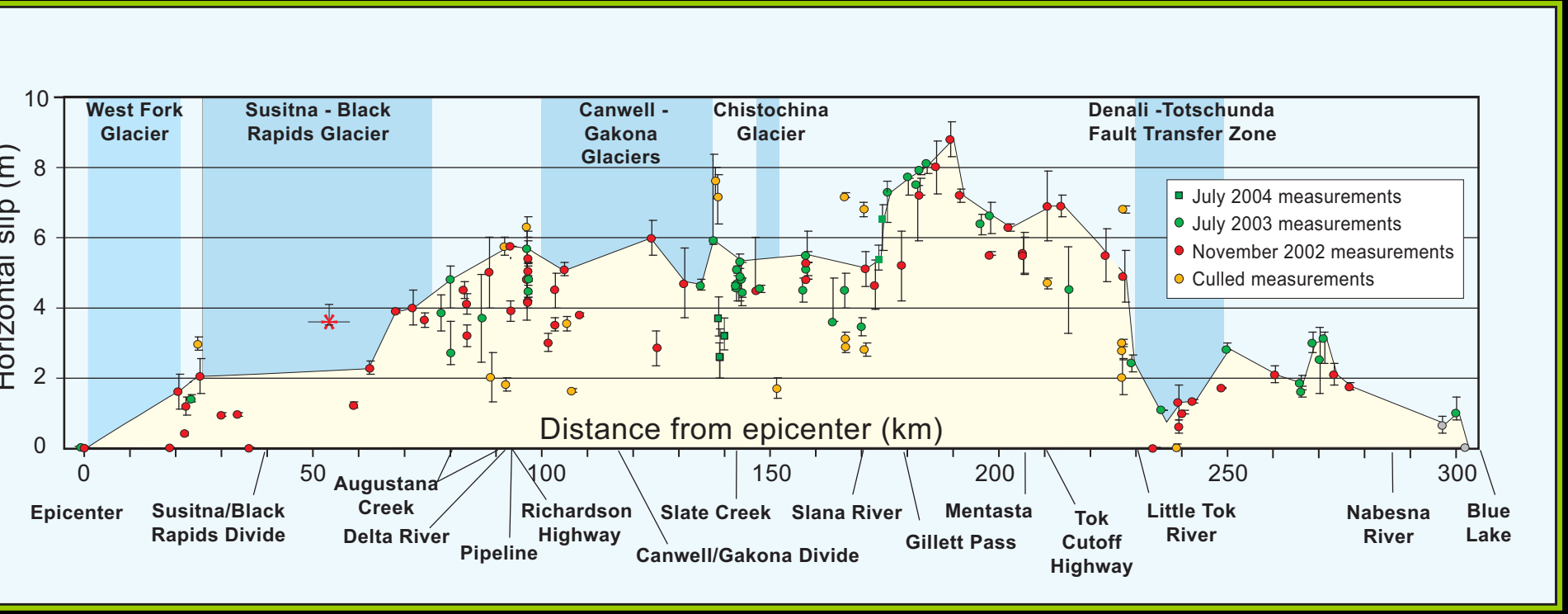
Denali 2002
Bulnay 1905

Tectonics of southern Alaska



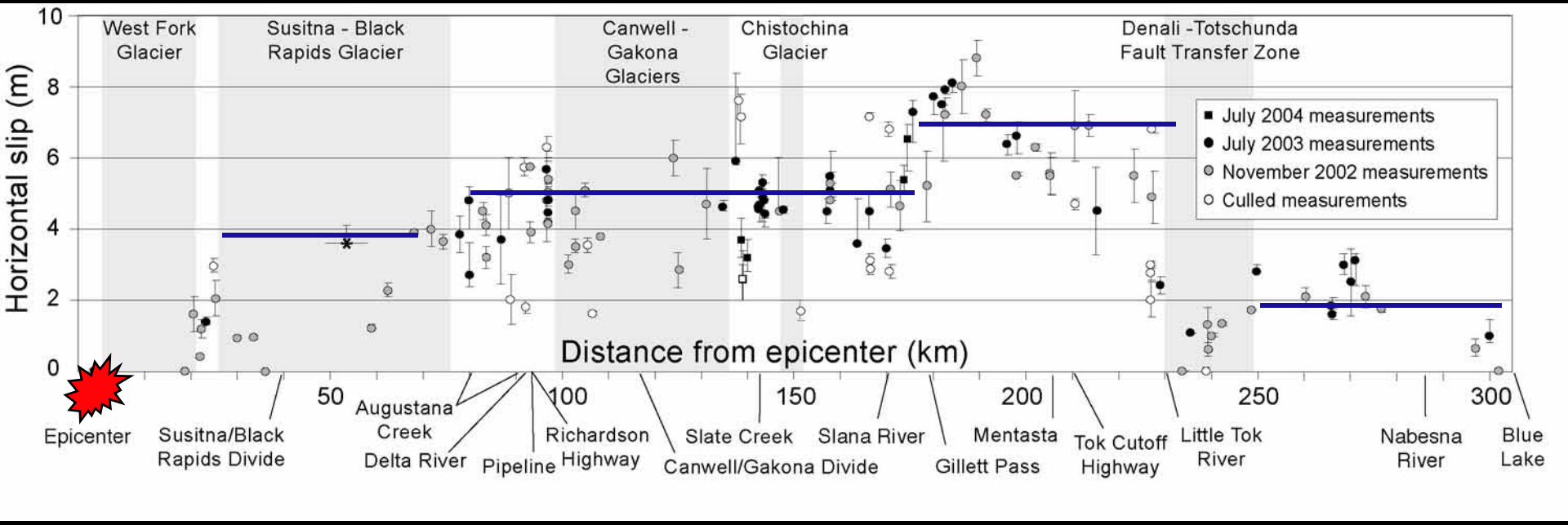

Trans-Alaska pi
West Fork Glacier
Susitna - Black Rapids Glacier
Canwell - Gakona Glaciers
Chistochina Glacier
Denali -Totschunda Fault Transfer Zone
Horizontal slip (m)
Distance from epicenter (km)
July 2004 measurements
July 2003 measurements
November 2002 measurements
Culled measurements
Epicenter
Susitna/Black Rapids Divide
Augustana Creek
Delta River
Pipeline
Richardson Highway
Canwell/Gakona Divide
Slate Creek
Slana River
Gillett Pass
Mentasta
Tok Cutoff Highway
Little Tok River
Nabesna River
Blue Lake
2002 rupture
Coulomb stress change for strike-slip faults
-1.0
0.0
1.0 bar

Denali-Totschunda Slip Distribution



Haeussler et al (2004)

Horizontal Slip distribution



Estimates of Average Slip

M_w **7.8**

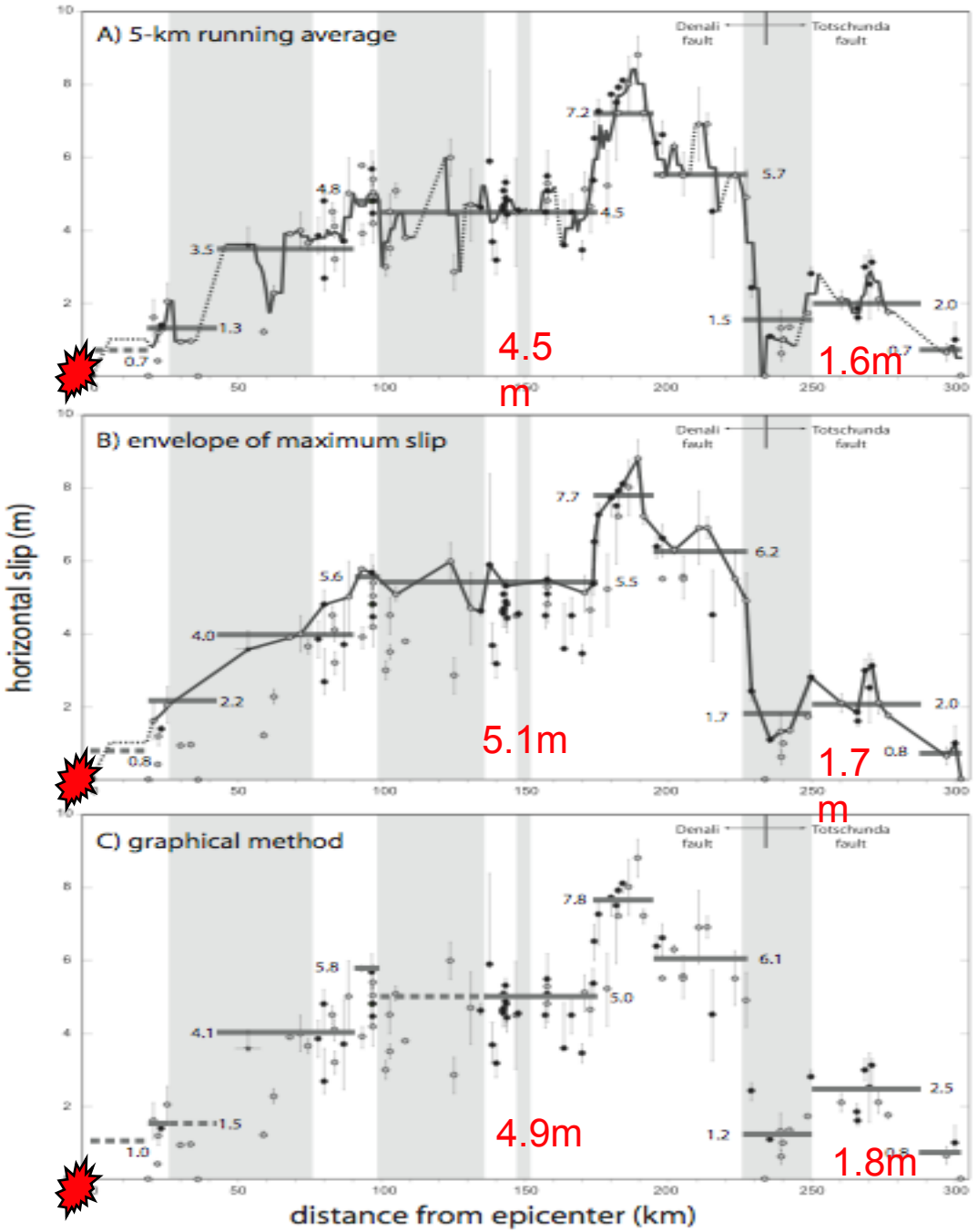


Figure 12.

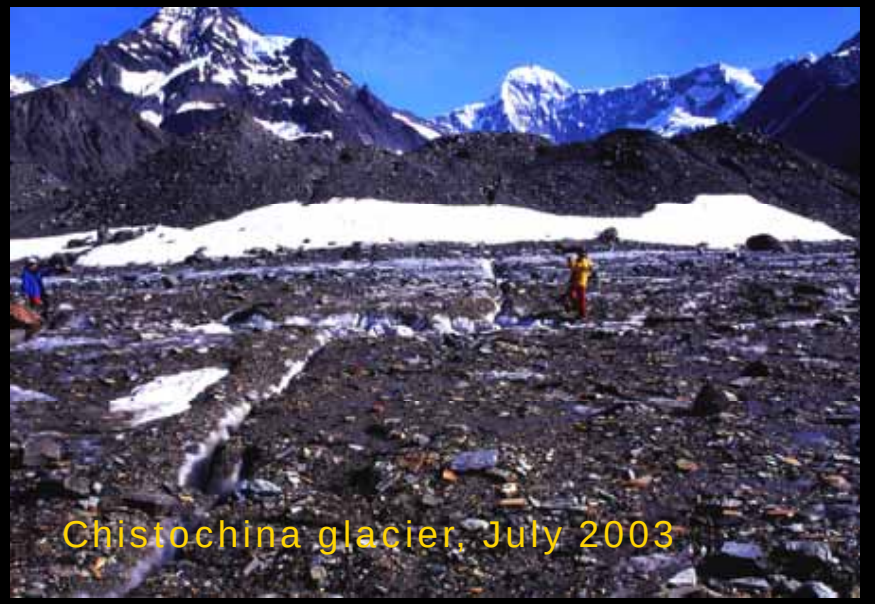
Haeussler et al (2004) BSSA

Short-lived glacial offsets

Susitna glacier thrust, Nov. 2002

Canwell glacier, Nov. 2002

Chistochina glacier, July 2003



Chistochina glacier, July 2003

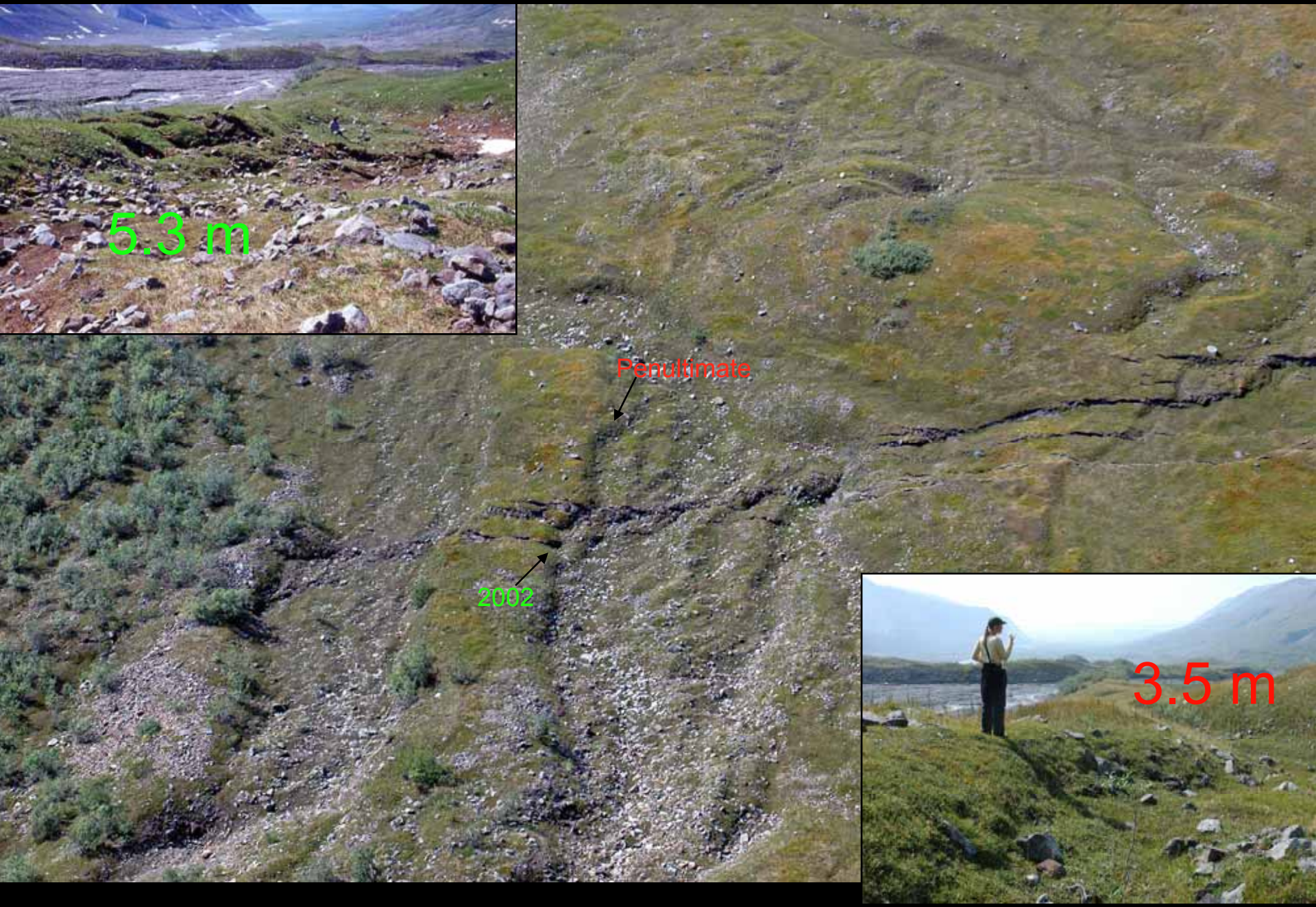
Km 18
1.5 m

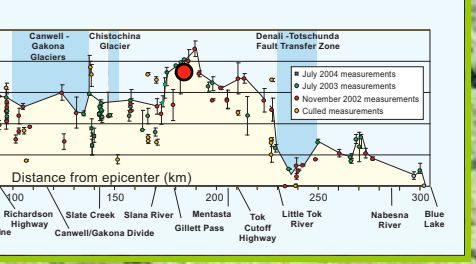
Km 18
2.9 (1.5)
1.4

Slate Creek
Km 140

5m

5m


5.3 m
Penultimate
2002
3.5 m



2002 + penultimate offset

7.9

16 (8.1)

Km 18

Gillett Pas
Km 184

8.1 m

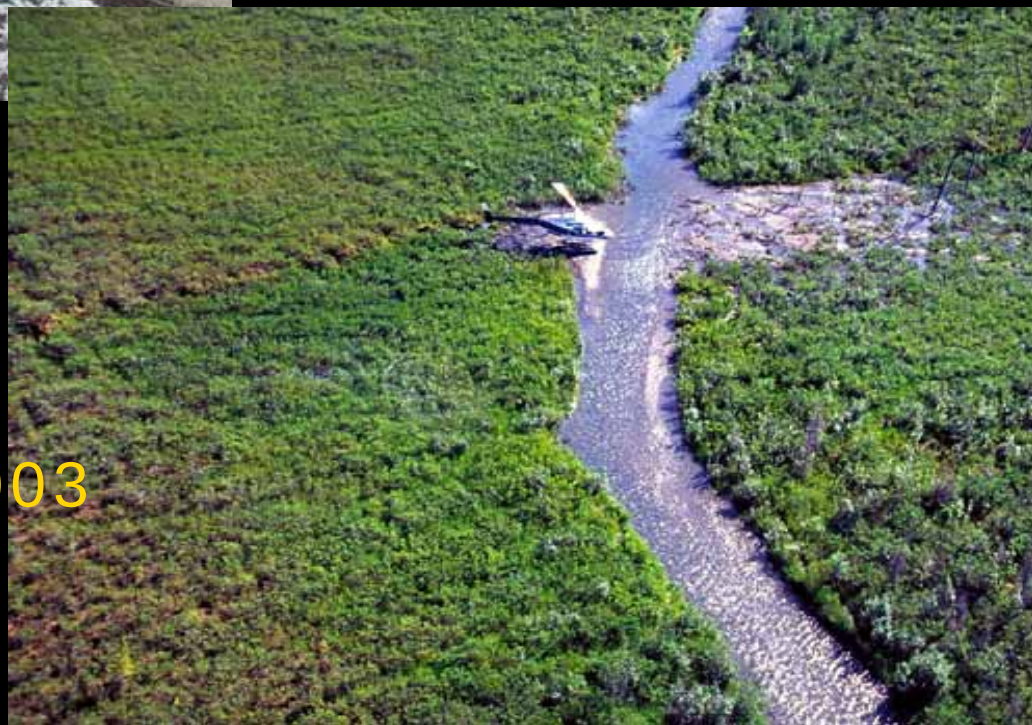
science for a changing world

November 2002

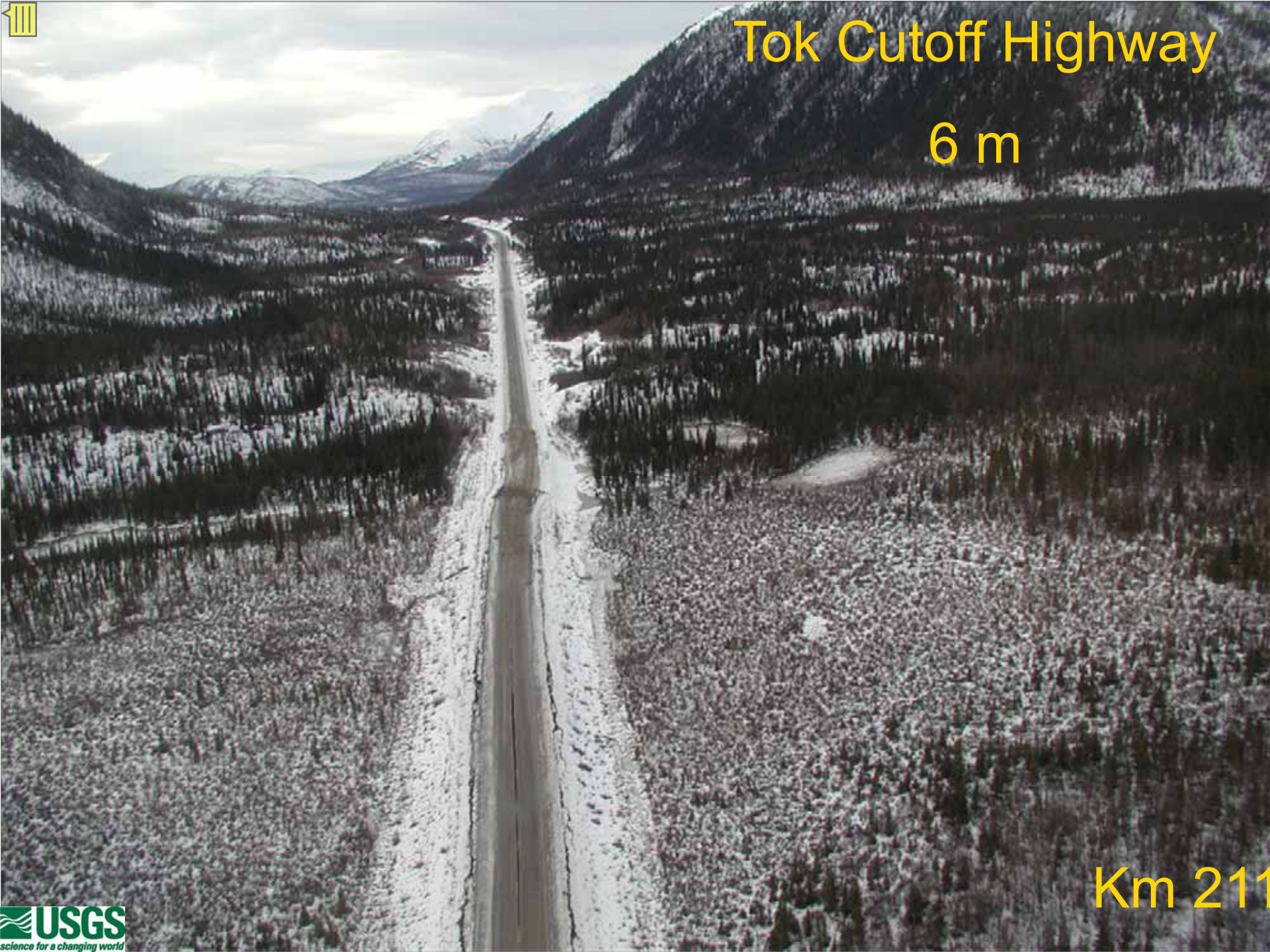
Bone Creek

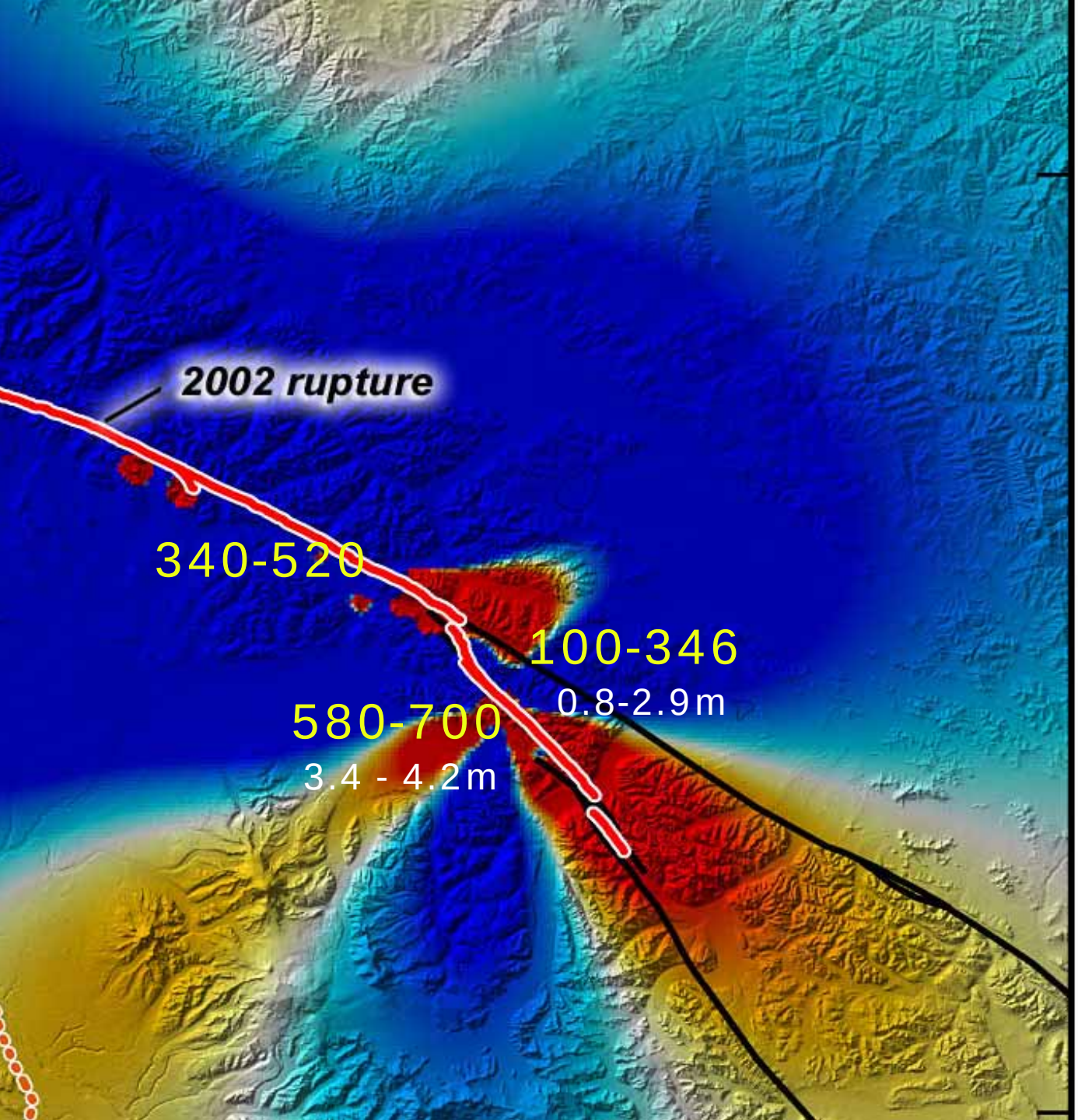
5.5m

July 2003



Km 197

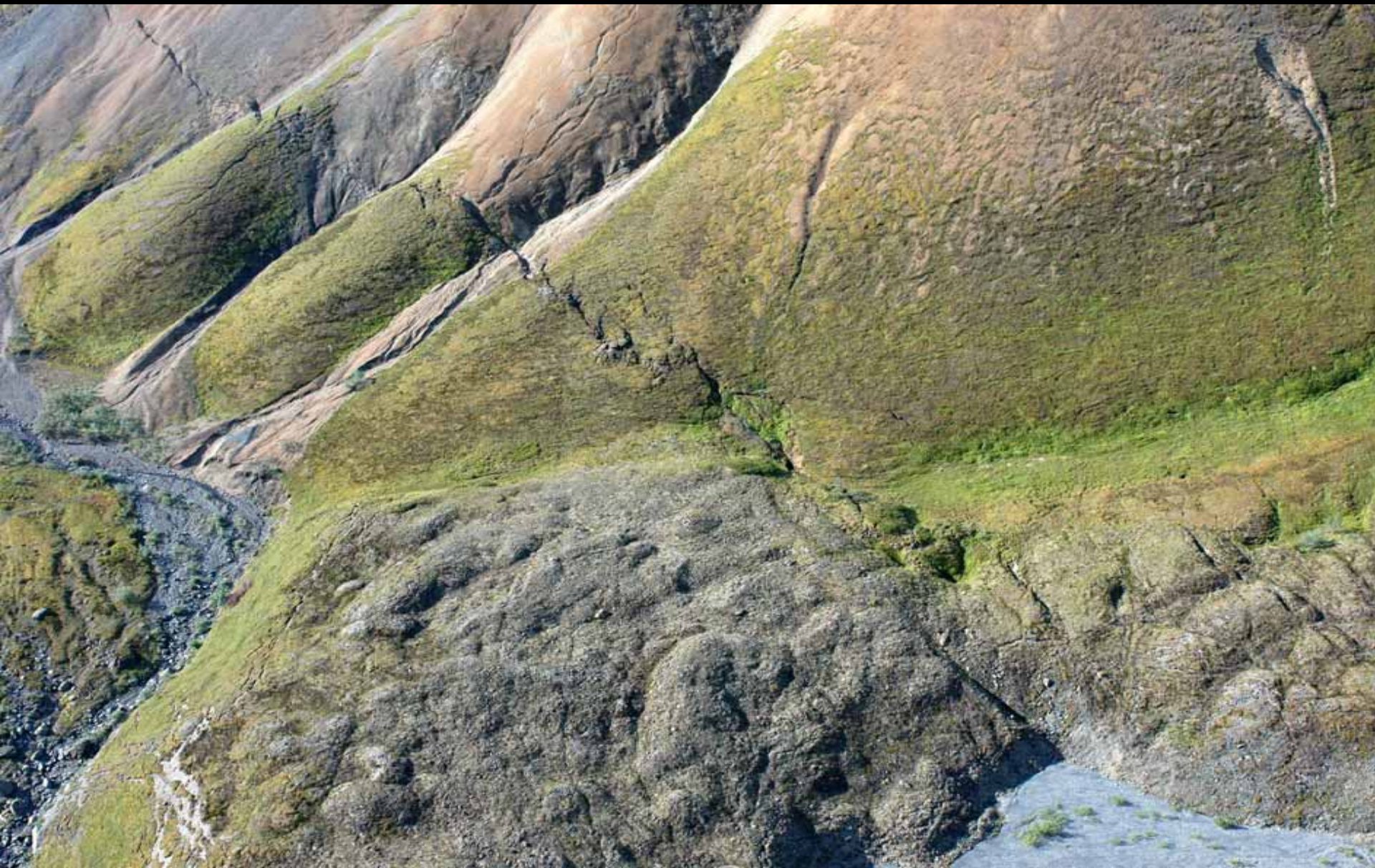

Tok Cutoff Highway
6 m
Km 211

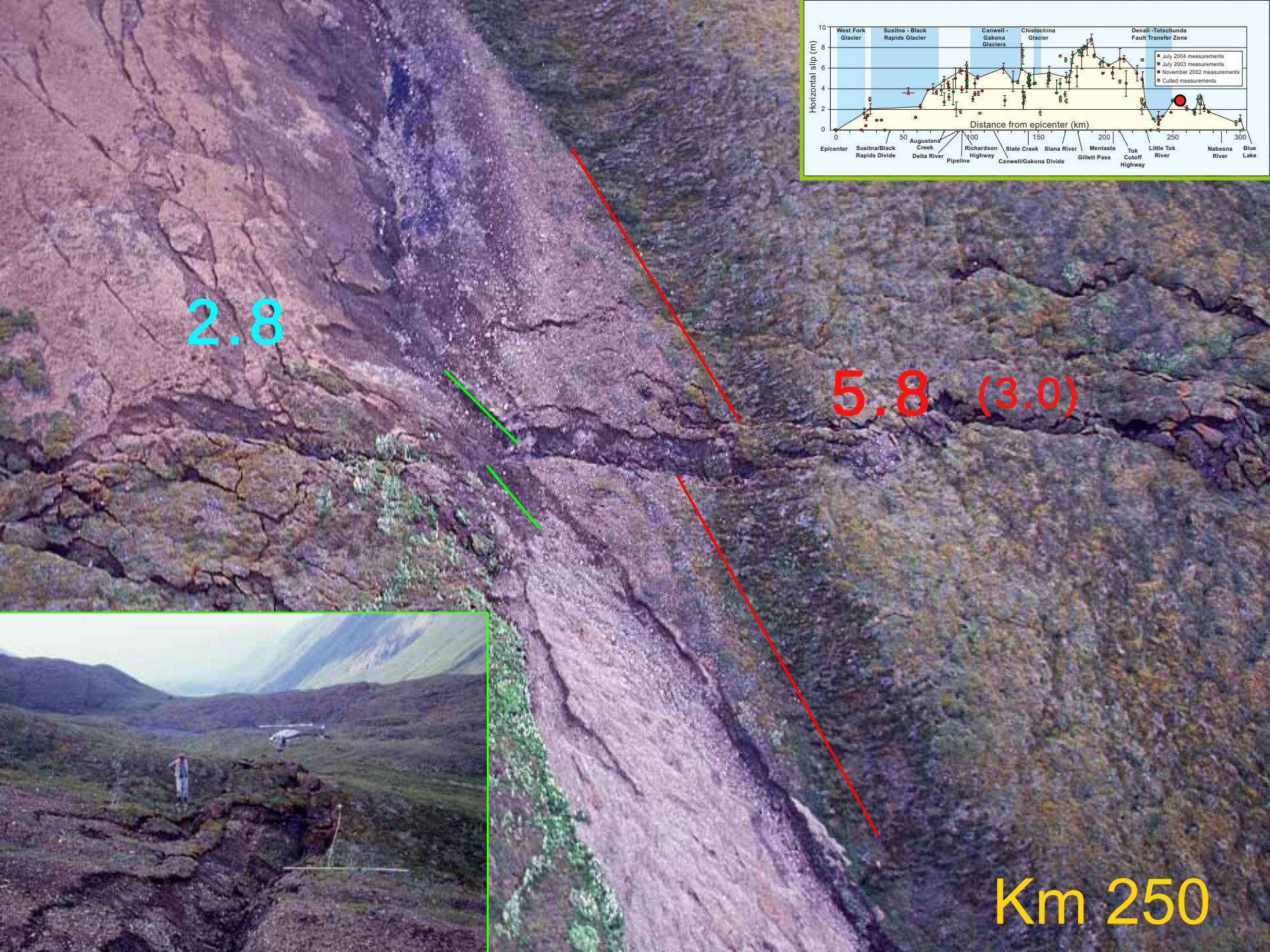


Primary control of 2002 rupture path is timing of past earthquakes/ accumulated strain on the Totschunda

Totschunda fault

250 km east of
02 epicenter




2.8
5.8 (3.0)
Km 250
West Fork Glacier
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Denali -Totschunda Fault Transfer Zone
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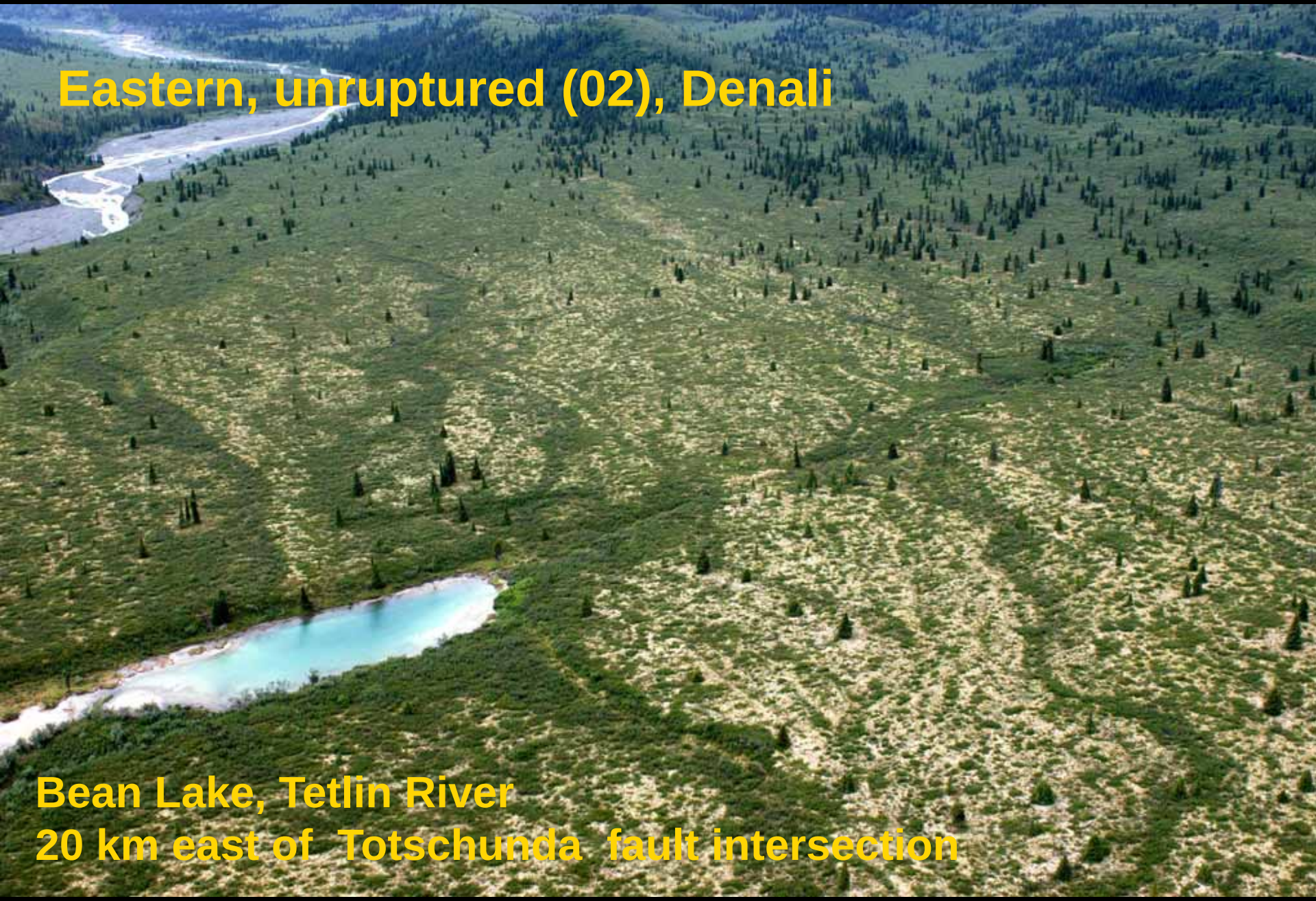
Tok Cutoff Highway
Little Tok River
Nabesna River
Blue Lake

Western Denali paleo-offsets

50 km west of 02 epicenter
8m in 2 events


Eastern, unruptured (02), Denali
Bean Lake, Tetlin River
20 km east of Totschunda fault intersection

Denali Rupture Characteristics

Rupture of multiple faults:connectivity

Slip distribution asymmetric: Dmax 180 km east of epicenter

Slip divided into distinct sections (4-9) of Davg

Large changes in slip occur over short (≤400 m) distances

Within distinct sections point-specific D can vary by 90%

Rupture structurally simple except at bends and steps

Width of fault zone typically narrow (1-5m); no correlation between width of zone and Dnet

Paleo offsets similar in size to 2002

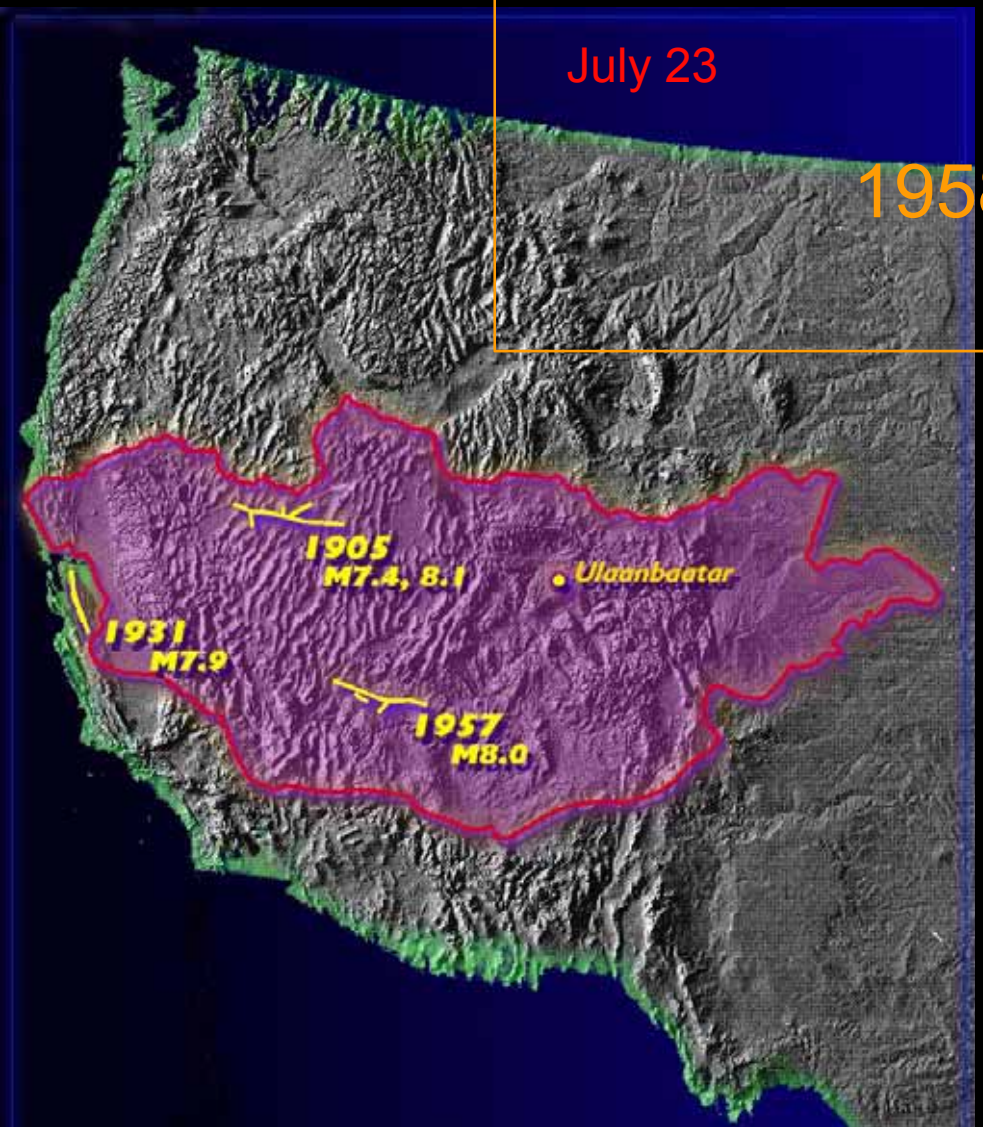
The July 23, 1905 Bulnay Fault, Mongolia Surface Rupture

D.P. Schwartz, S. Hecker, D. Ponti, W.E. Lund, H.D. Stenner, A. Bayasgalan

July 9

July 23

1958

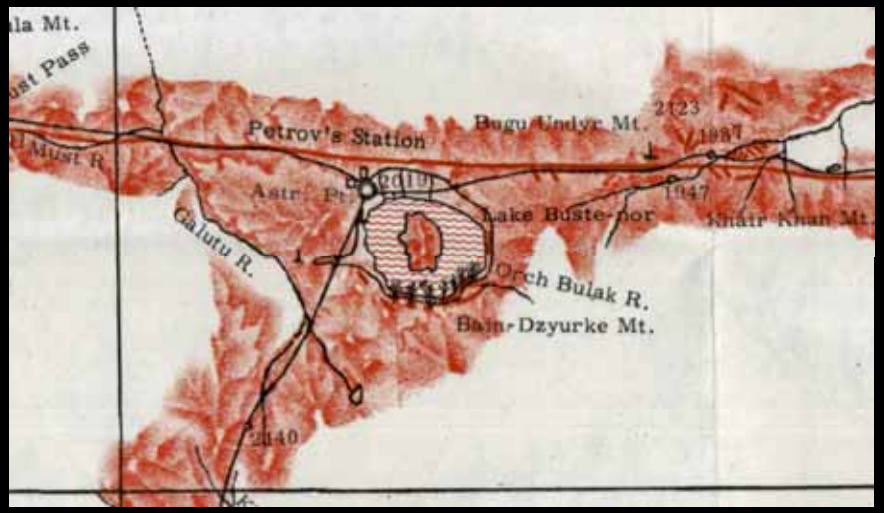


Schlupp and Cisternas (2007)

Bulnay fault

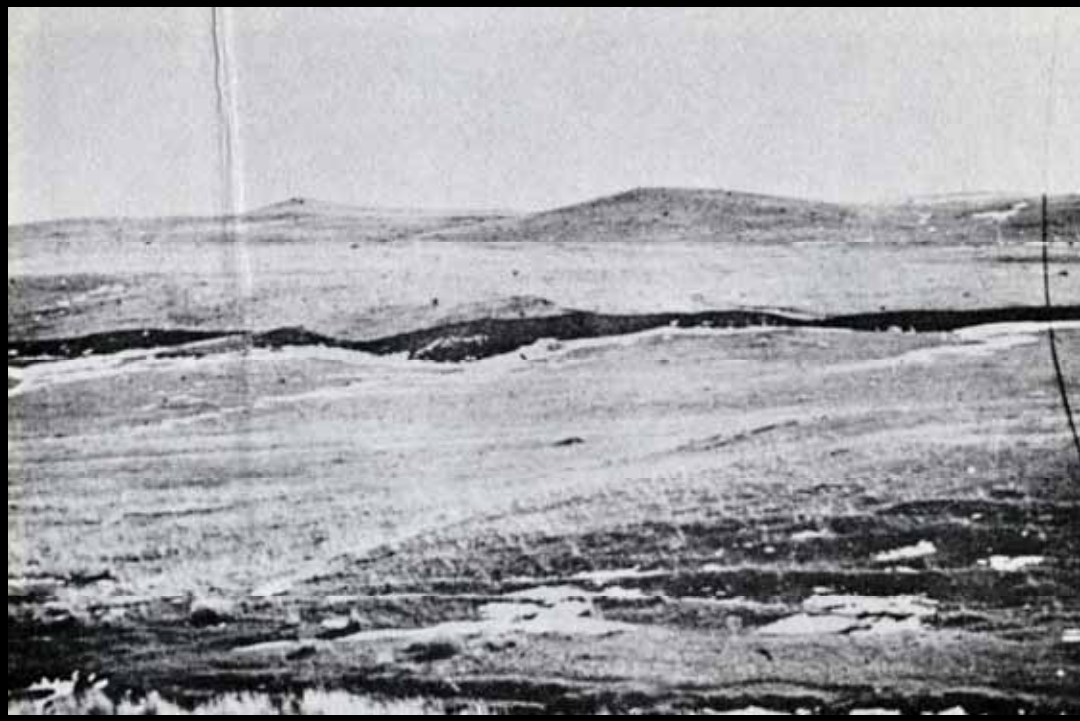
Map of the
REGION OF THE EARTHQUAKES OF
9 AND 23 JULY, 1905

Drawn by
A. V. VOZNESENSKII and V. CH. DOBROSTAJSKII
Supplemented by V. L. Popov's photographic data



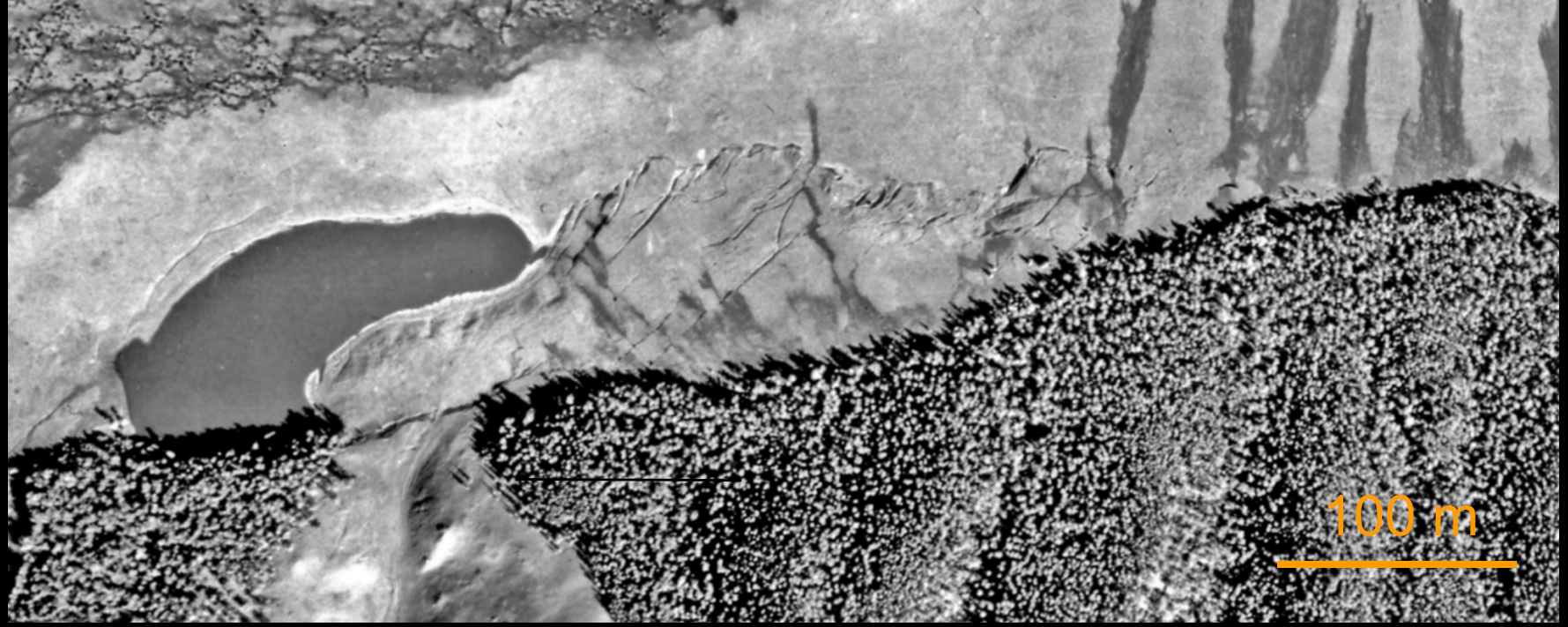
"Fissure with horizontal displacement"

Rupture Photos by A.Voznesenskii, 1905

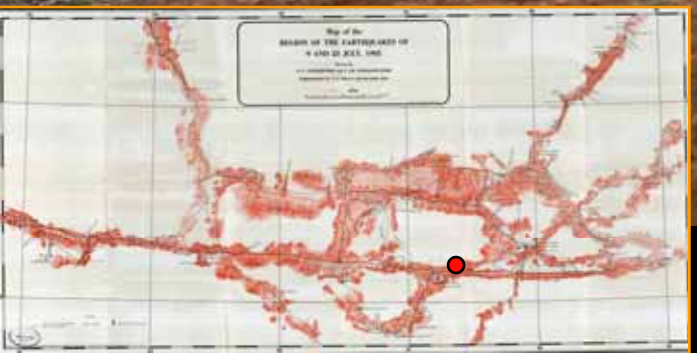


"Overthrust"

complex trace
large% of rupture


100 m

Buust Nuur



8.8 ± 2.3 m

west of Buust Nuur

18 ± 2.0

1905 + penultimate

8 ± 0.6 (1905)

11 ± 2 (1905)

8.8 ± 1.0 (1905)

west of Oygon Nuur **8.75 ± 0.25**

Zuun Hangay West

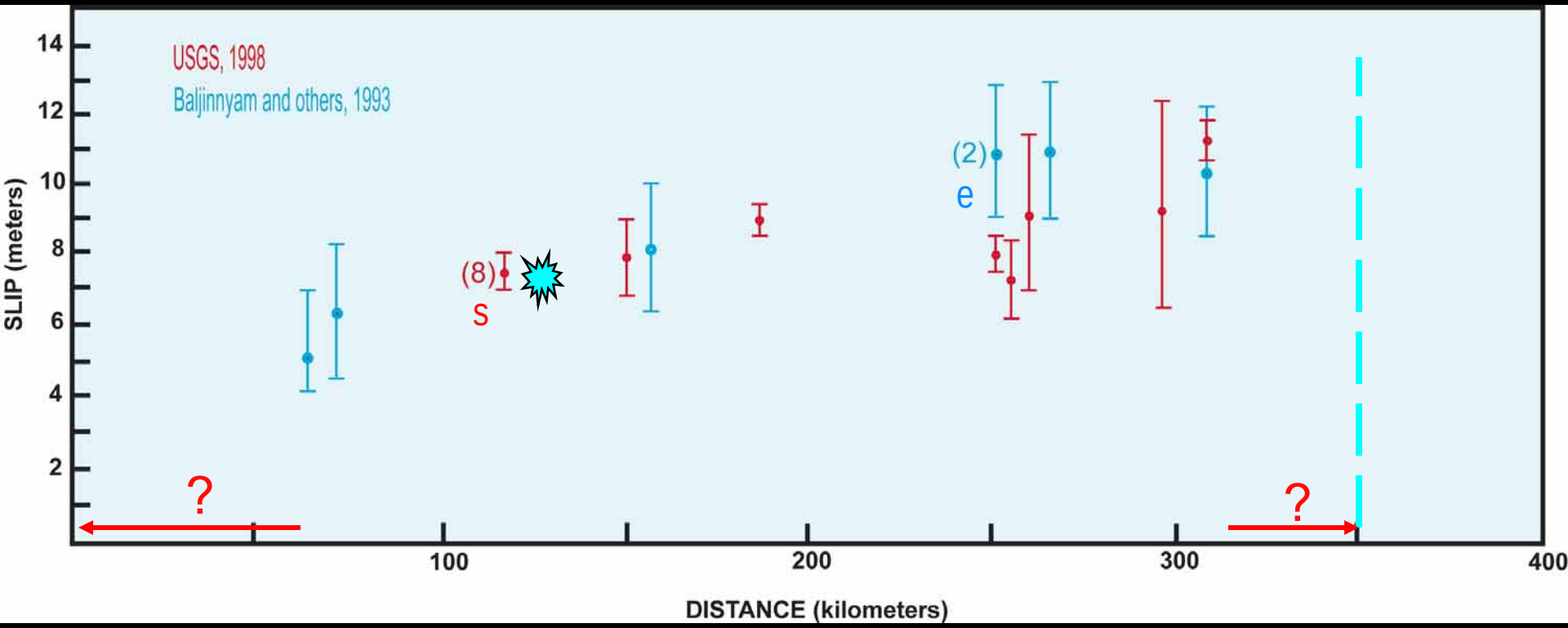
19058 ± 0.9 m

1905 + penultima

15.4-16.9 m

2924-3222 yb05

Bulnay slip distribution



Bi-lateral asymmetry

Slight asymmetry

Dmax (11 m) near eastern end

Davg (8 m) at surface

Characteristic slip

Bulnay Rupture Characteristics

Rupture of multiple faults: connectivity

Slip distribution asymmetric: Dmax 170 km east of epicenter

Similar amount of slip over long distances (≥ 200 km)

Rupture commonly complex; multiple traces 0.1-1.0 km apart

Complexity may reflect long recurrence (~ 3ka)

Paleo offsets similar in size to 1905