A Proposed Revision to the NSHM Generalization of the Salt Lake City Segment (Wasatch Fault) Surface Trace

by

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Acknowledgments

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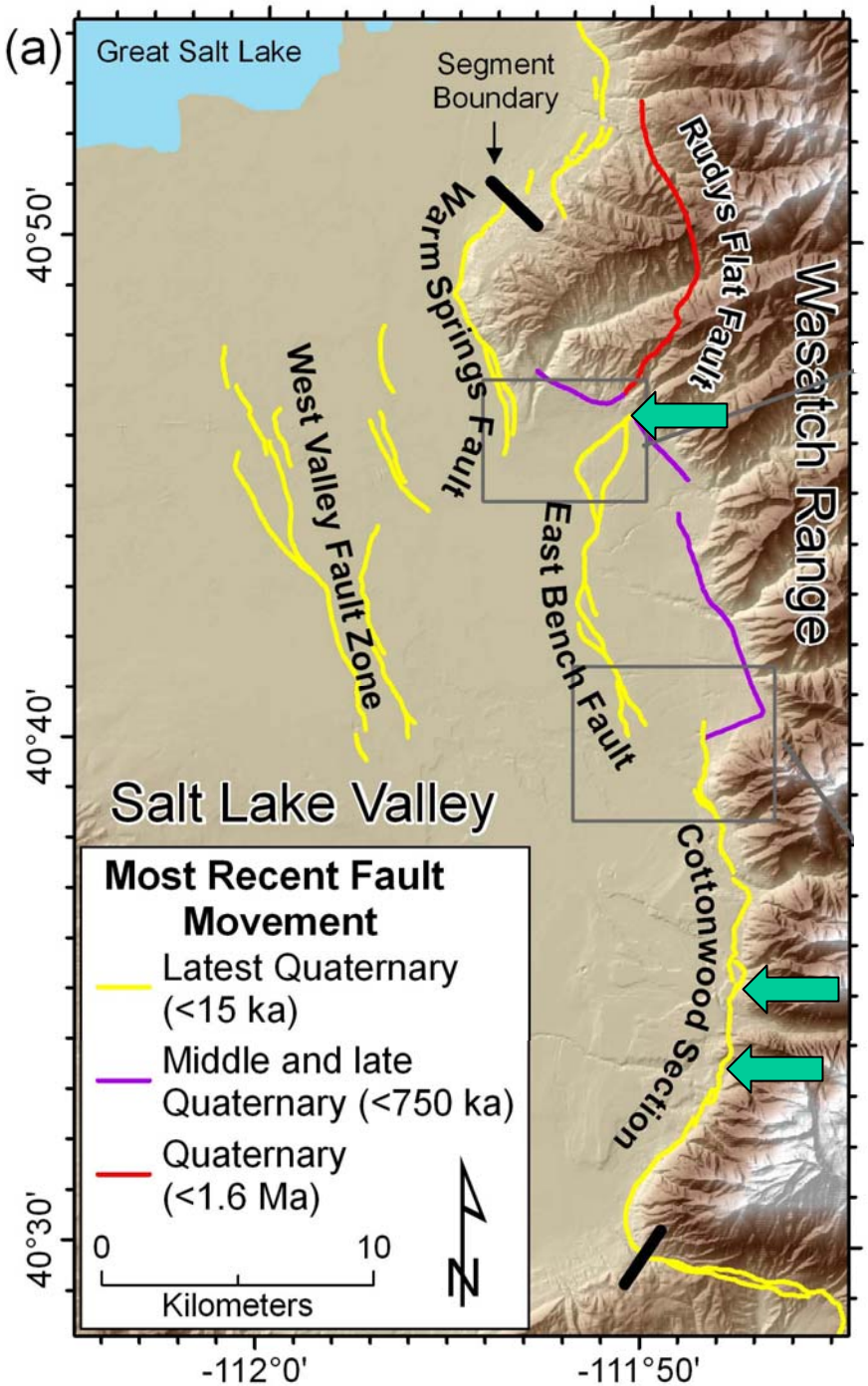


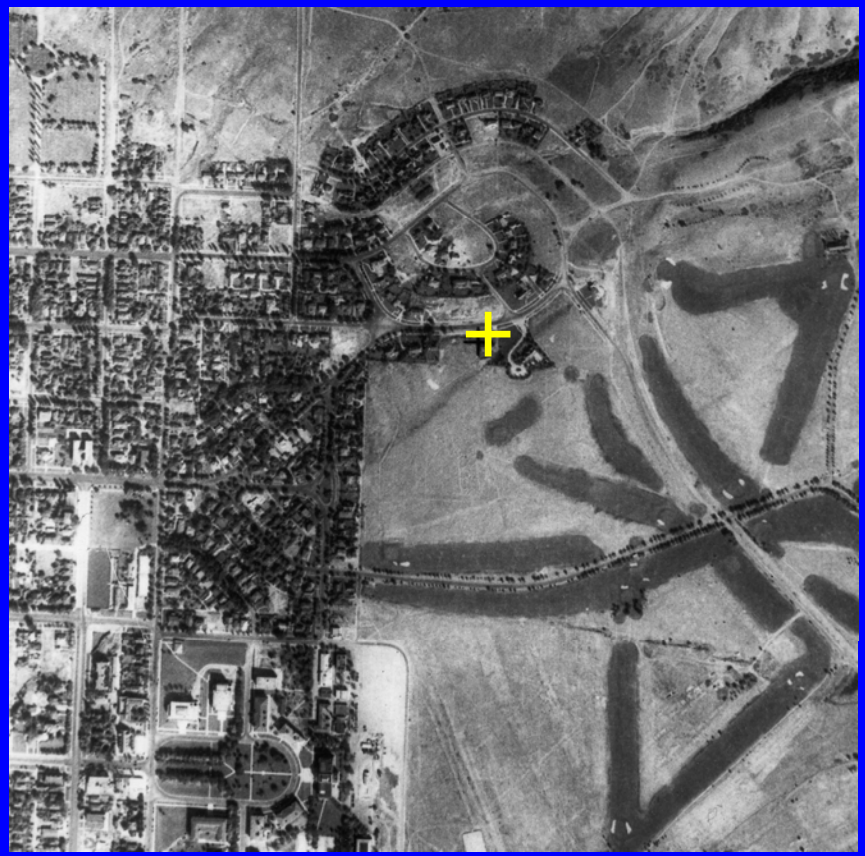
Salt Lake City Segment Wasatch Fault

Trench Sites with Earthquake Dates

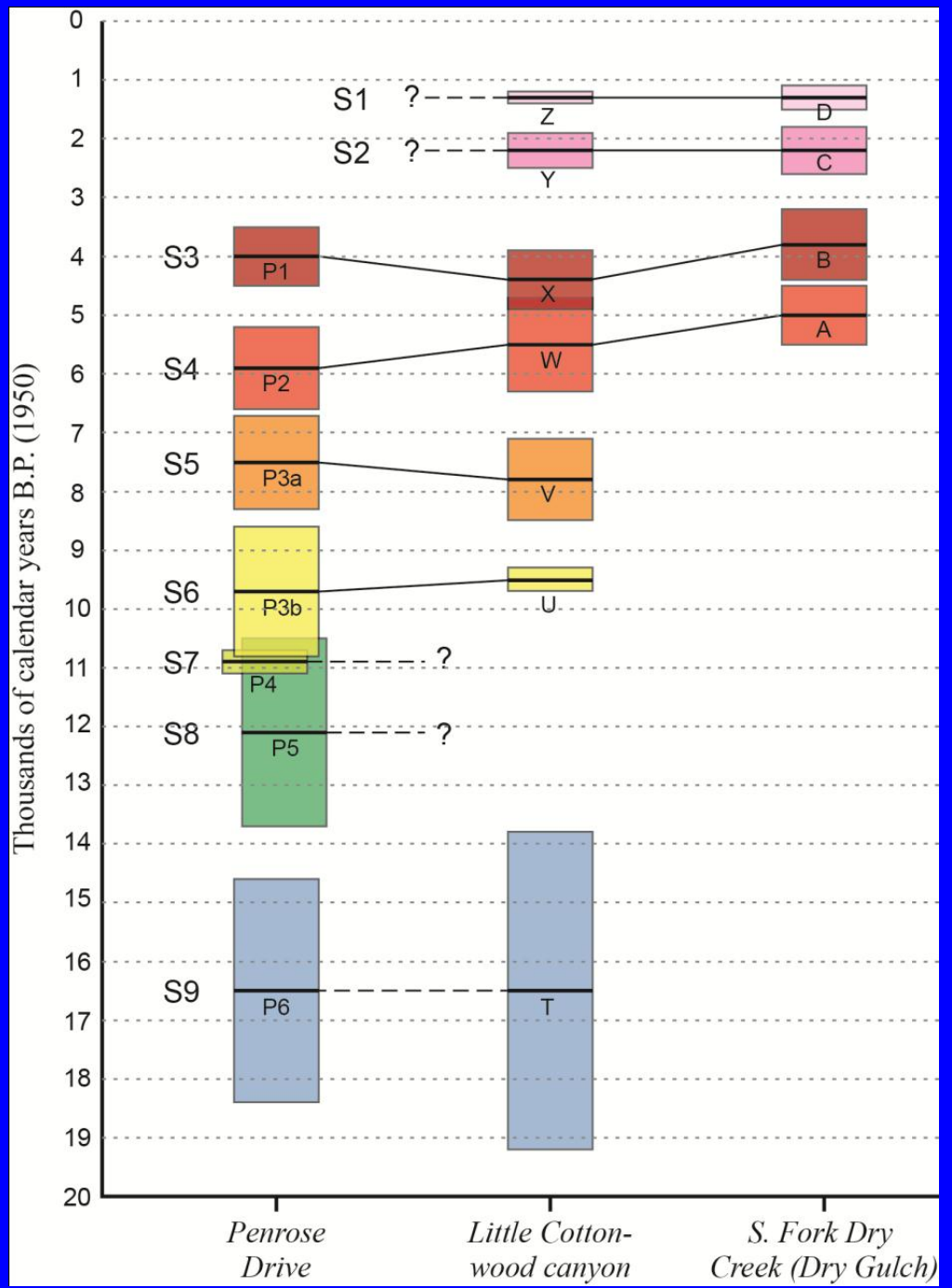
PENROSE DRIVE

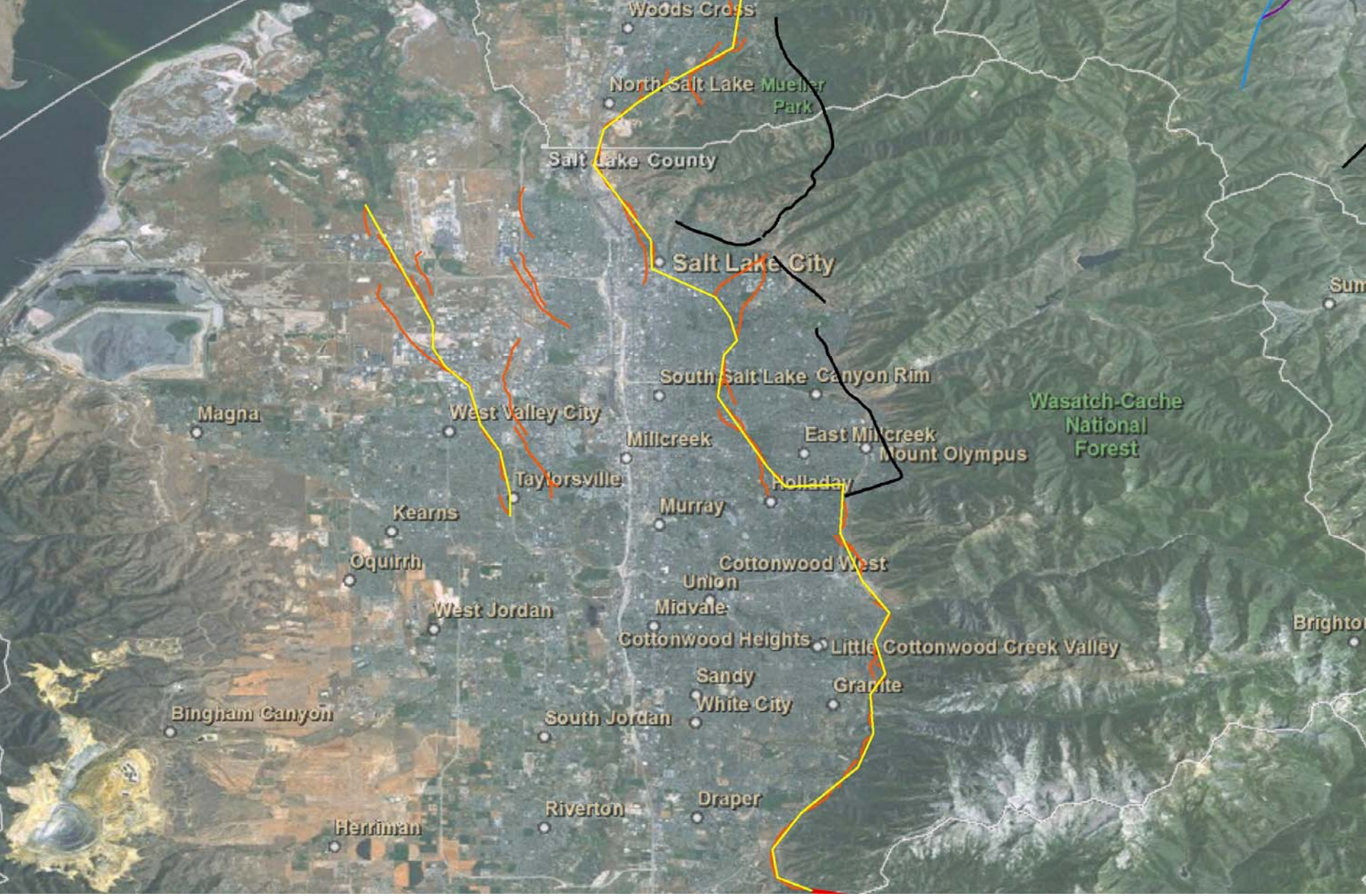
LITTLE COTTONWOOD CANYON

SOUTH FORK DRY CREEK



From DuRoss et al. (2012)





Mapped fault traces: Orange (post glacial) and Black (Quaternary)
NSHM Generalized faults: Yellow (from Kathy Haller, 2008)

Problem

The NSHM generalization of the SLC segment (Wasatch fault) needs to be revised because it is inconsistent with the known surface trace. But how?

Options

1. Connect the stepovers in a manner consistent with the known Quaternary fault traces and other information.

- **a. The Roten et al. (2011) model (my proposal)**
- **b. Other models?**

2. Do not connect the stepovers and assume that the ruptures jump across them (more later).

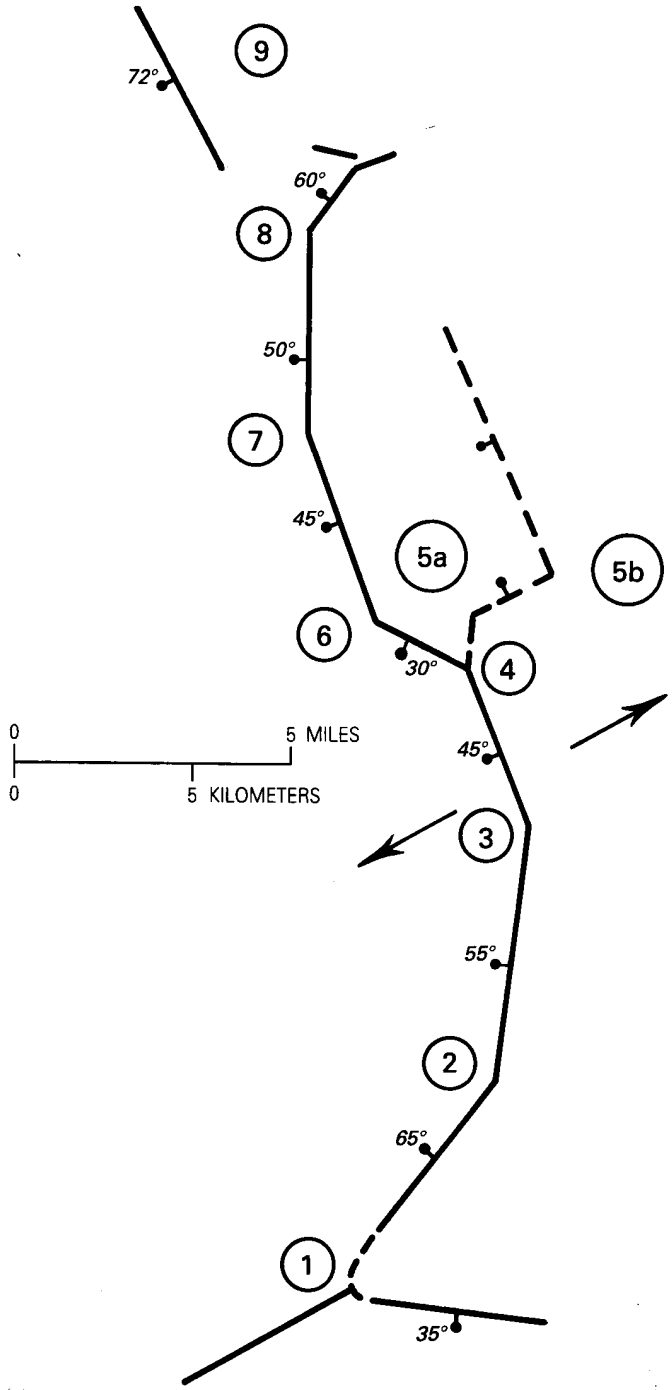
3. Move the Warm Springs fault from the SLC segment to the Weber segment (not favored by paleoseismologists).

Alternative Generalization for SLC Segment (Roten et al., 2011)

- **Why? 3-D model of the SLC segment needed for 3-D numerical ground motion modeling of an M ~7.0 earthquake on this segment.**
- **Basic model is from Bruhn et al. (1992) near surface, transitioning to 50° dip at depth.**
- **We decided to connect the stepovers based on:**

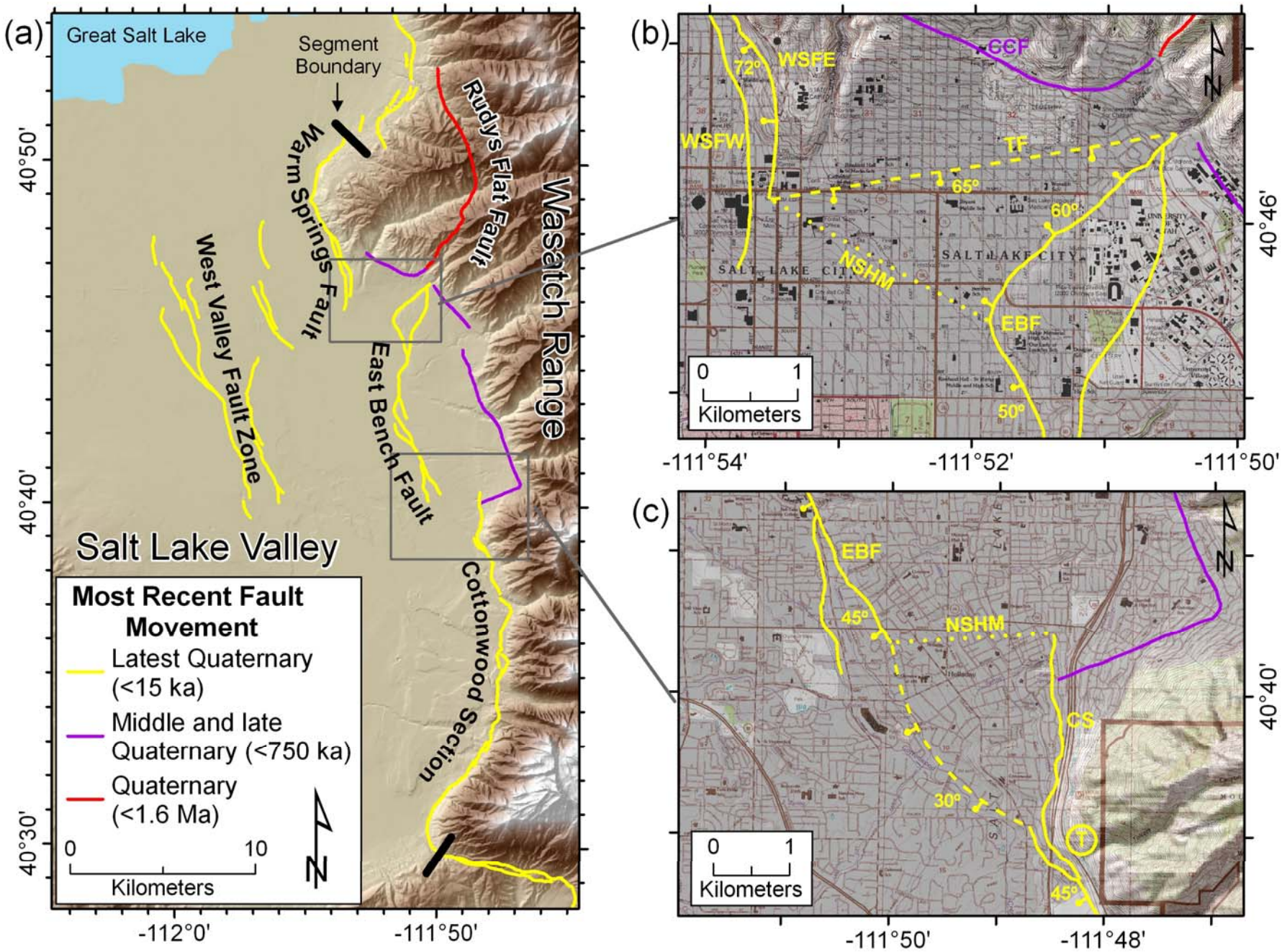
  (1) Mechanical considerations (structural geologists)

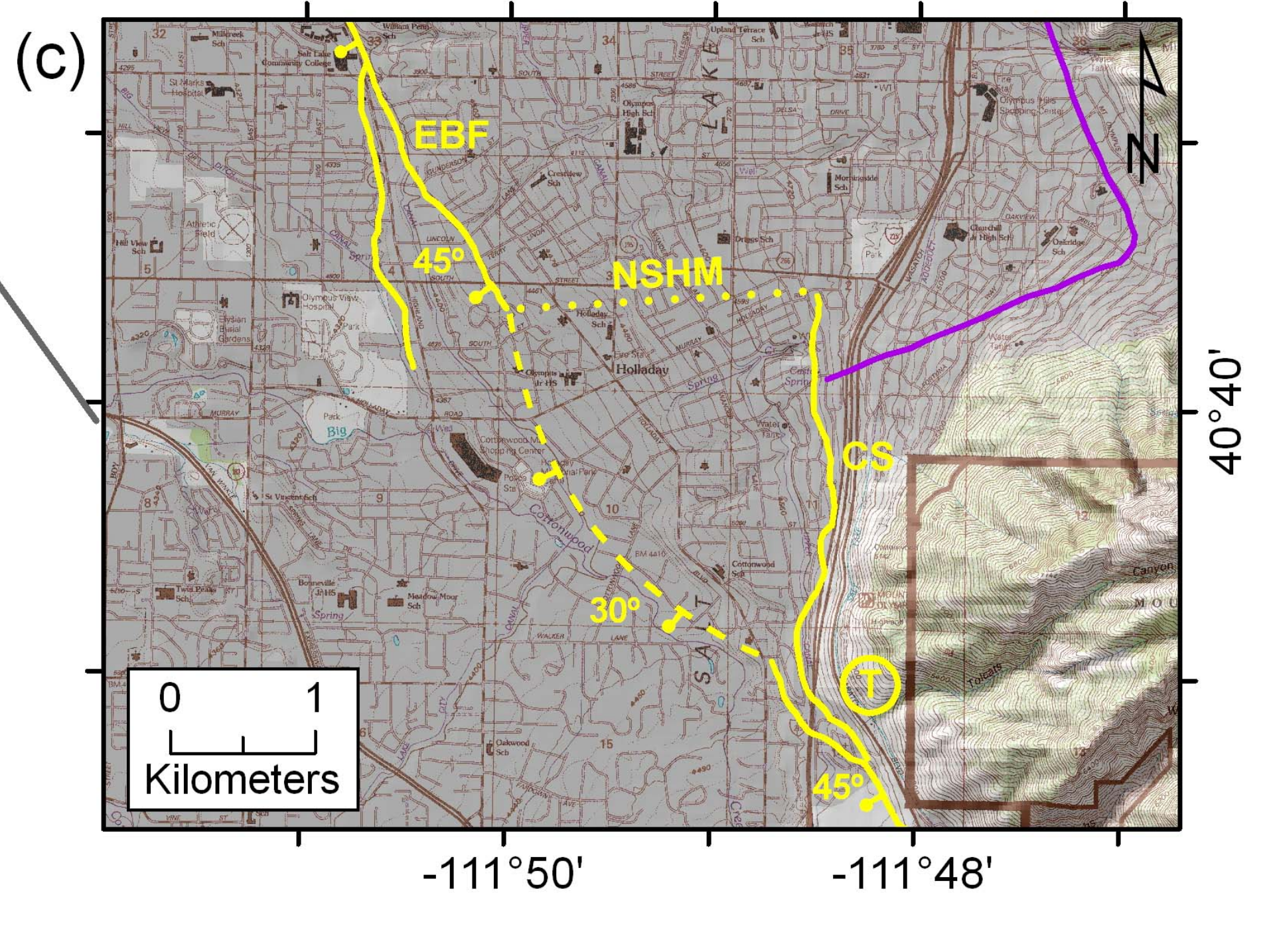
  (2) Dynamic rupture considerations (seismologists): Dynamic rupture models do not support rupture jumps across 2- to 4-km gaps between en-echelon planar faults.
- **Counter argument (Quaternary geologists): No evidence for a connection across the northern SLC segment stepover.**

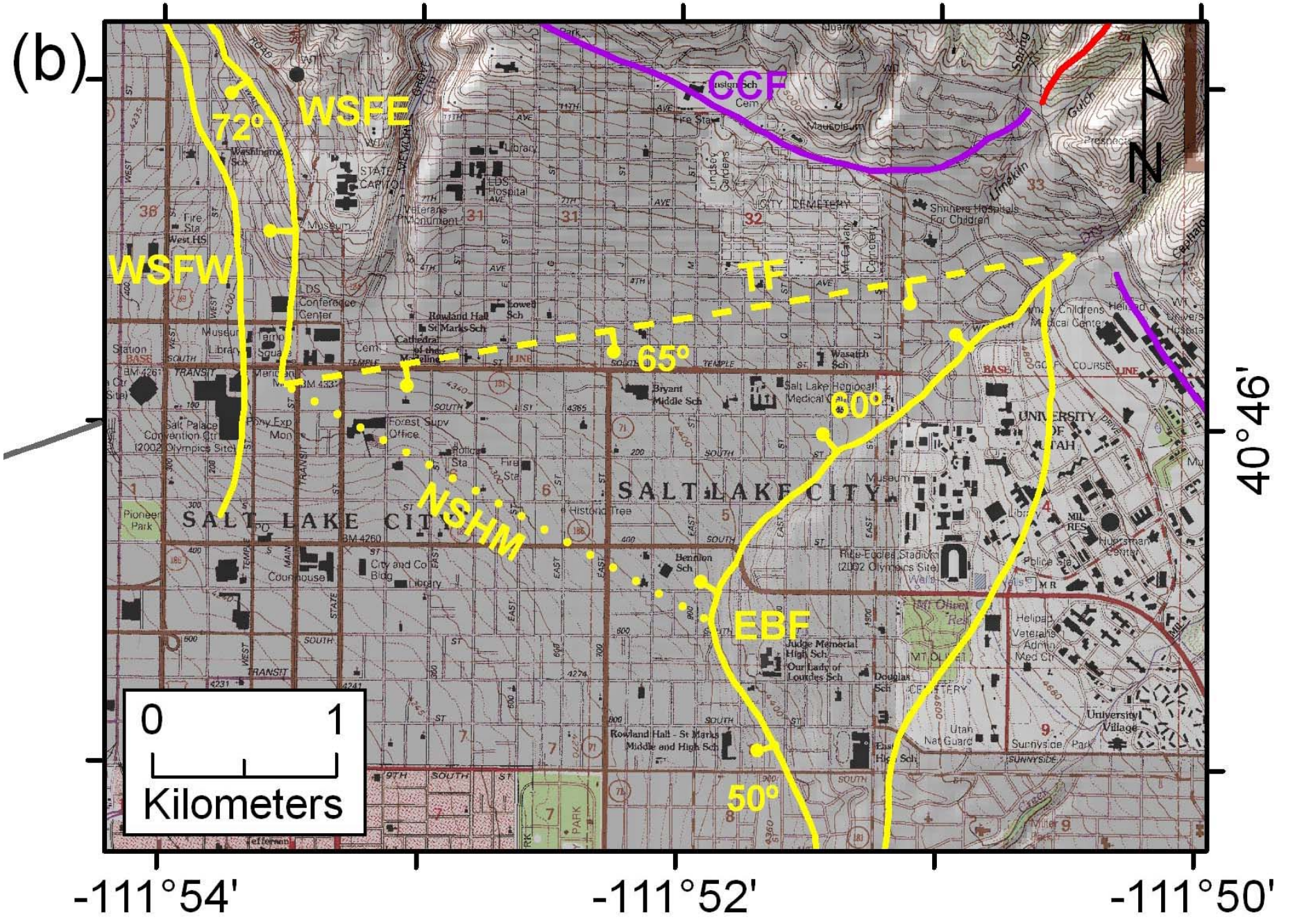


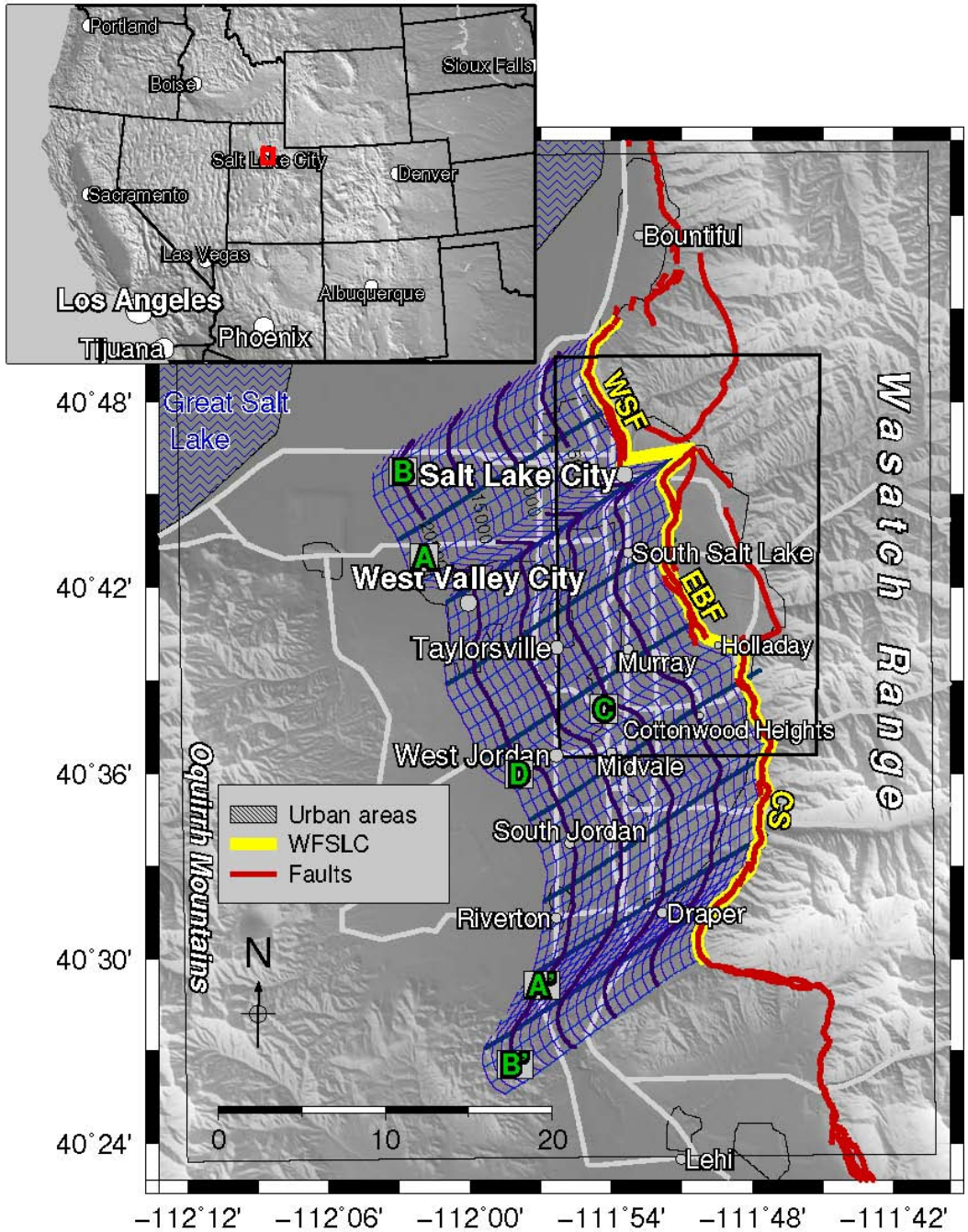
Bruhn et al. (1992) Model

- Based on slickenside and fault surface orientations at N and S ends of the segment
- Slip azimuth = 240°
- Assumes conservative barriers between fault sections with different strikes
- Dips of 35° to 72°; mean ~50°


(a)
Great Salt Lake
Segment Boundary
Rudys Flat Fault
Warm Springs Fault
West Valley Fault Zone
East Bench Fault
Cottonwood Section
Wasatch Range
Salt Lake Valley
Most Recent Fault Movement
Latest Quaternary (<15 ka)
Middle and late Quaternary (<750 ka)
Quaternary (<1.6 Ma)
0
10
Kilometers
N
40°50'
40°40'
40°30'
-112°0'
-111°50'
(b)
WSFE
CCF
WSFW
TF
72°
65°
60°
50°
NSHM
EBF
SALT LAKE CITY
0
1
Kilometers
N
40°46'
-111°54'
-111°52'
-111°50'
(c)
EBF
45°
NSHM
CS
30°
45°
0
1
Kilometers
N
40°40'
-111°50'
-111°48'


(c)
EBF
45°
NSHM
30°
45°
CS
N
0
1
Kilometers
40°40'
-111°50'
-111°48'


(b)
CCF
WSFE
72°
WSFW
TF
65°
60°
NSHM
EBF
50°
SALT LAKE CITY
0
1
Kilometers
-111°54'
-111°52'
-111°50'
40°46'



Roten et al. (2011) "Tear Fault" Model

Effect on PGA for an SLC Segment M 7.0

1. At three hospitals in NE SLC, the geometric mean PGAs from four NGA GMPEs are 24-43% higher for the tear fault and rupture jump SLC segment models than for the NSHM model.
2. The PGAs estimated from the NGA relations are similar for the rupture jump and tear fault models at most sites BUT…
3. Based in part on the work of Liu et al. (2011), we would not expect these two models to produce similar ground motions in actual earthquakes or numerical simulations.

Conclusions

(1) The NSHM generalization of the SLC segment of the Wasatch fault needs to be revised because
(a) It omits the northernmost 3 km of the EBF
(b) It puts a fault trace for which there is no evidence right through the middle of the downtown SLC high rise district, and
(c) The E-striking connection between the EBF and the Cottonwood section is less likely than a SE-striking connection

(2) The Roten et al. (2011) model of the SLC segment is a reasonable alternative to the NSHM model if a continuous surface trace is preferred or required.

(3) Model choice significantly affects ground motions.