

The power of passenger faults as passive recorders: refining the timing and mechanics of San Andreas-San Jacinto joint rupture through Cajon Pass

Alba M Rodriguez Padilla, Michael E Oskin, Thomas K Rockwell,

UCDAVIS

DEPARTMENT OF EARTH
AND PLANETARY SCIENCES

SC/EC
AN NSF+USGS CENTER



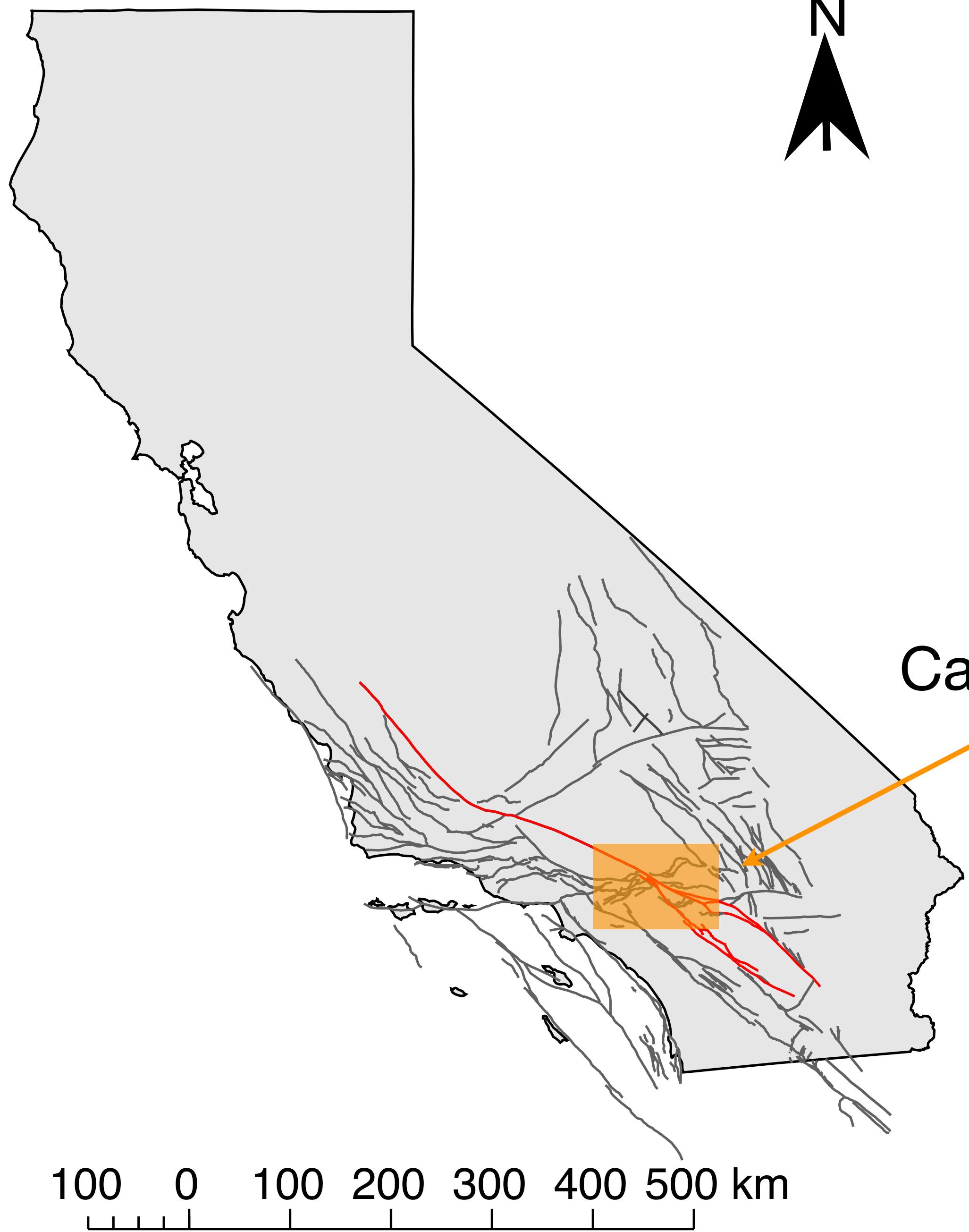
Irina Delusina, Drake Singleton

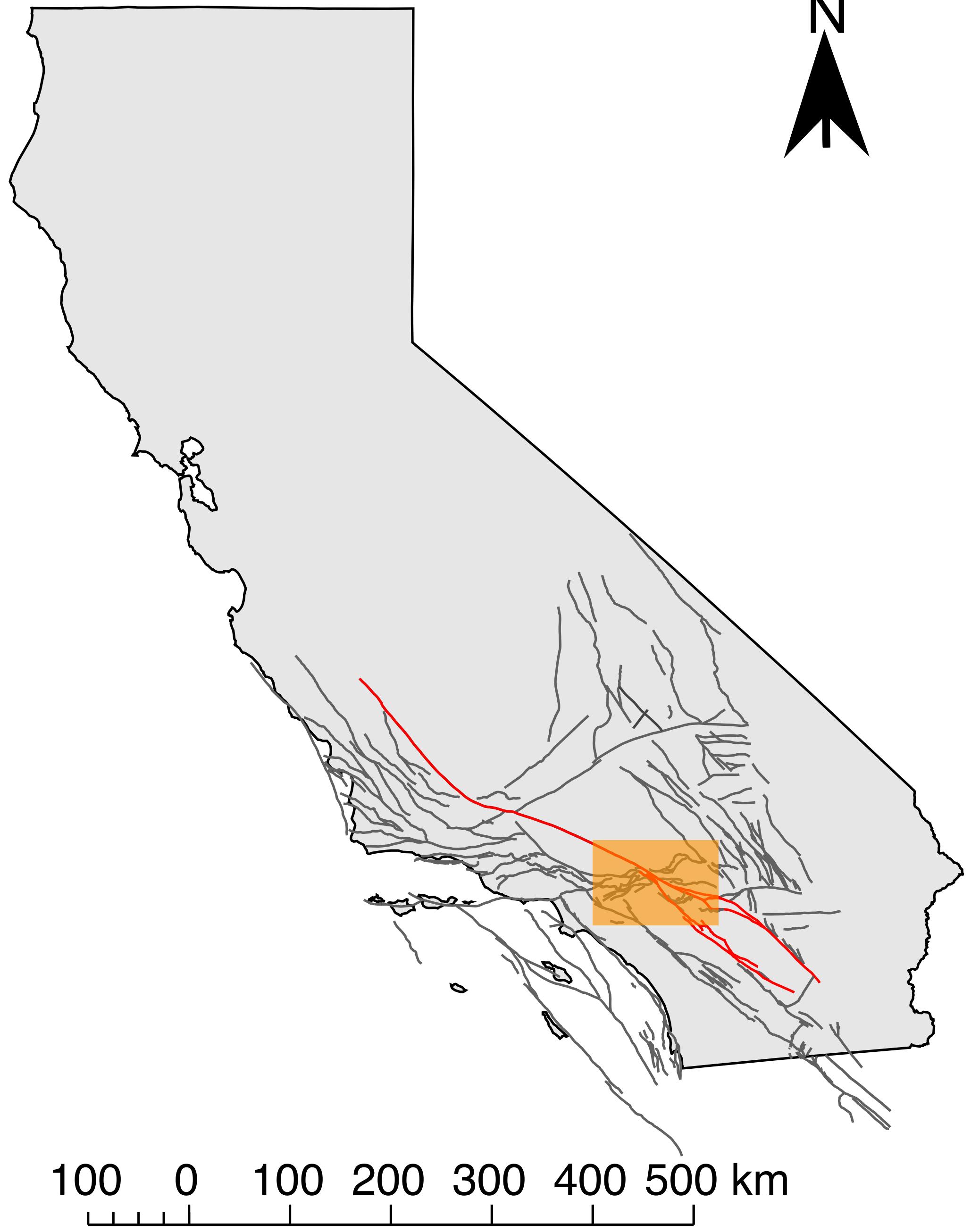
SCRIPPS INSTITUTION OF
OCEANOGRAPHY
UC San Diego

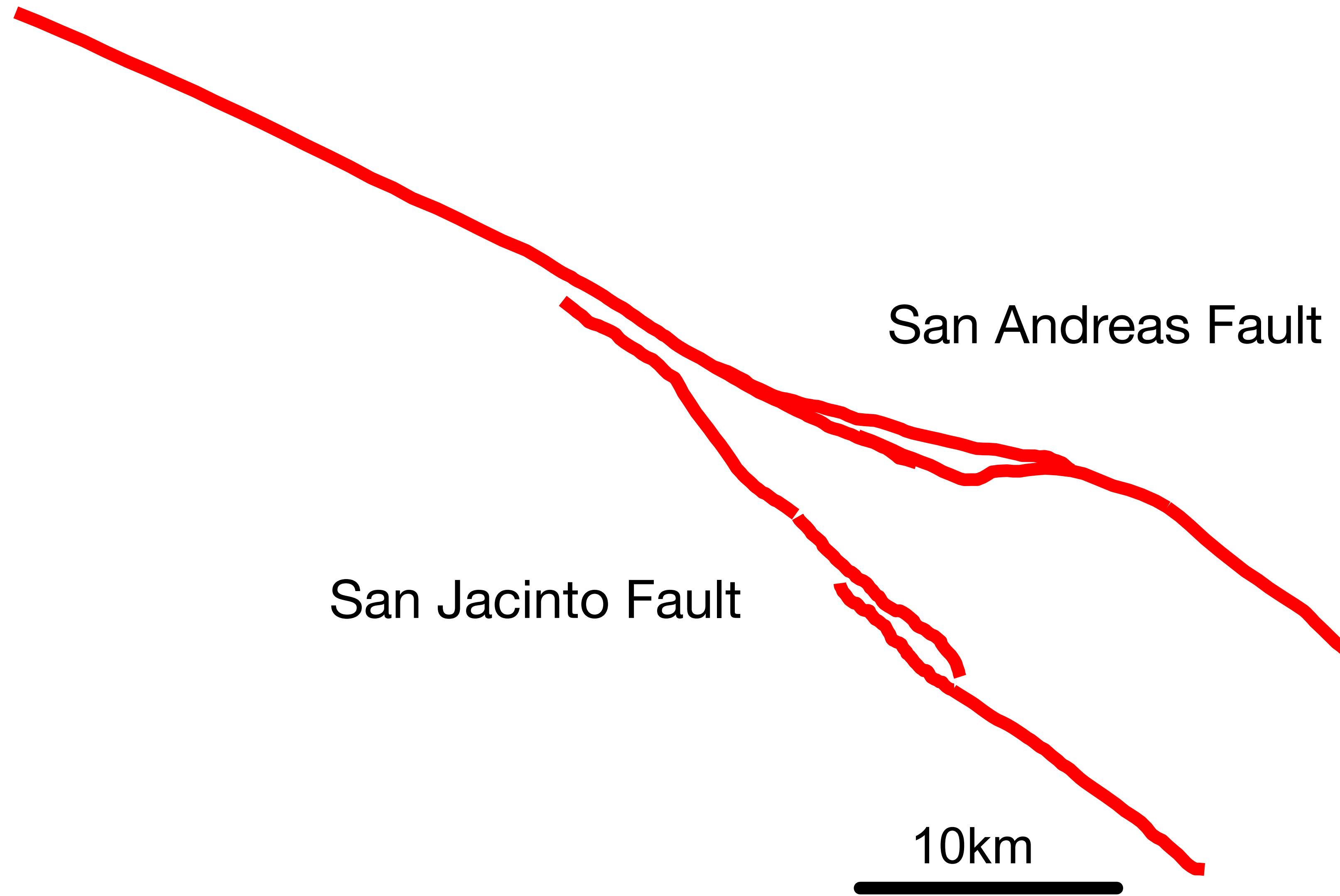


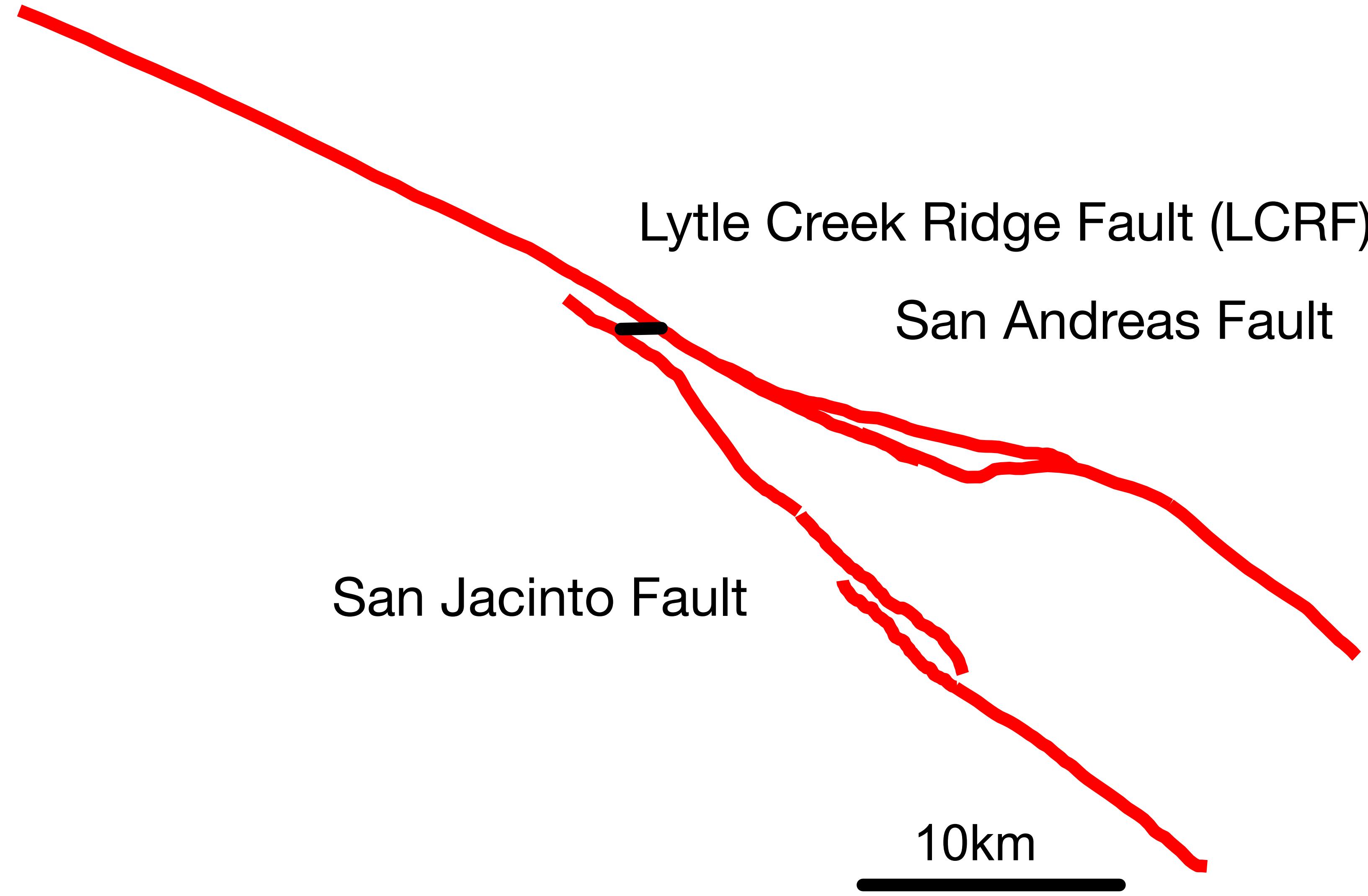
SC/EC
AN NSF+USGS CENTER





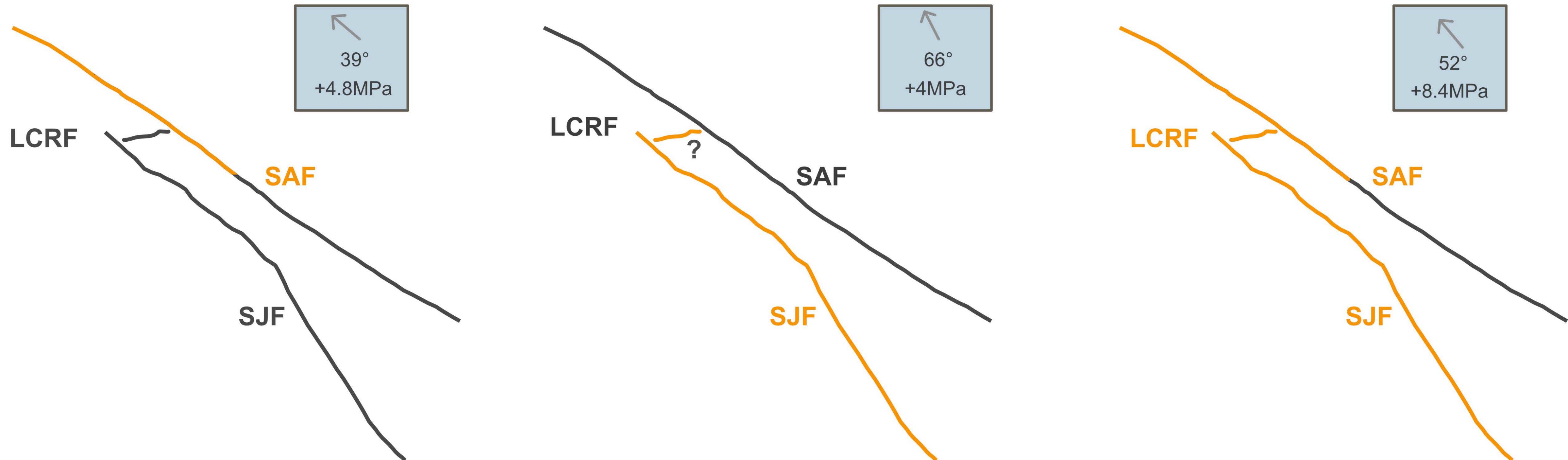






Too short, too shallow - unlikely to be seismogenic or act as a transfer structure

The Lytle Creek Ridge Fault (LCRF): a passive recorder?

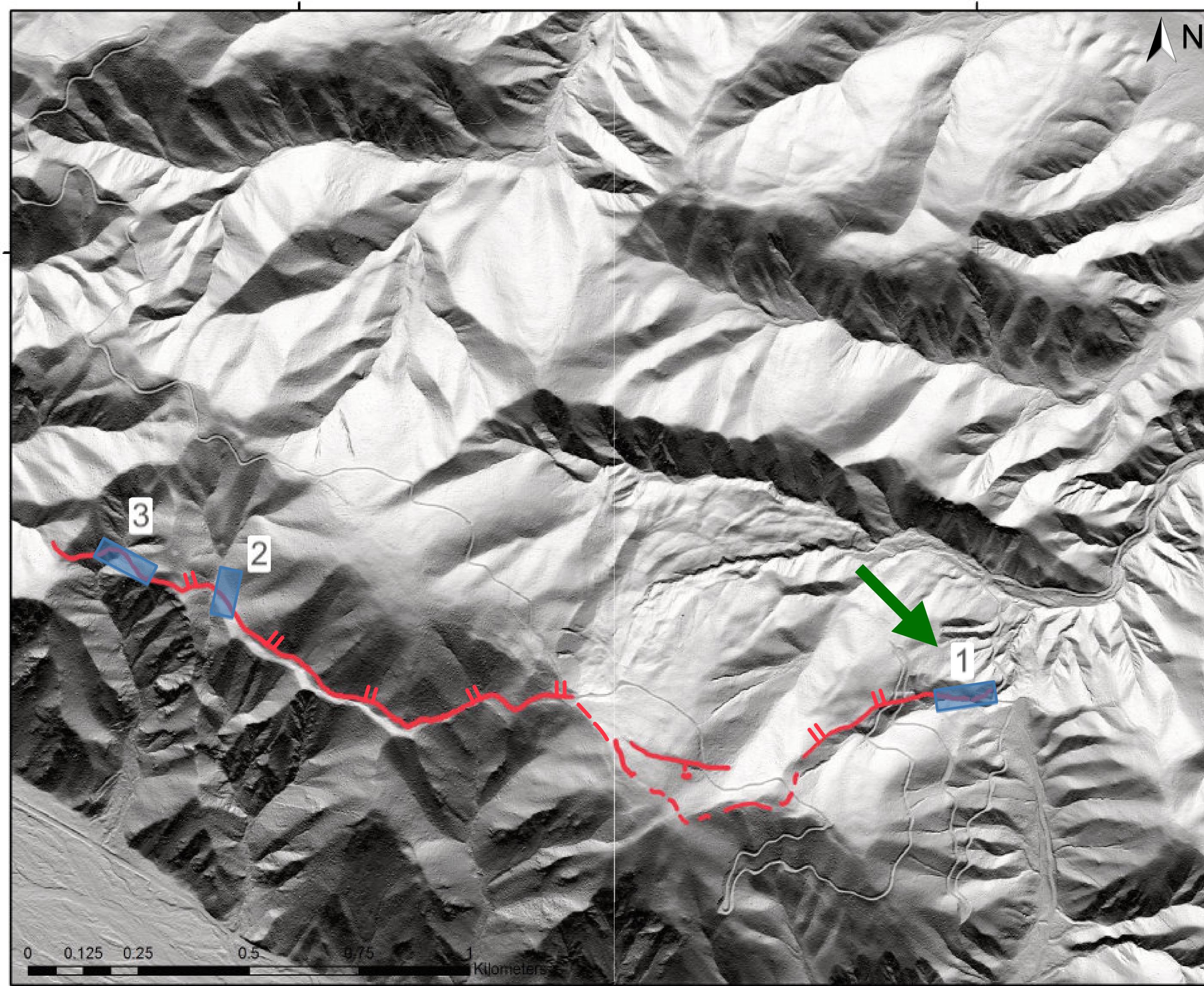


Scenario 1: Rupture in the SAF past Cajon Pass. Imposes left-lateral slip on LCRF. Inconsistent with slip vector on LCRF.

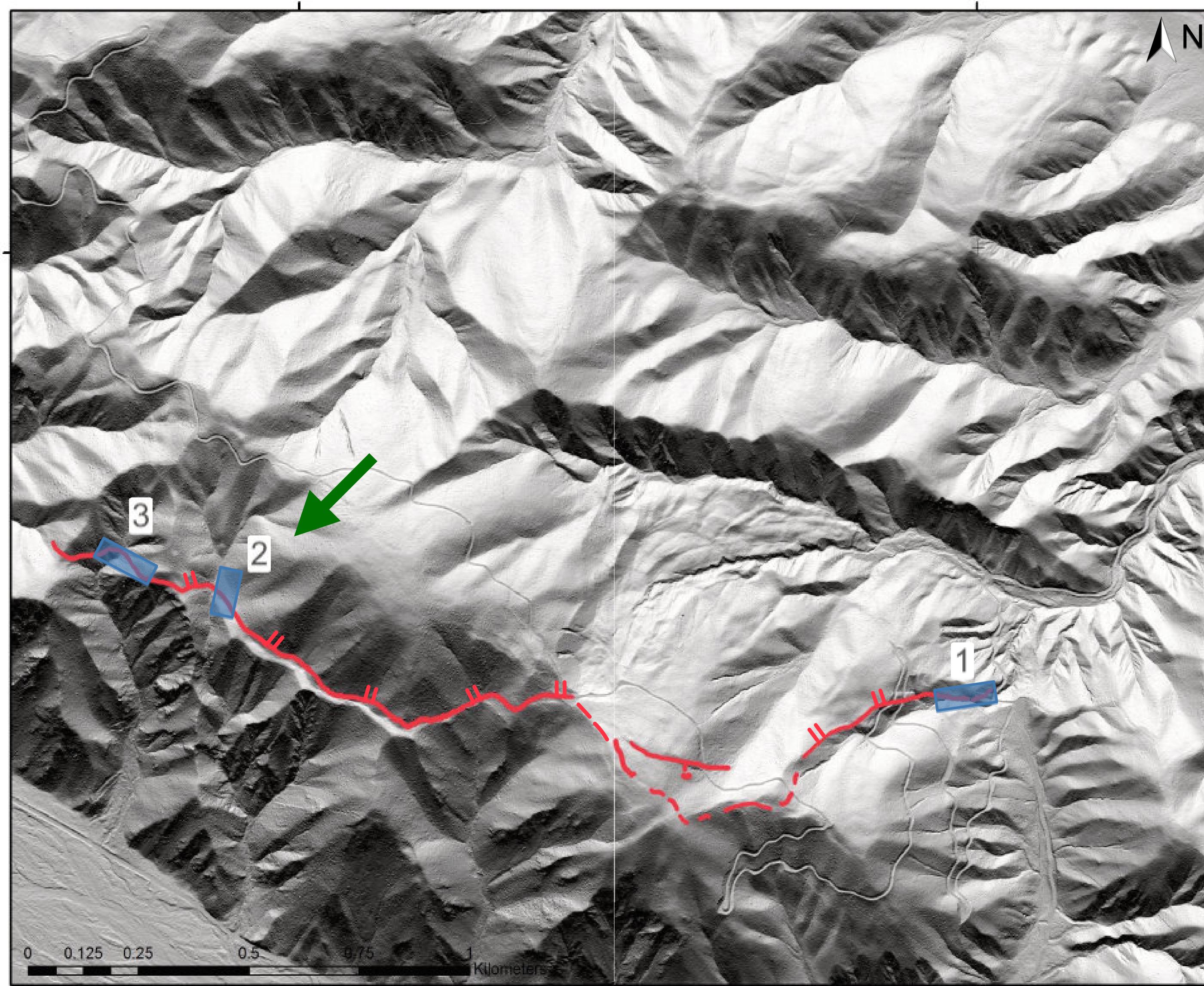
Scenario 2: Rupture propagating northwards in the SJF. Imposes normal-sinistral motion on the LCRF but small change in stress.

Scenario 3: Rupture on both the SAF and the SJF. Imposes right magnitude and direction of slip and highest stress change on the LCRF.

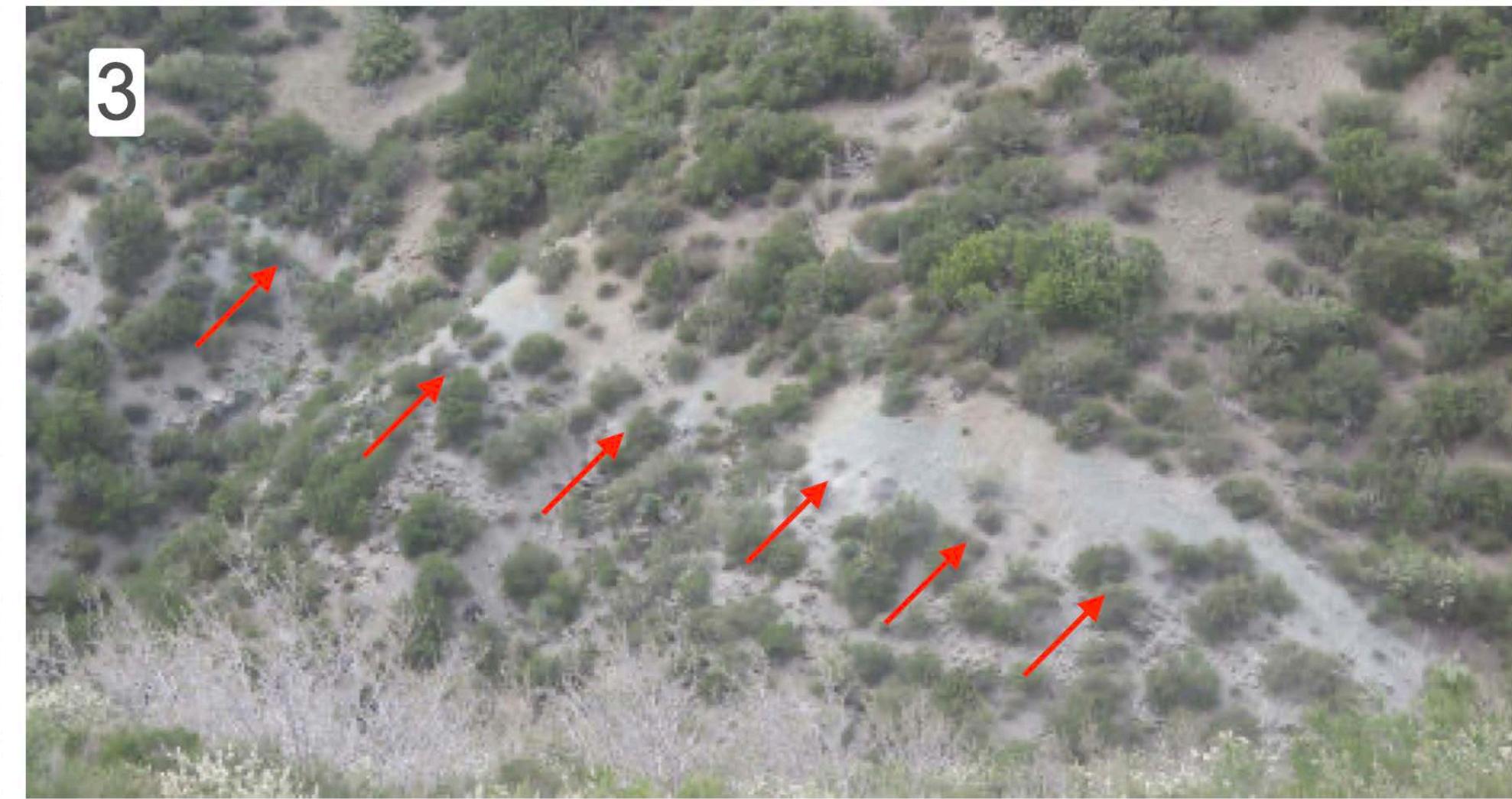
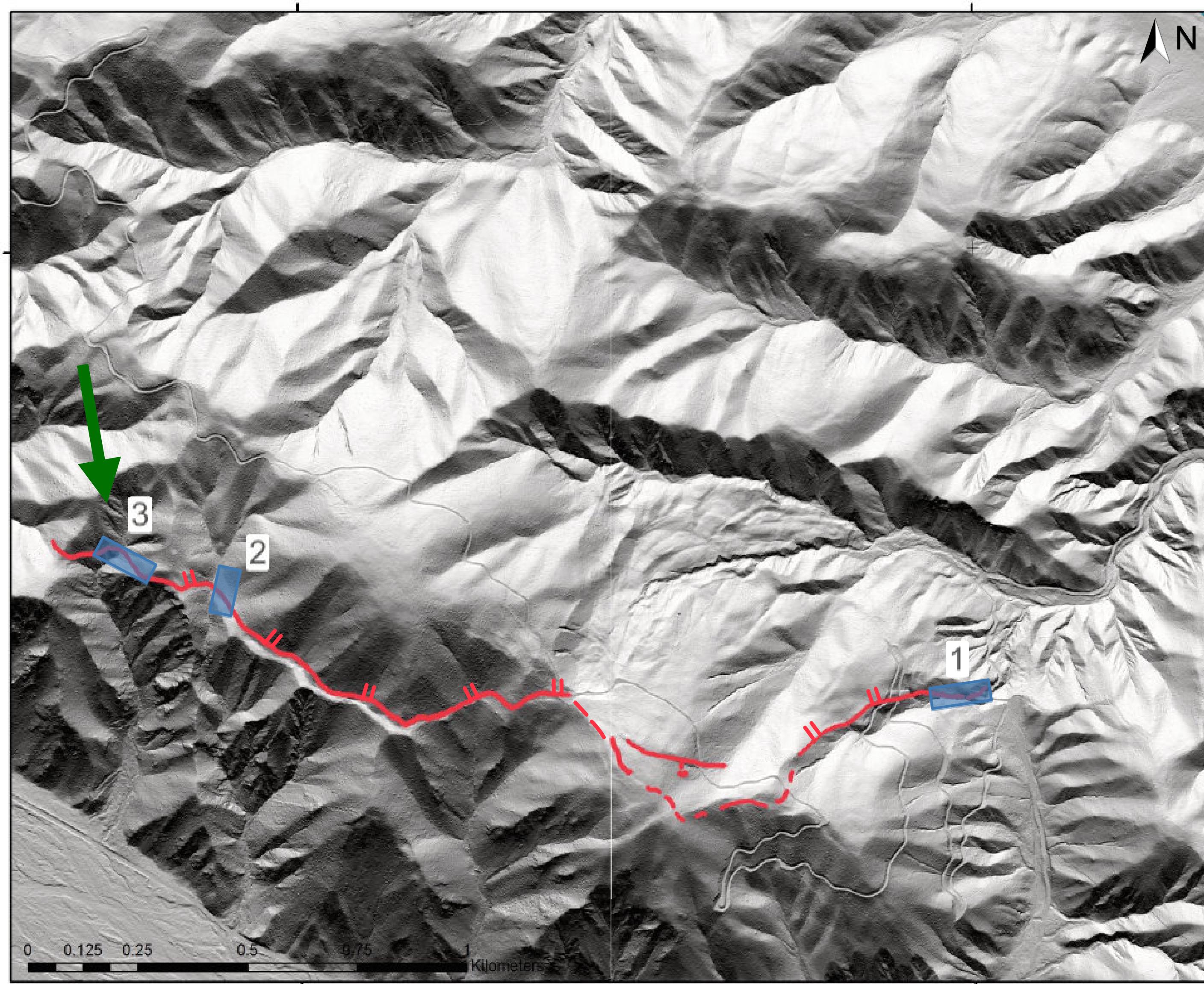
The Lytle Creek Ridge Fault (LCRF)



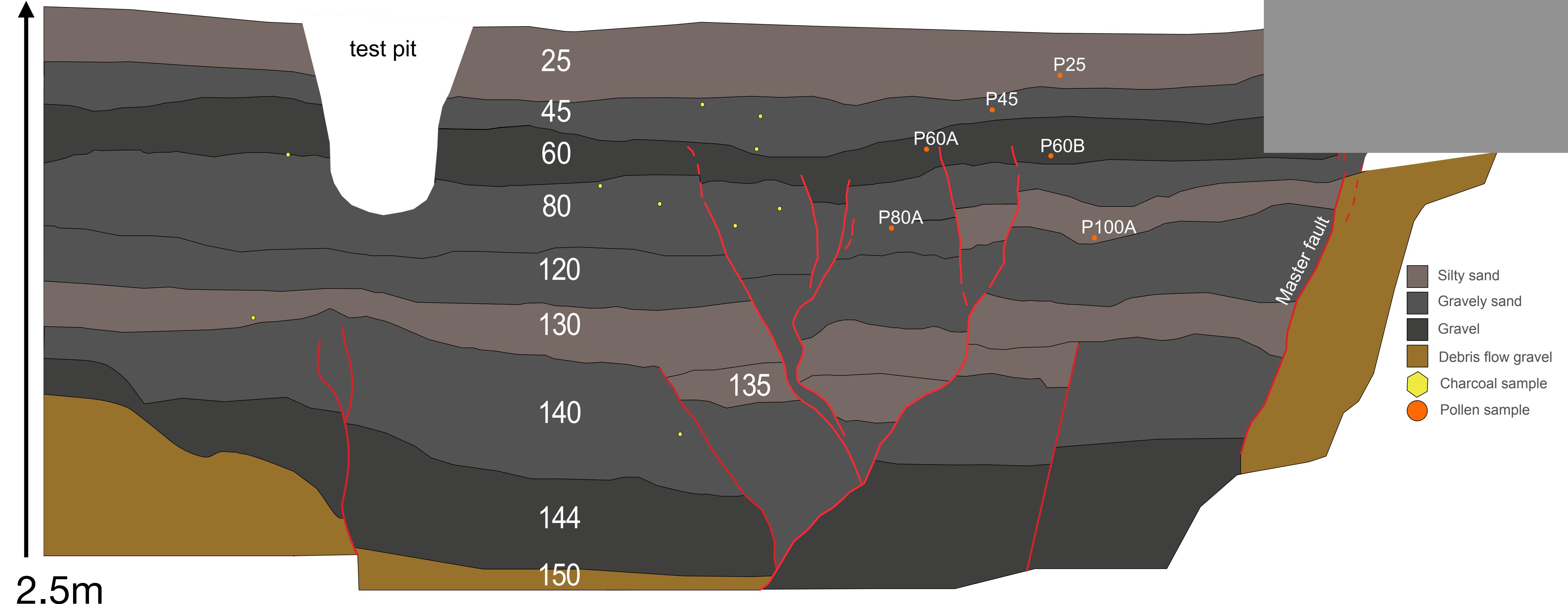
The Lytle Creek Ridge Fault (LCRF)



The Lytle Creek Ridge Fault (LCRF)







Event 1

Unit 60 (bottom) Unit 60 (top), unit 45?
Event horizon Growth strata

Event 2 ?

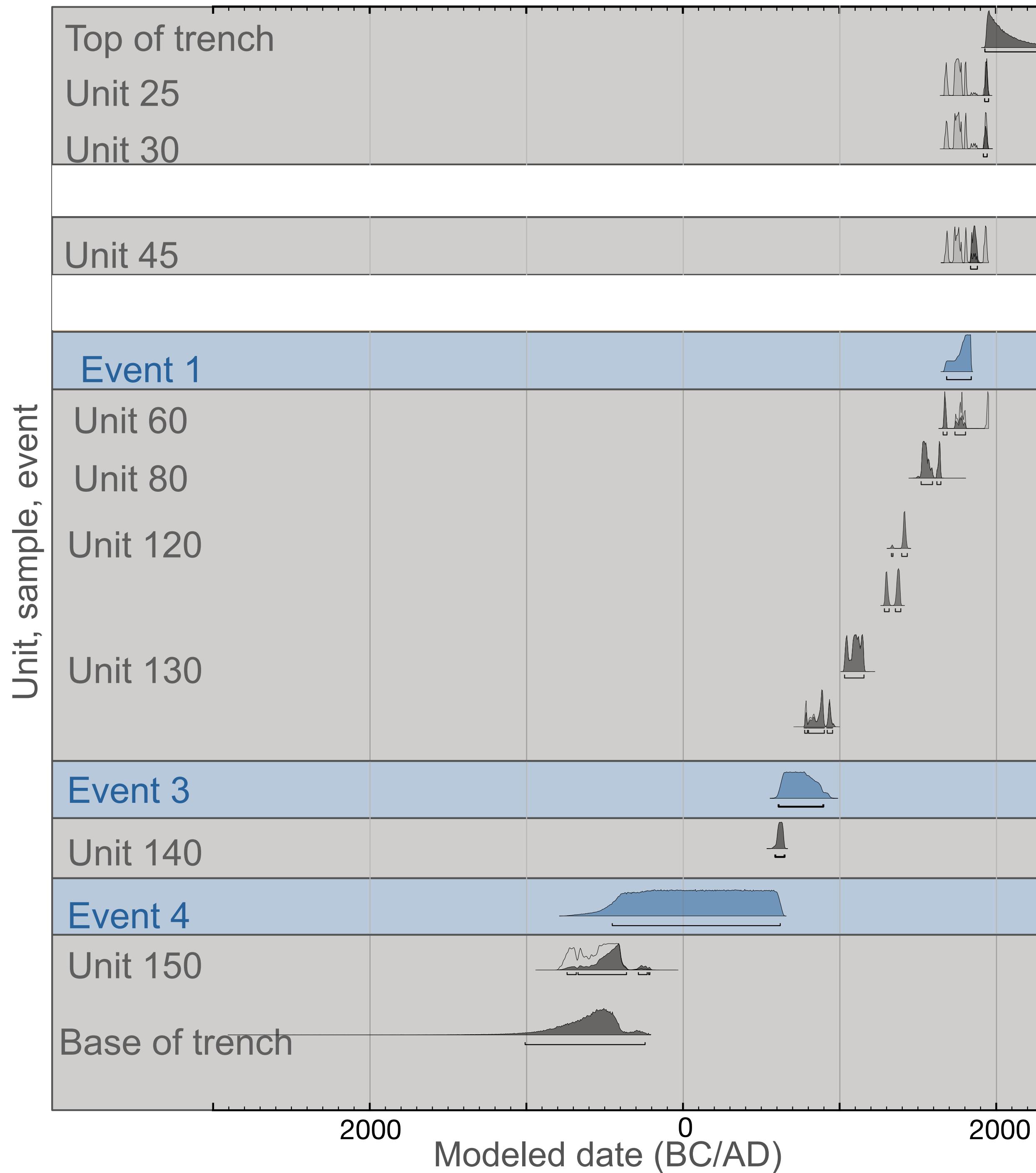
Unit 130 (top)
Event horizon

Event 3

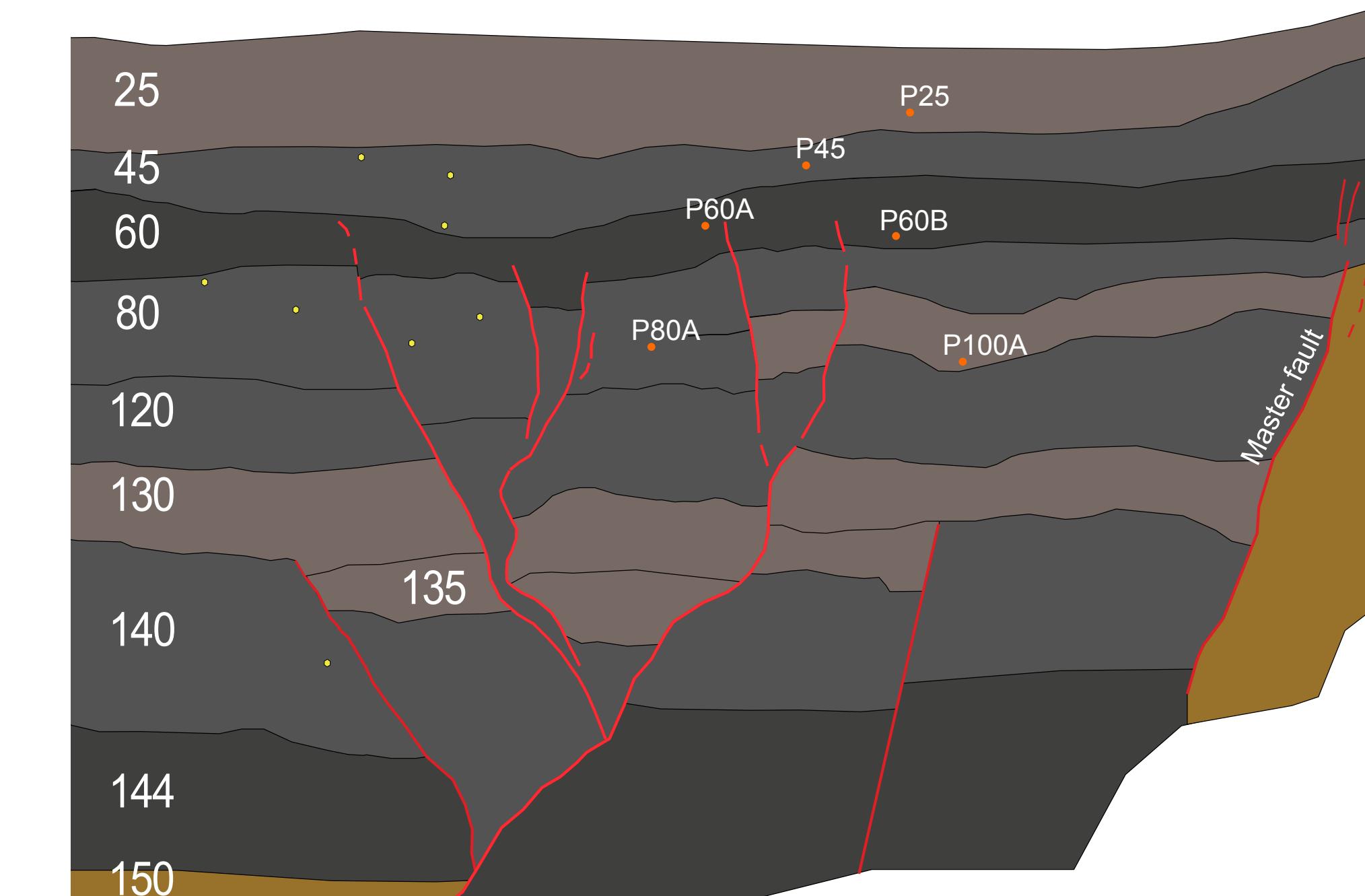
Unit 140 (top) Unit 135
Event horizon Growth strata

Event 4

Unit 150 (top) Unit 144
Event horizon Growth strata



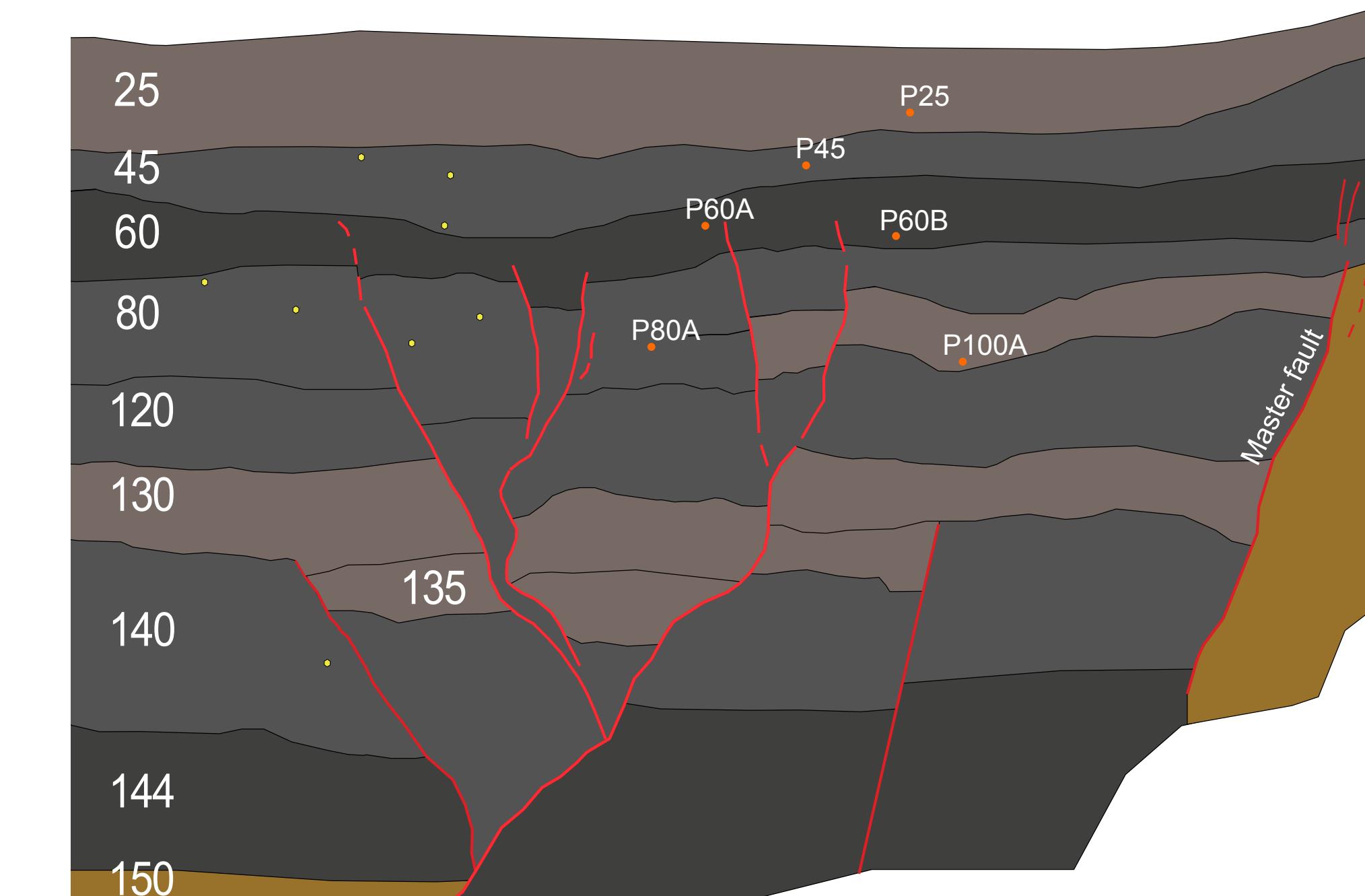
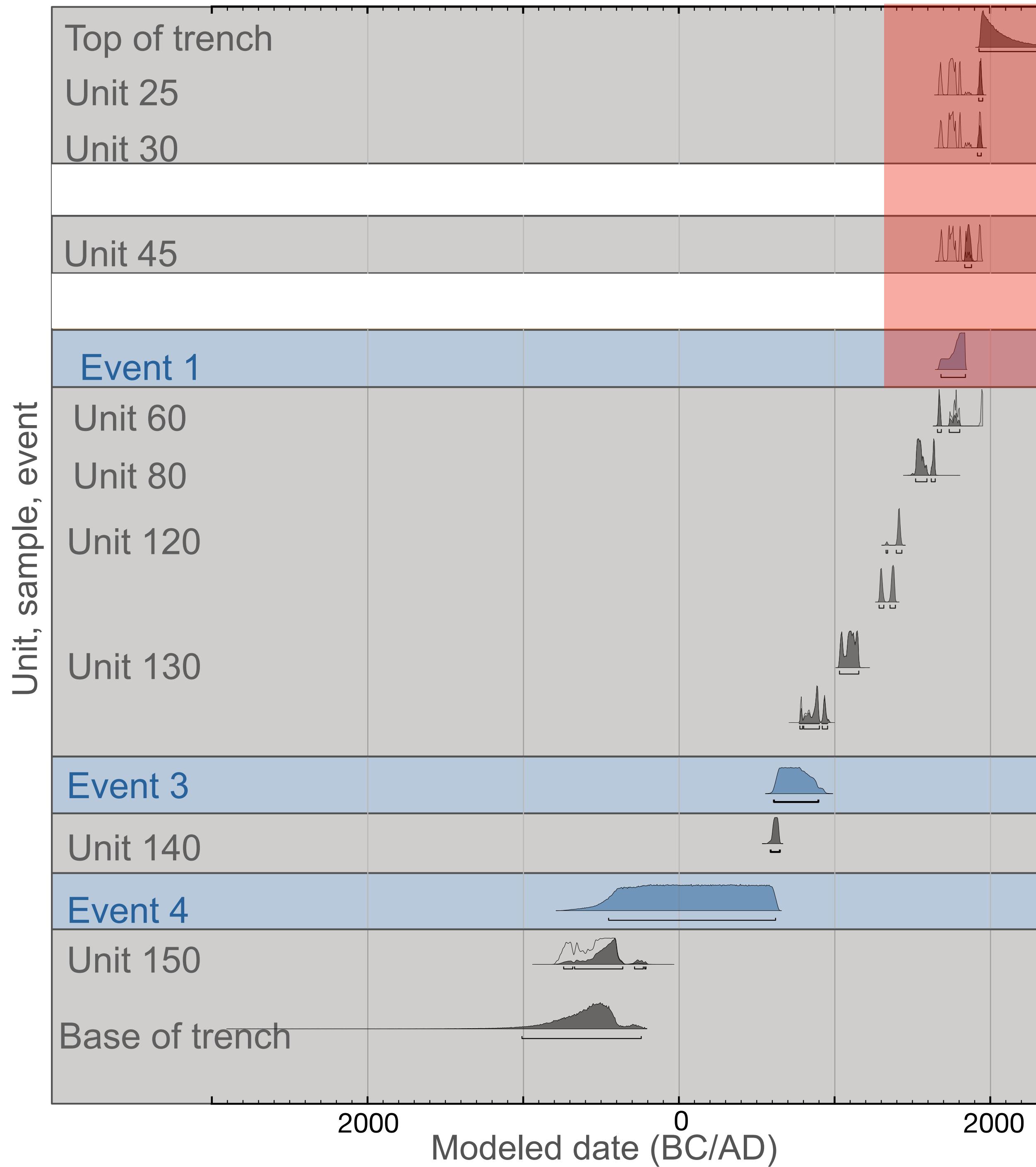
Chronology of the LCRF trench



Stratigraphic unit (Bayesian)

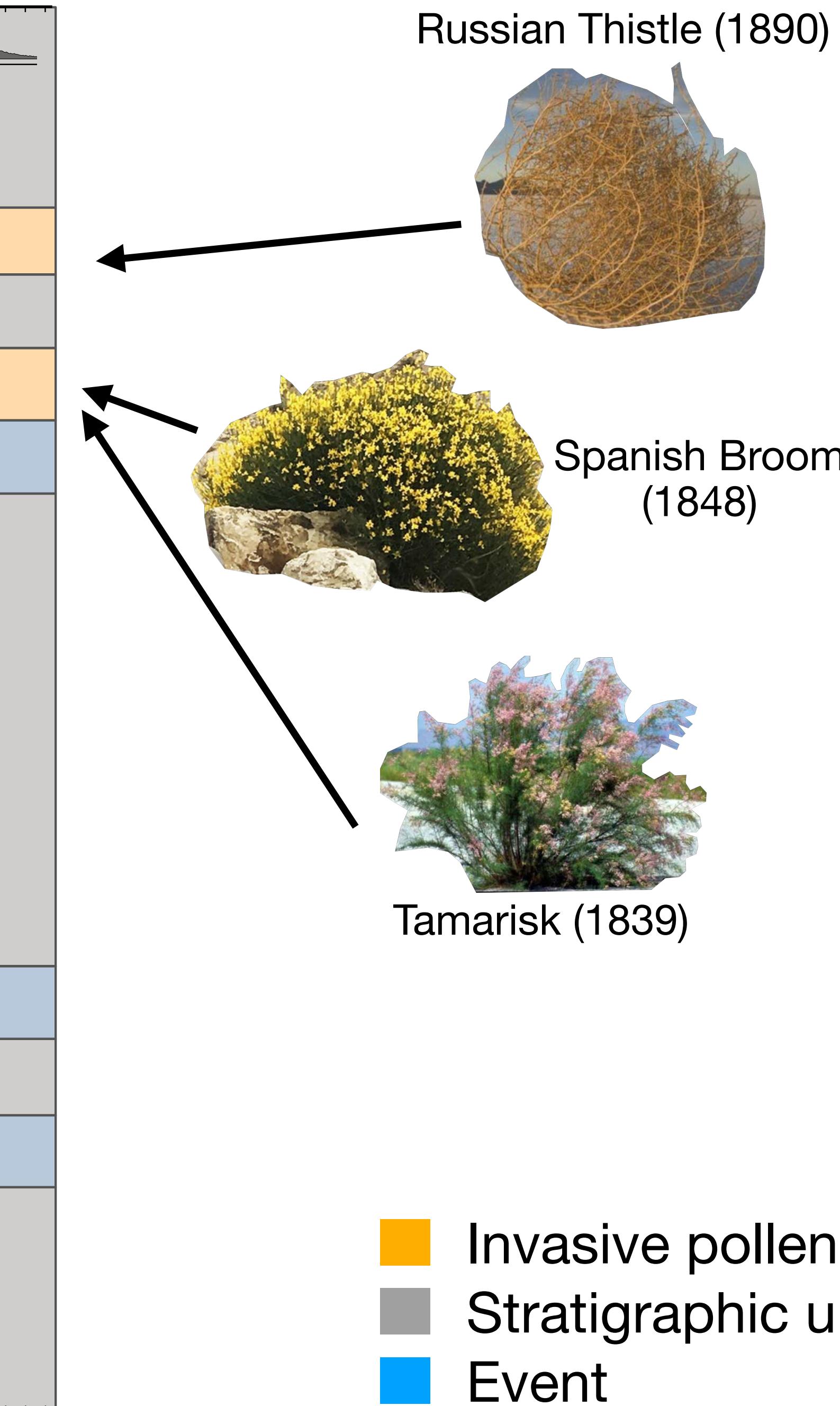
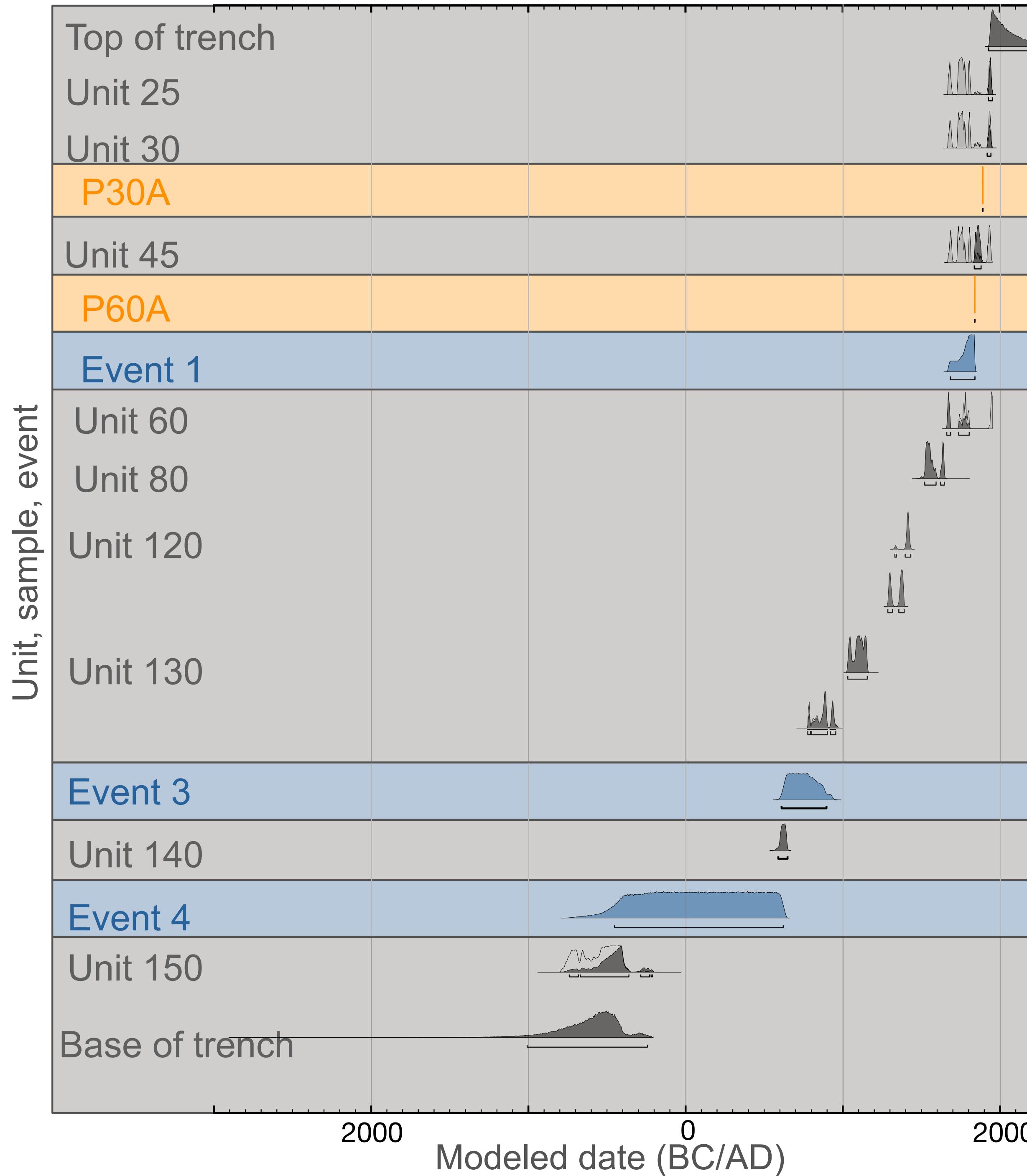
Event

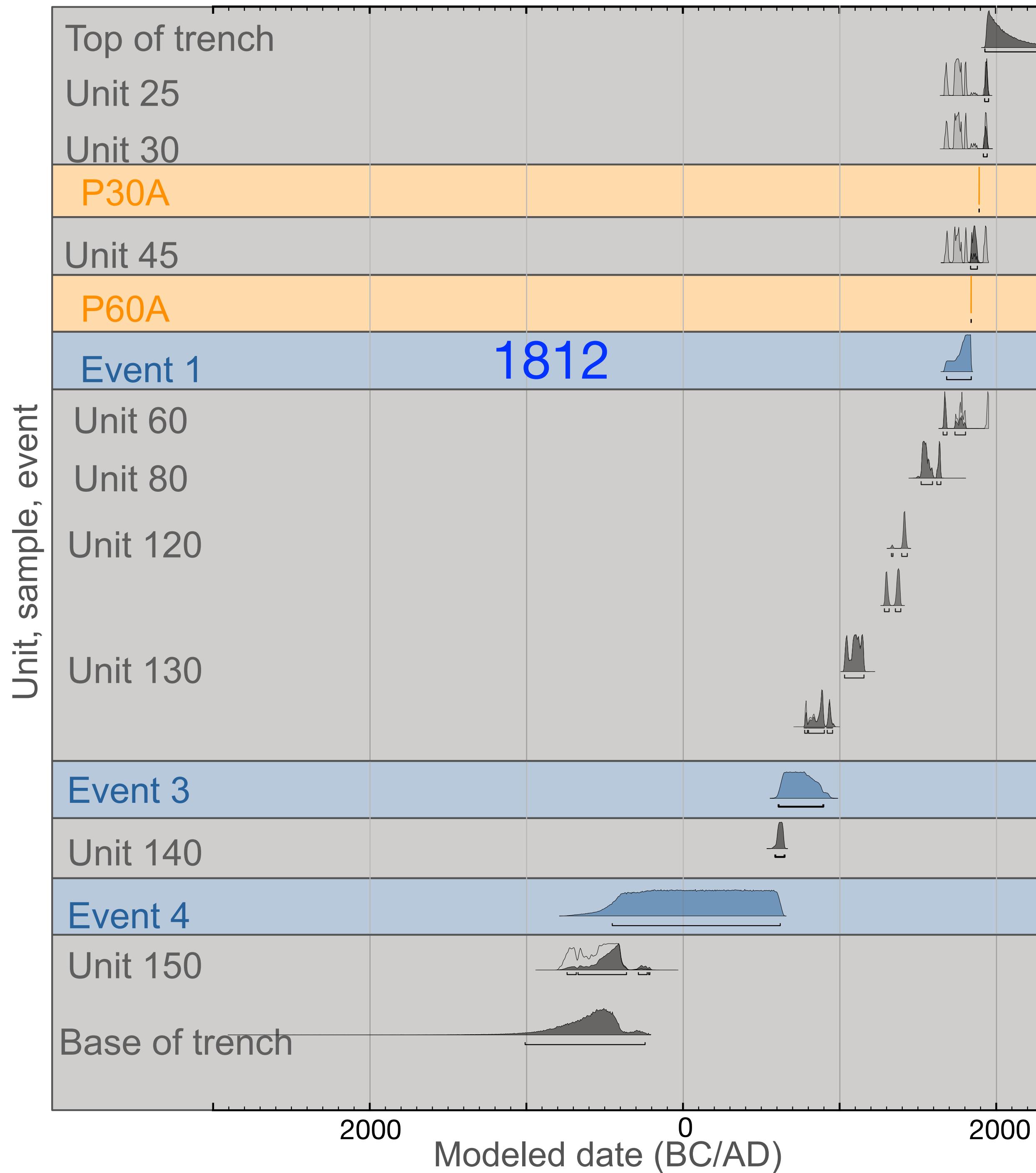
Chronology of the LCRF trench



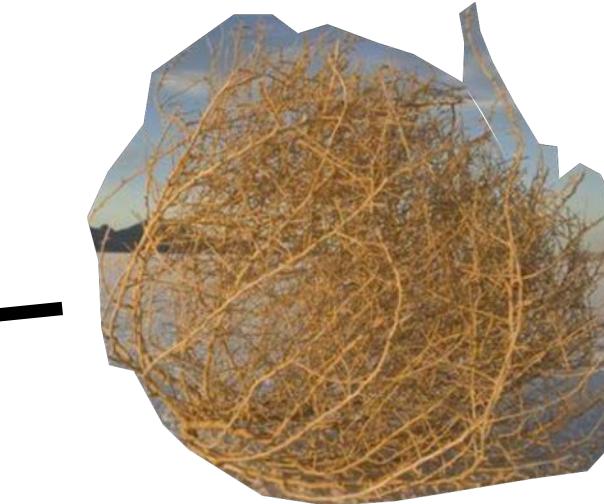
Stratigraphic unit (Bayesian)

Event

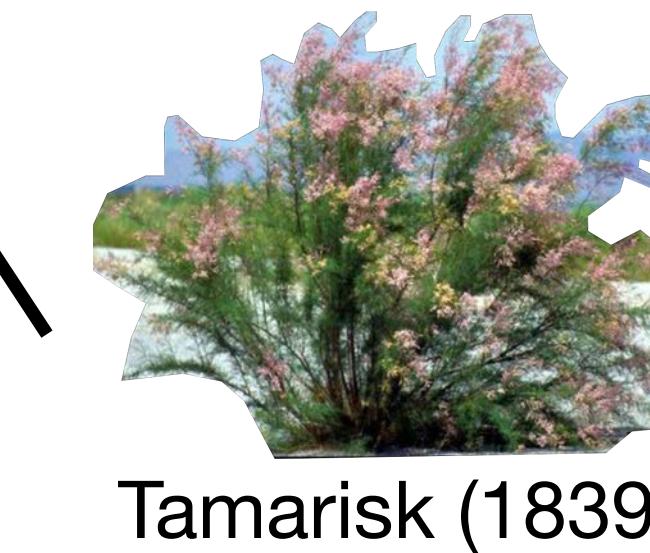




Russian Thistle (1890)



Spanish Broom (1848)

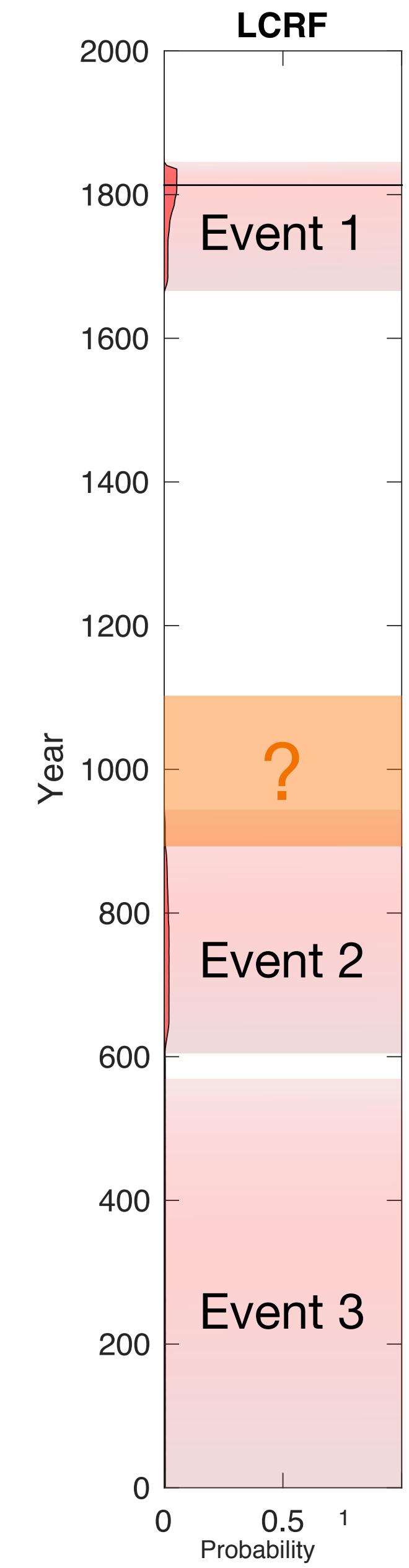


Tamarisk (1839)

- █ Invasive pollen
- Stratigraphic unit (Bayesian)
- █ Event

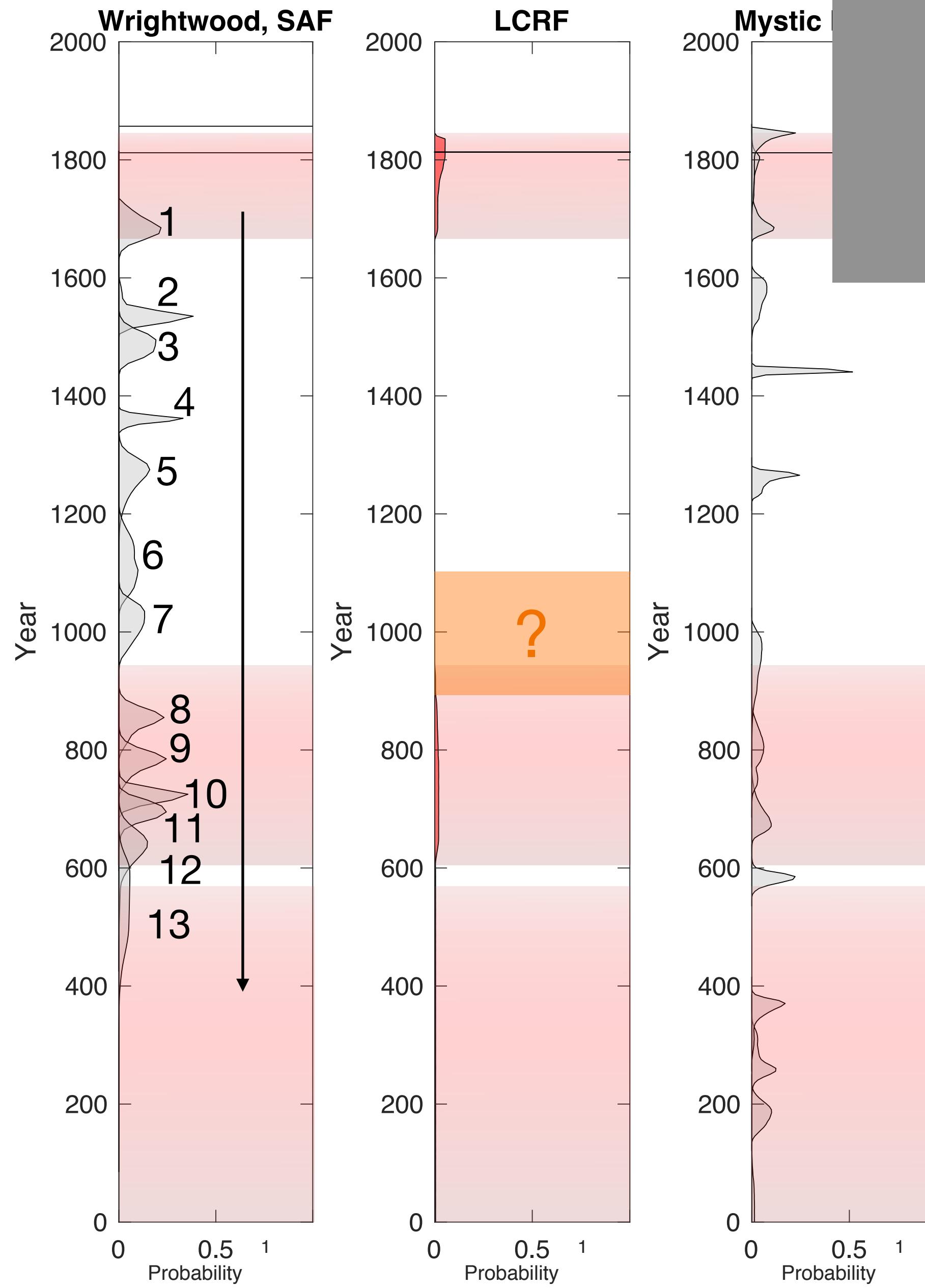
Recurrence interval LCRF

625-830 years



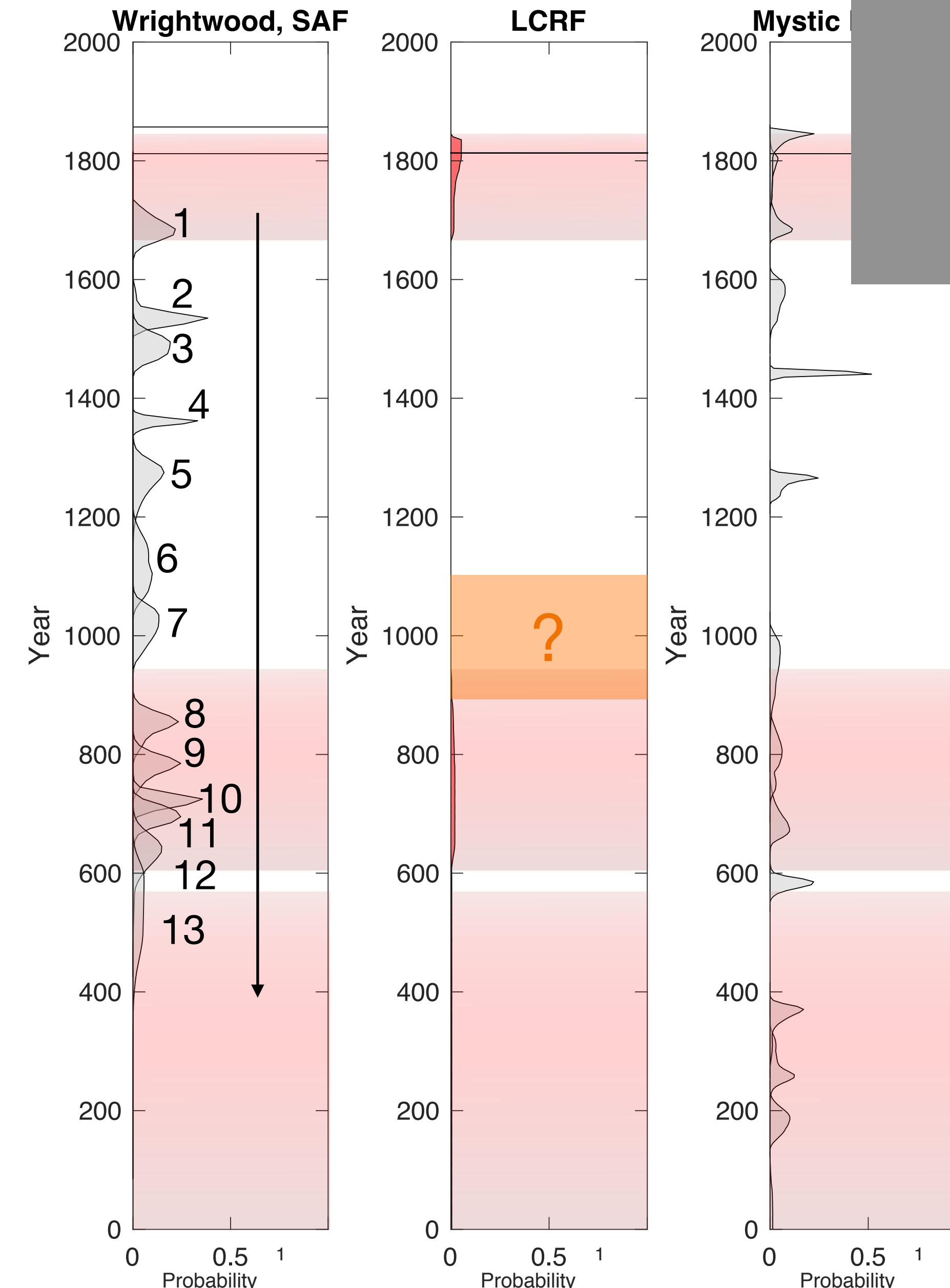
Recurrence interval LCRF 625-830 years

Can't match specific early events to SAF and SJF chronologies, but we can understand how many are shared



Recurrence interval LCRF 625-830 years

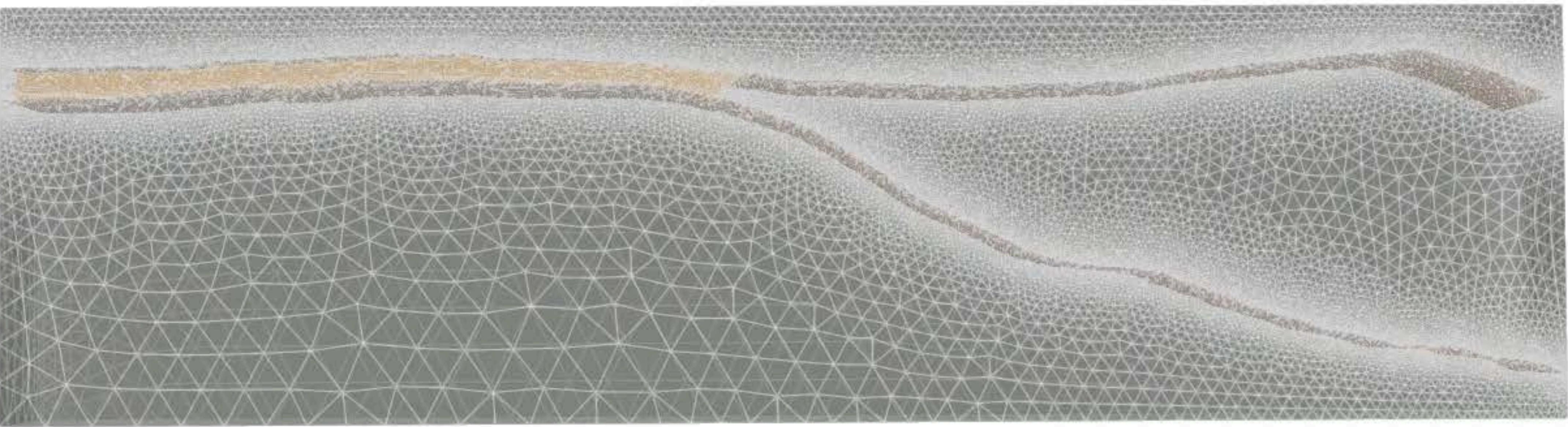
~1/4 ruptures involve
the San Andreas, the
San Jacinto, and the
LCRF



Scharer et al., 2010

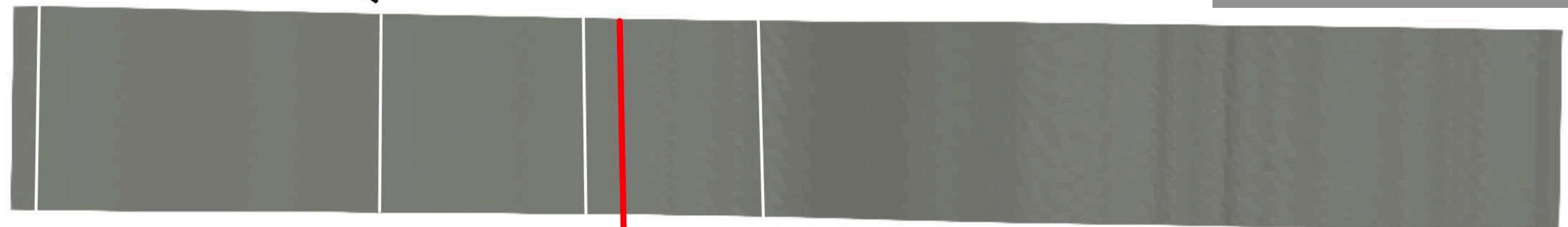
Ordendorff et al., 2018

Using the LCRF to better understand the mechanics of linkage through Cajon Pass



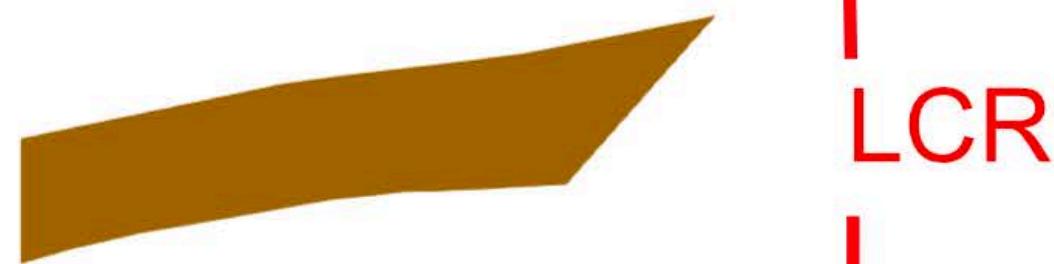
SAF

Pallet Creek
Wrightwood
Cajon Creek
Pitman Canyon



Model setup
(vertical cross-
sections)

SJF



LCRF

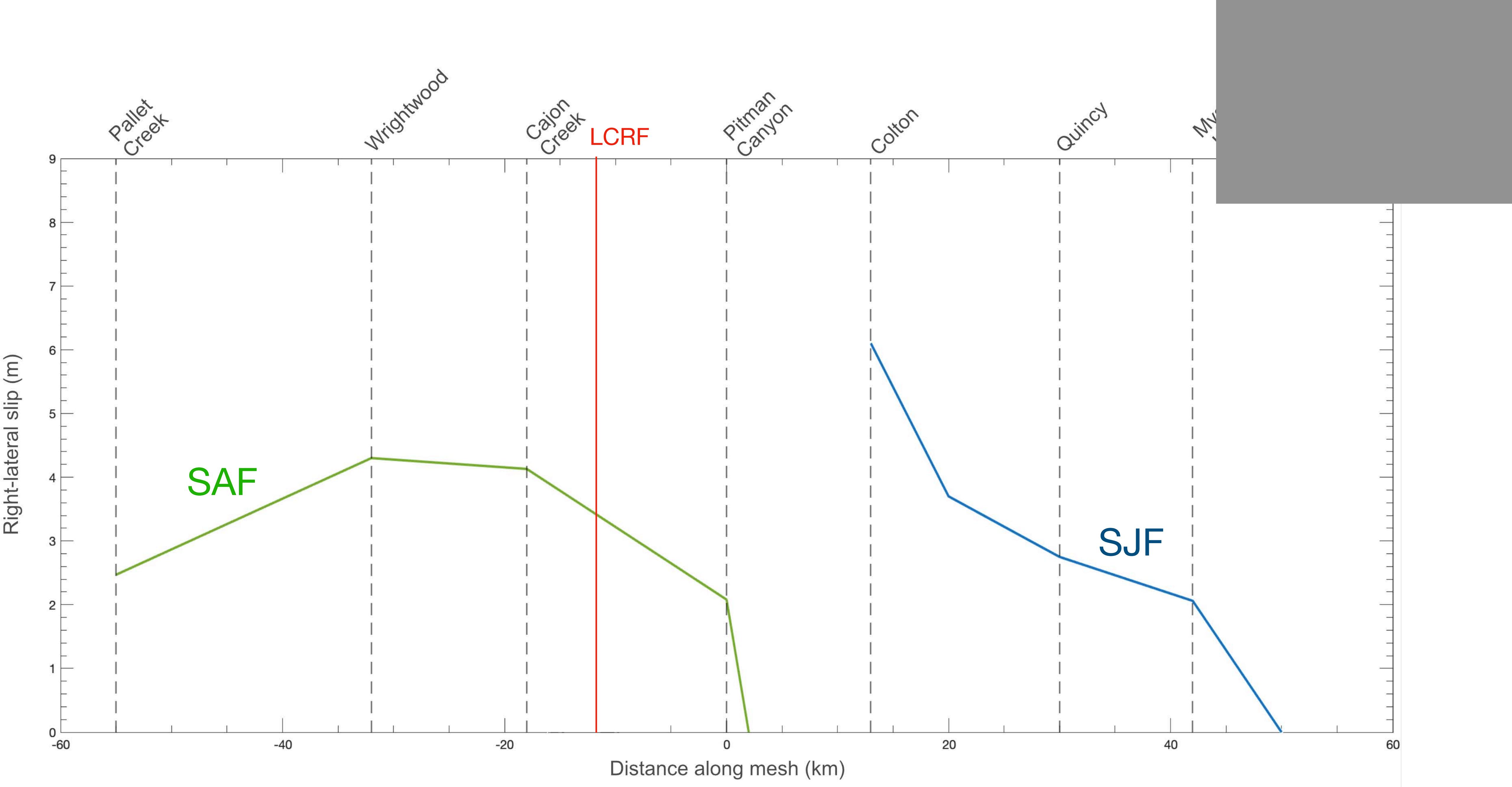
Colton

Quincy

Mystic Lake

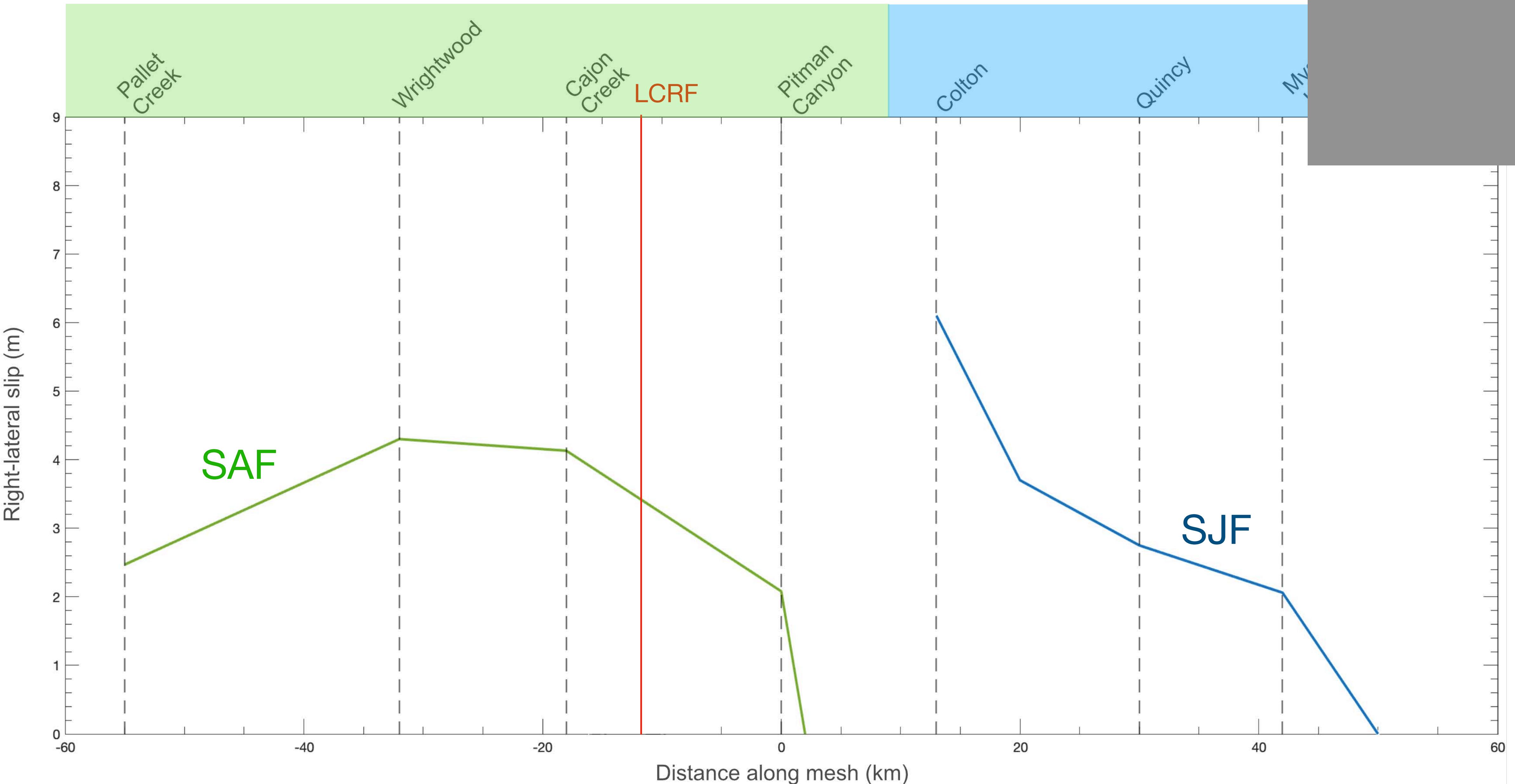
1857 - Sieh (1978), Zielke et al. (2012)
1812 - Lozos (2016)

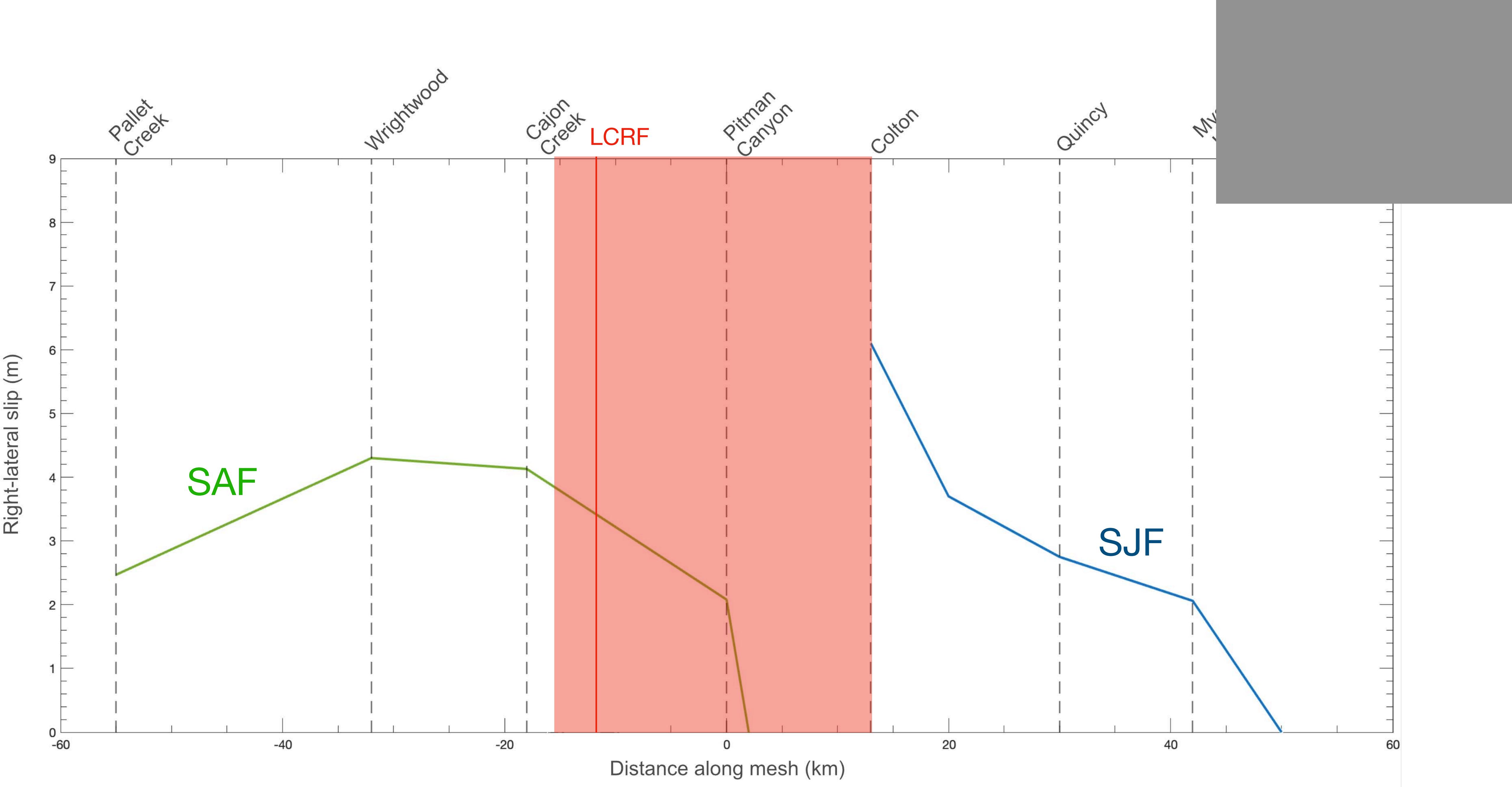
1812 - Lozos (2016)

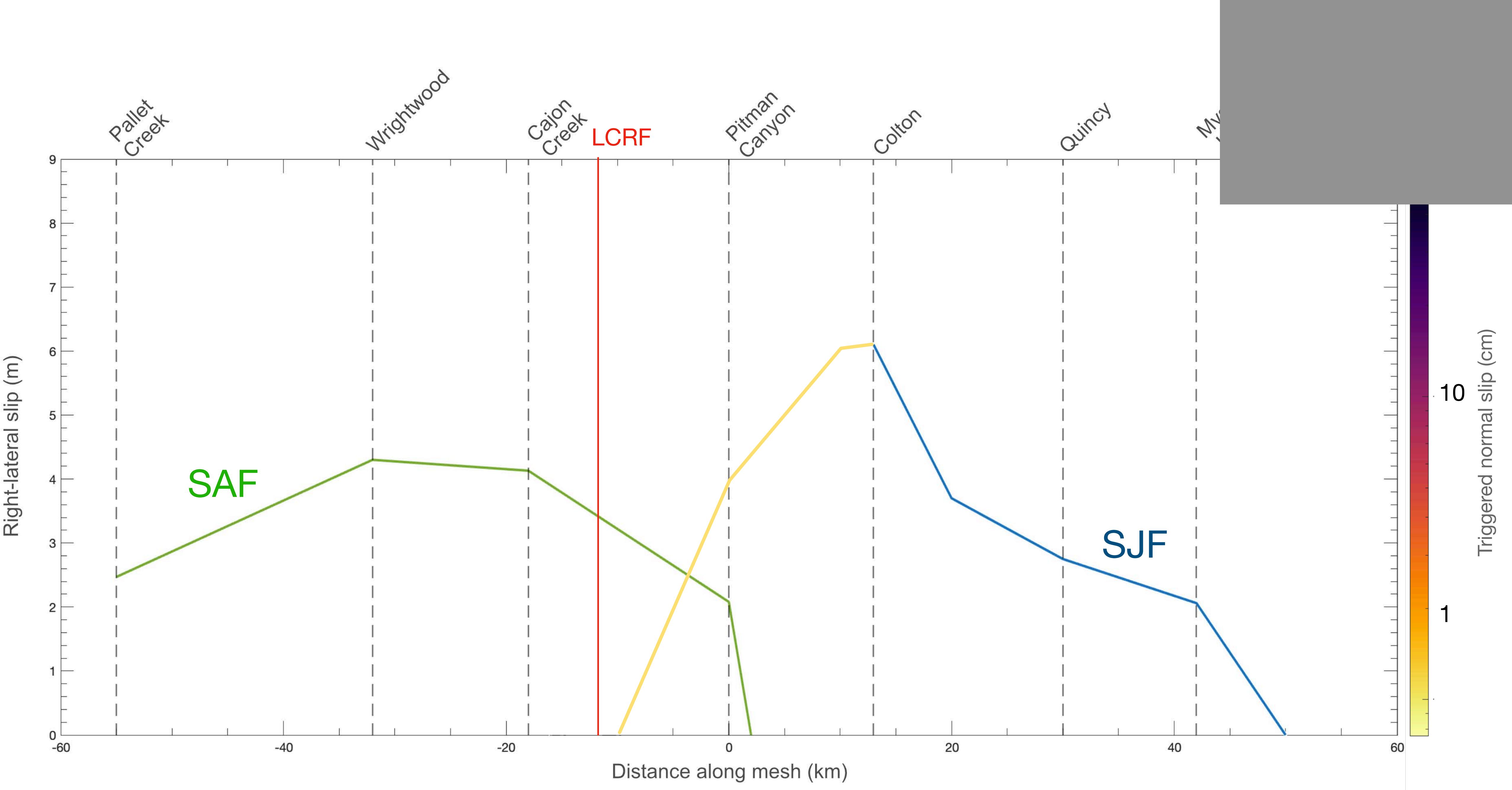


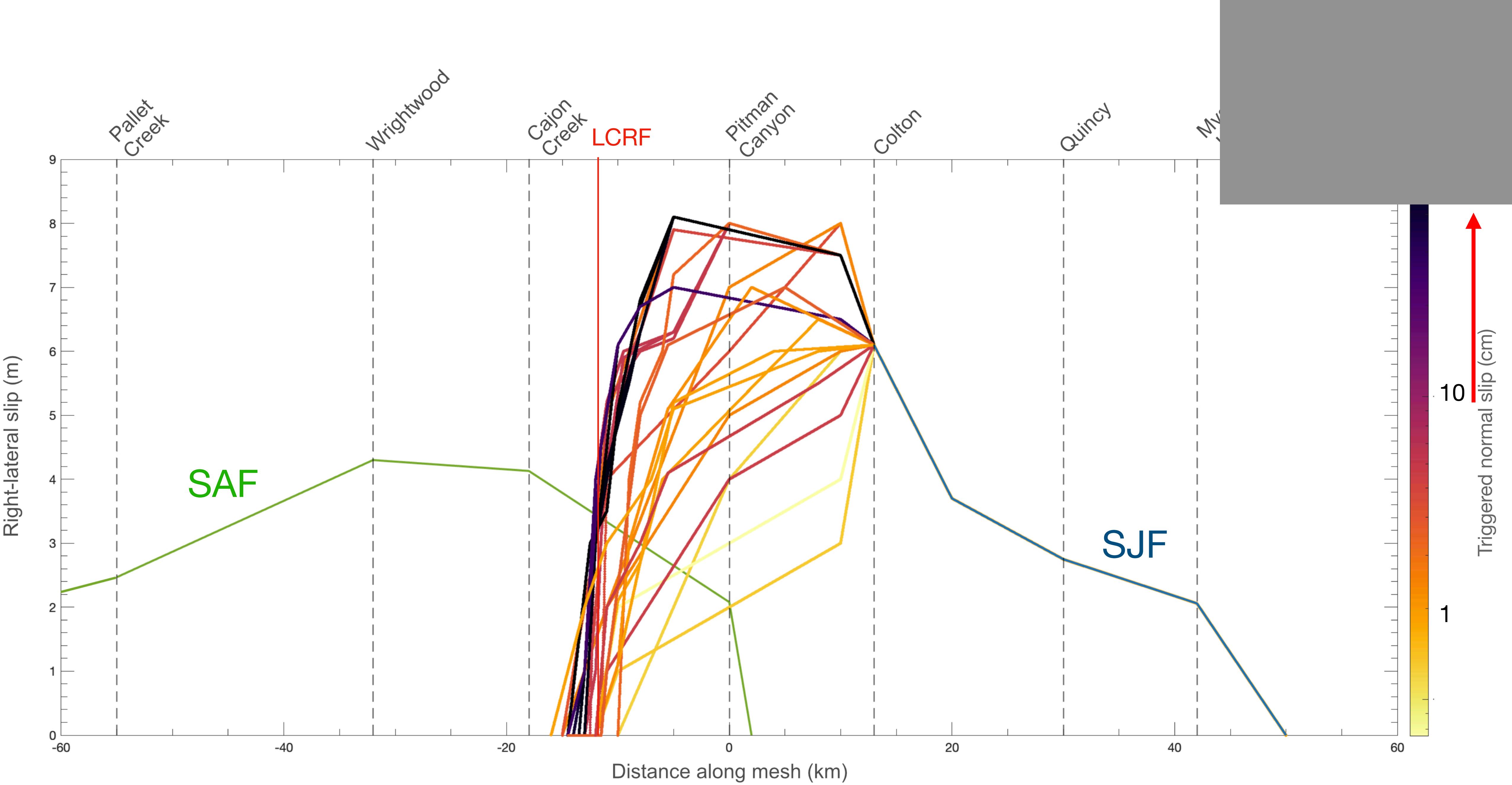
SAF paleoseismic sites

SJF paleoseismic sites





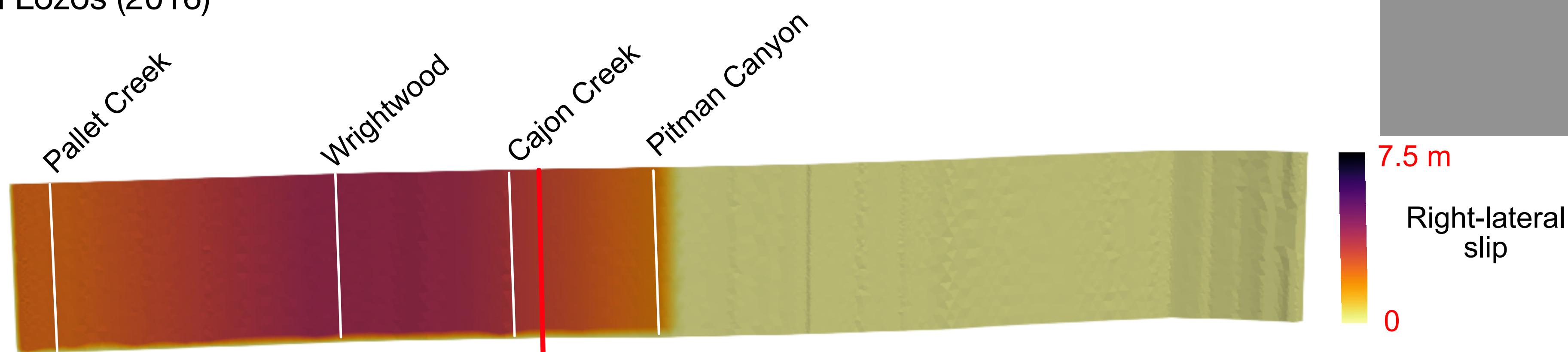




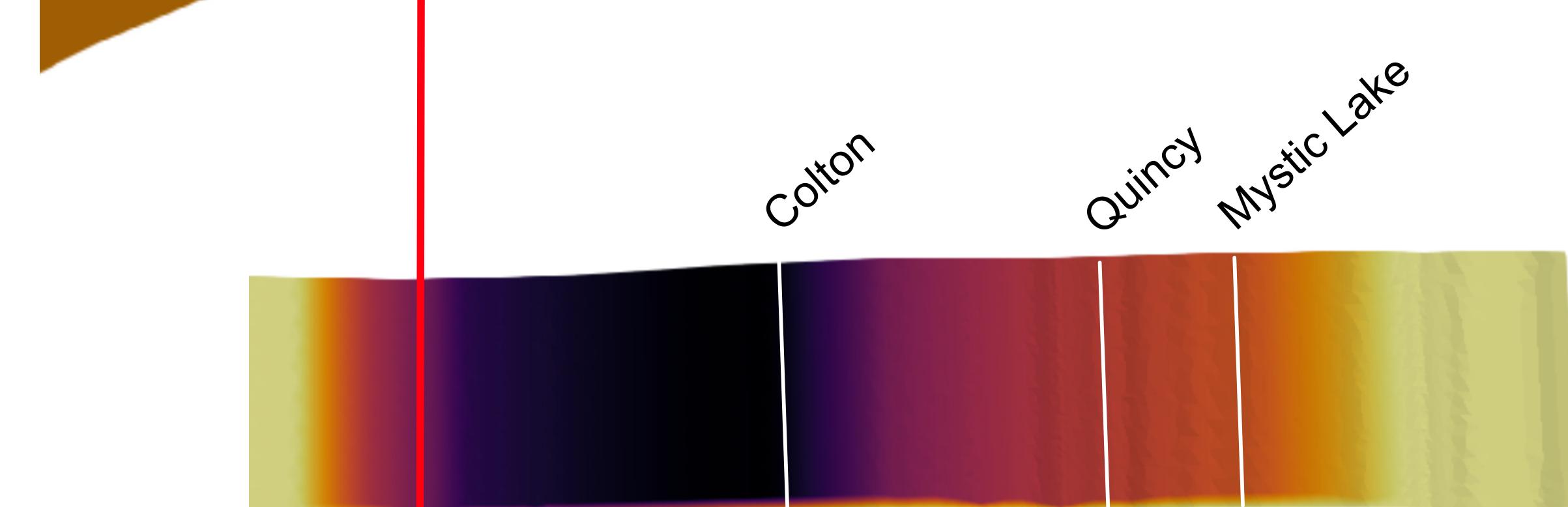
1812 preferred model

Slip distribution from Lozos (2016)

SAF



SJF



Modeled slip Slip distribution from Lozos (2016)



7.5 m
Right-lateral slip
0

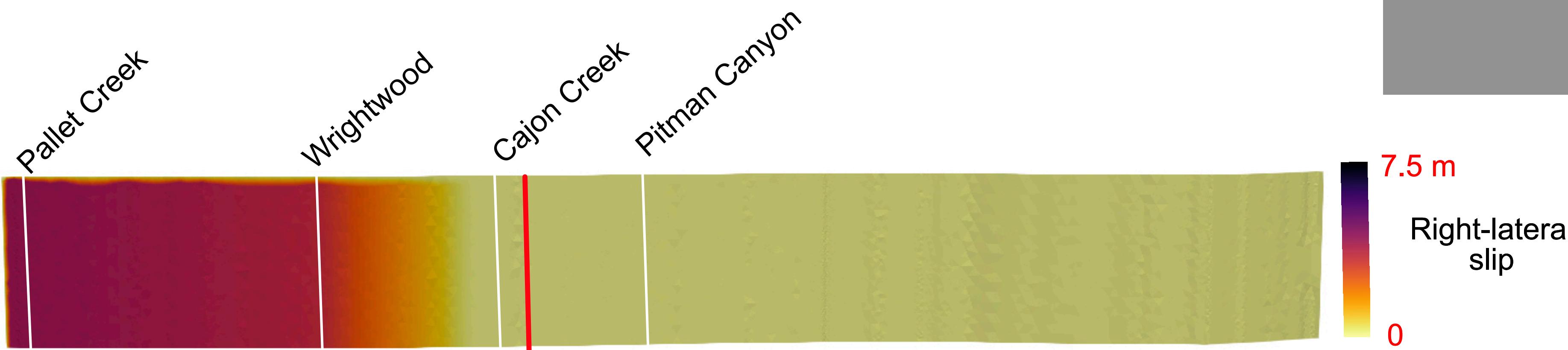
60 cm
Triggered normal slip
-2 cm

7.5 m
Right-lateral slip
0

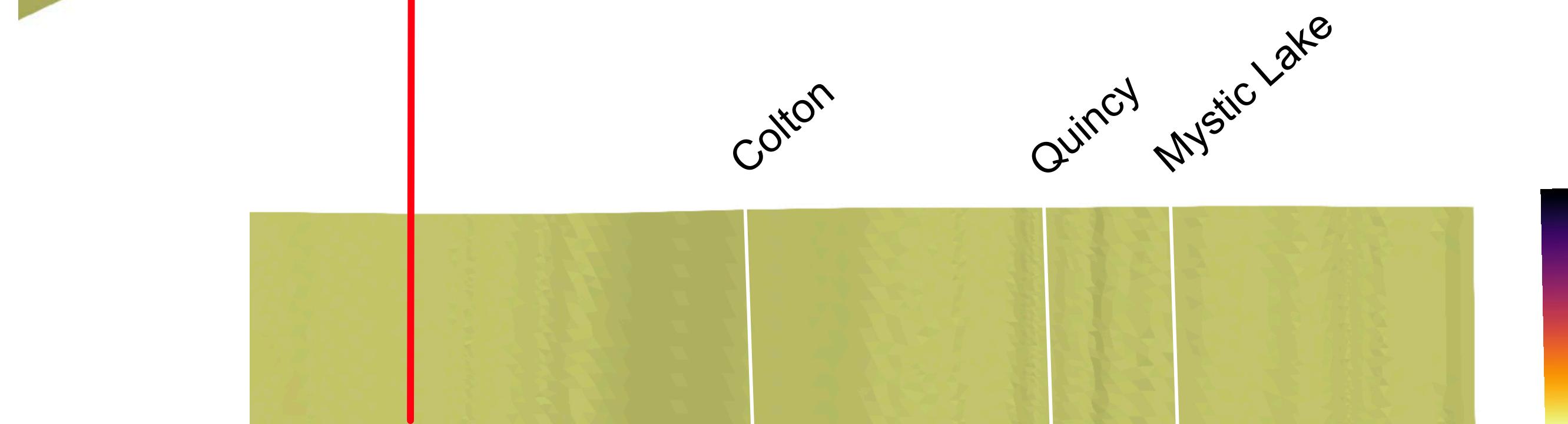
1857

Slip distribution from Sieh (1978)

SAF



SJF



7.5 m
Right-lateral
slip
0

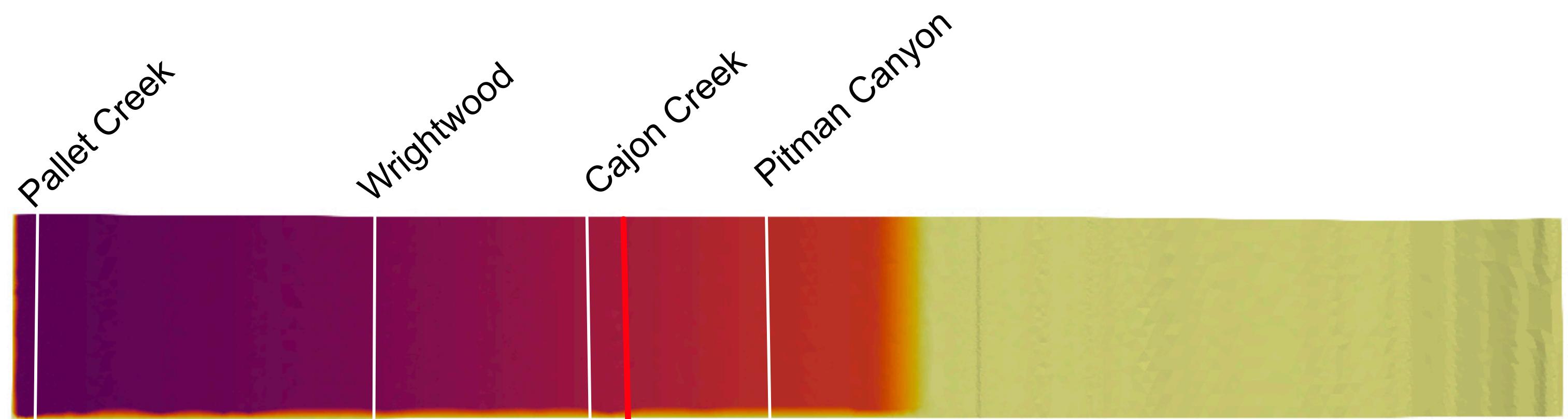
60 cm
Triggered
normal slip
0 cm

7.5 m
Triggered
right-lateral
slip
0

1857

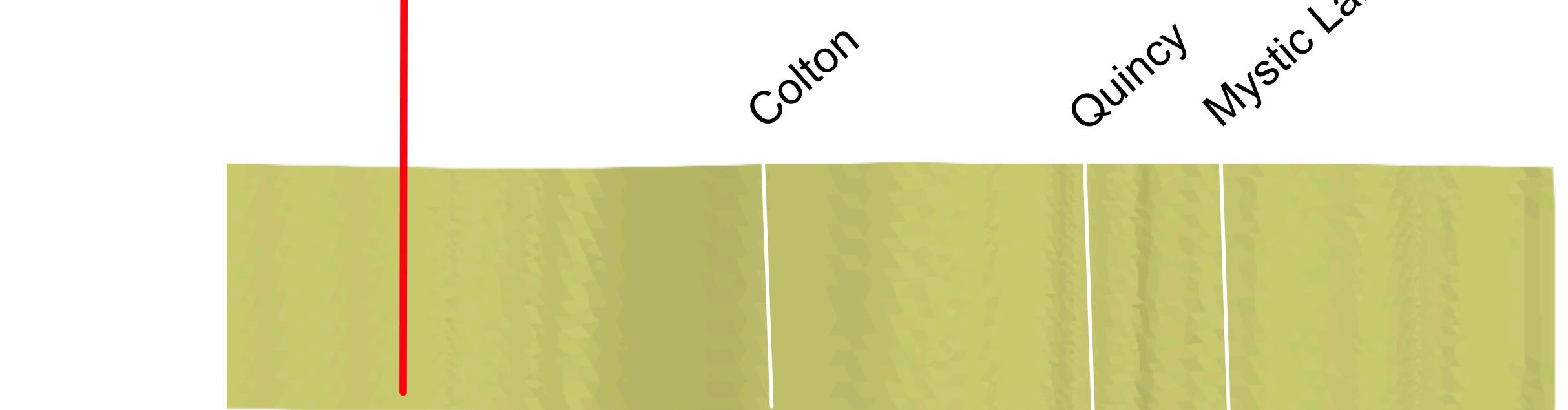
Slip distribution from Zielke et al. (2012)

SAF



7.5 m
Right-lateral slip
0

SJF



60 cm
Triggered normal slip
0 cm

7.5 m
Triggered right-lateral slip
0

Conclusions



The San Andreas and the San Jacinto have ruptured together at least three times in the past 2500 years at 1812 AD, 611-896 AD, and 452 BC-622 AD.

The LCRF passively ruptures with a recurrence interval of 625-830 years, with 1/4 ruptures being shared by the San Andreas and the San Jacinto faults.

To activate the LCRF with slip in the cm-scale in 1812, slip on the SJF must have tapered steeply and halt abruptly ~3km northwest of the LCRF. Models of 1857 show no more than 10cm of slip on the LCRF, consistent with a closed gate.



Acknowledgments

We would like to thank SCEC for funding this work through awards 20150 and 18040

We would like to thank Julian Lozos for field and meshing assistance, and constructive discussion and recommendations

I would like to thank my live audience of roommates making sure I don't look and sound like a robot on my first Zoom talk

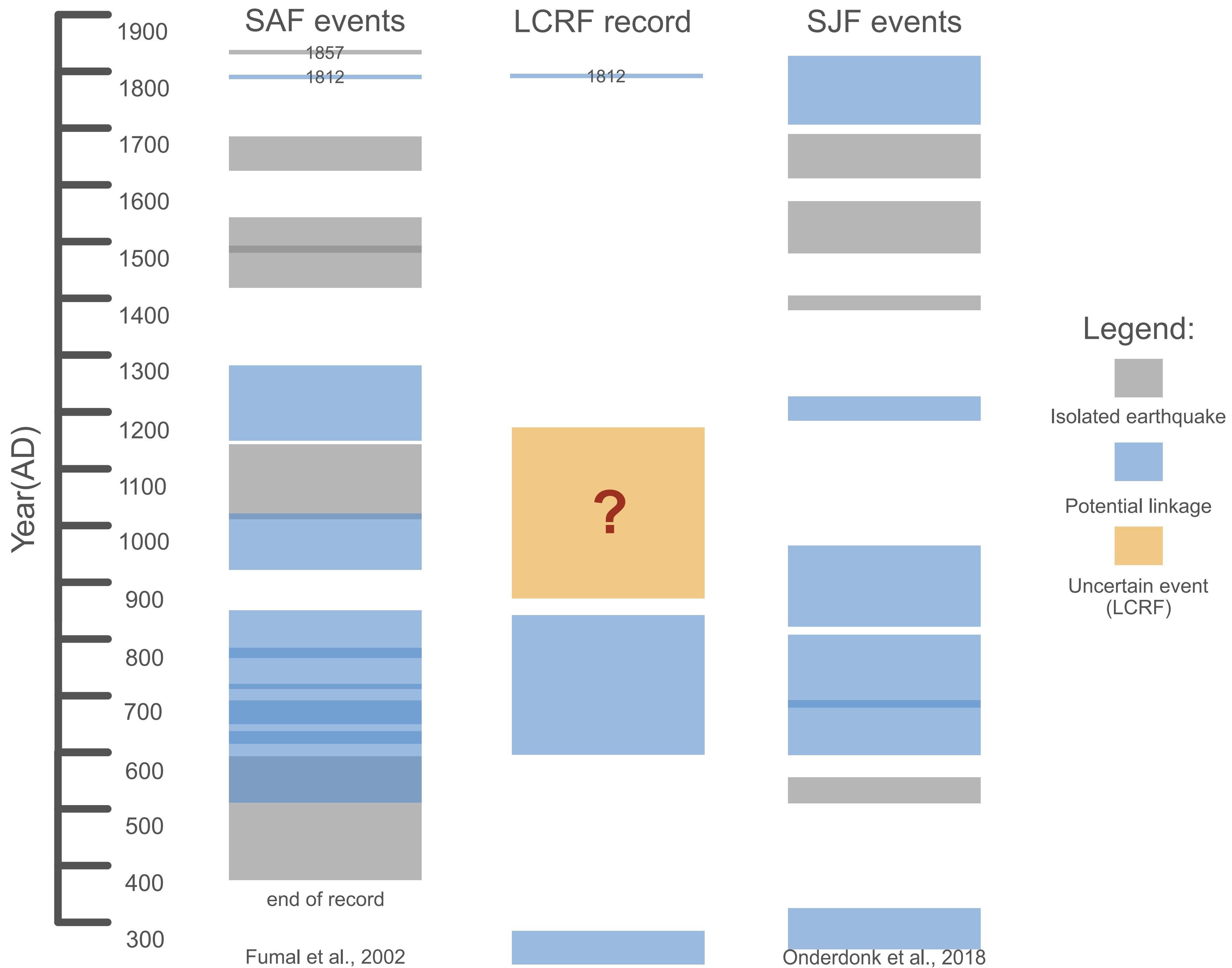


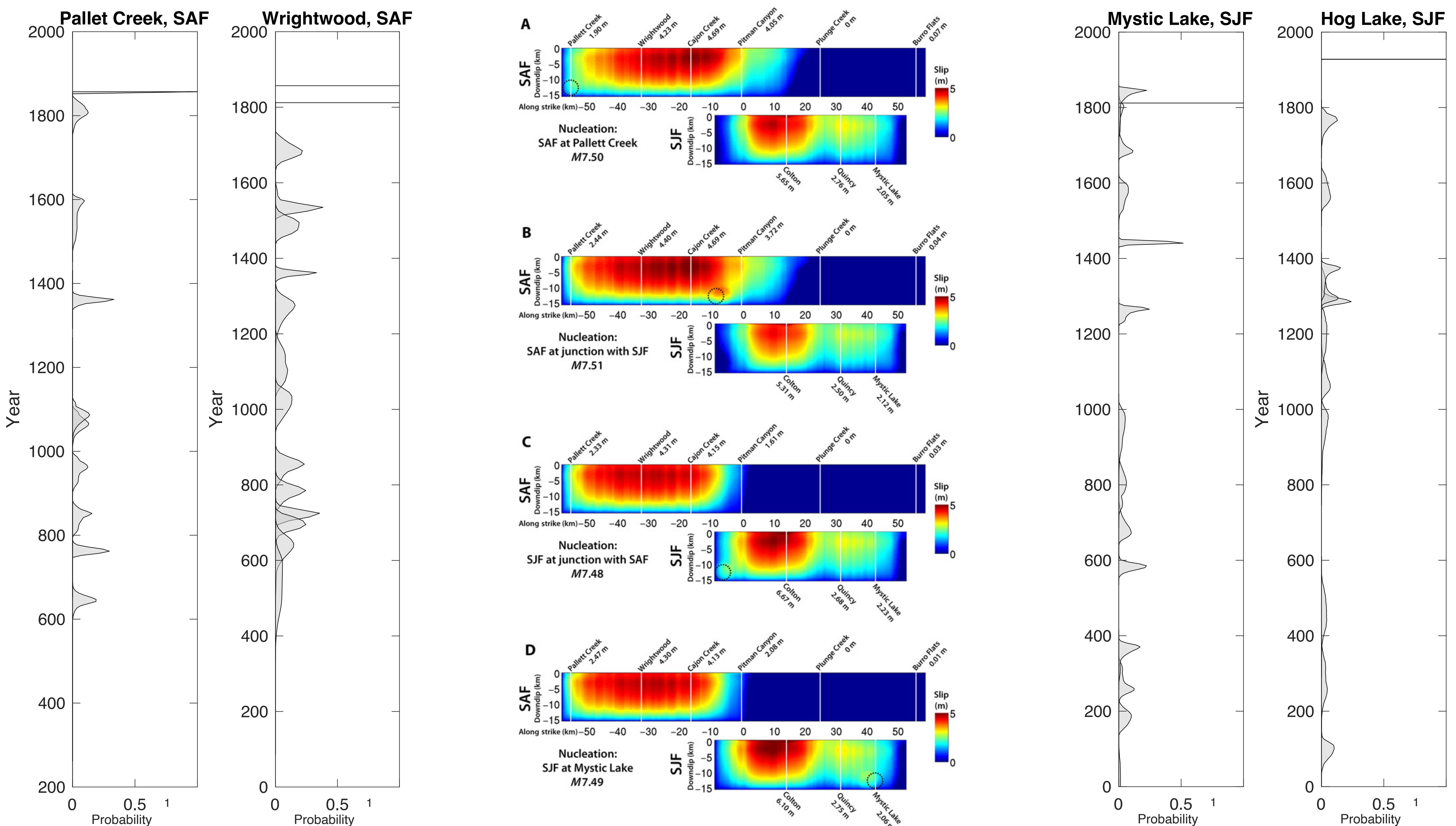
UCDAVIS
DEPARTMENT OF EARTH
AND PLANETARY SCIENCES

SCEC
AN NSF+USGS CENTER



Back ups





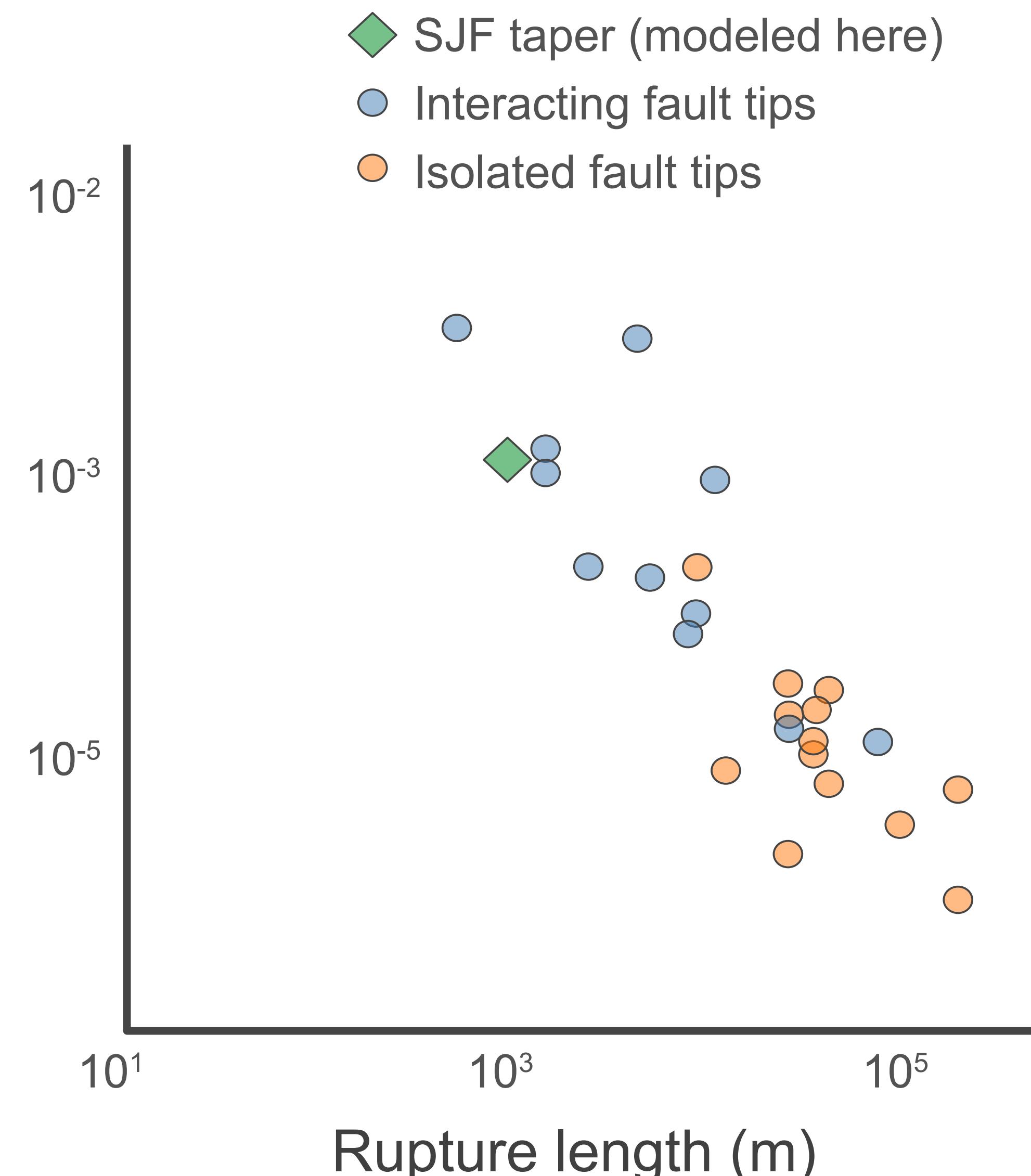
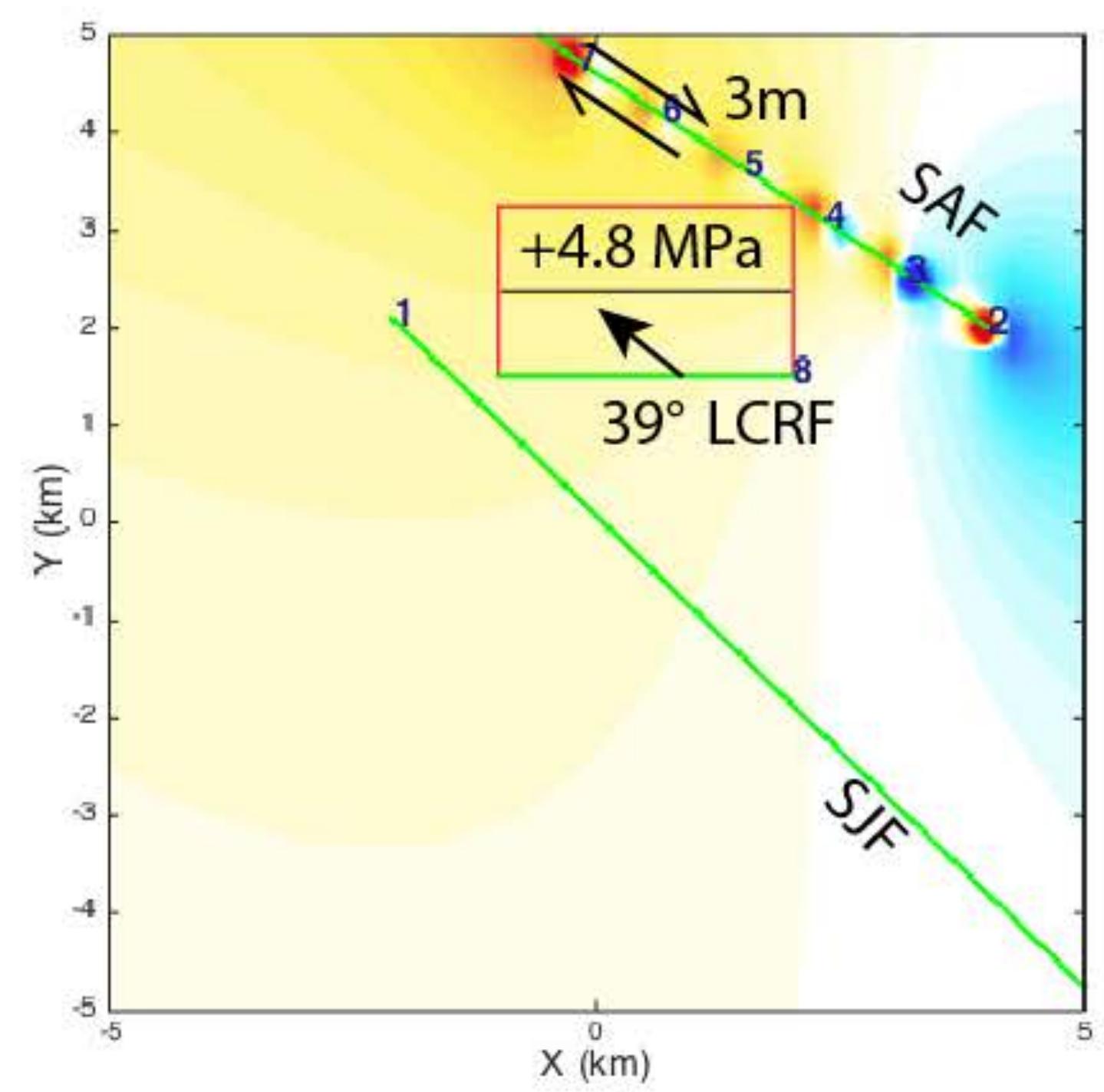
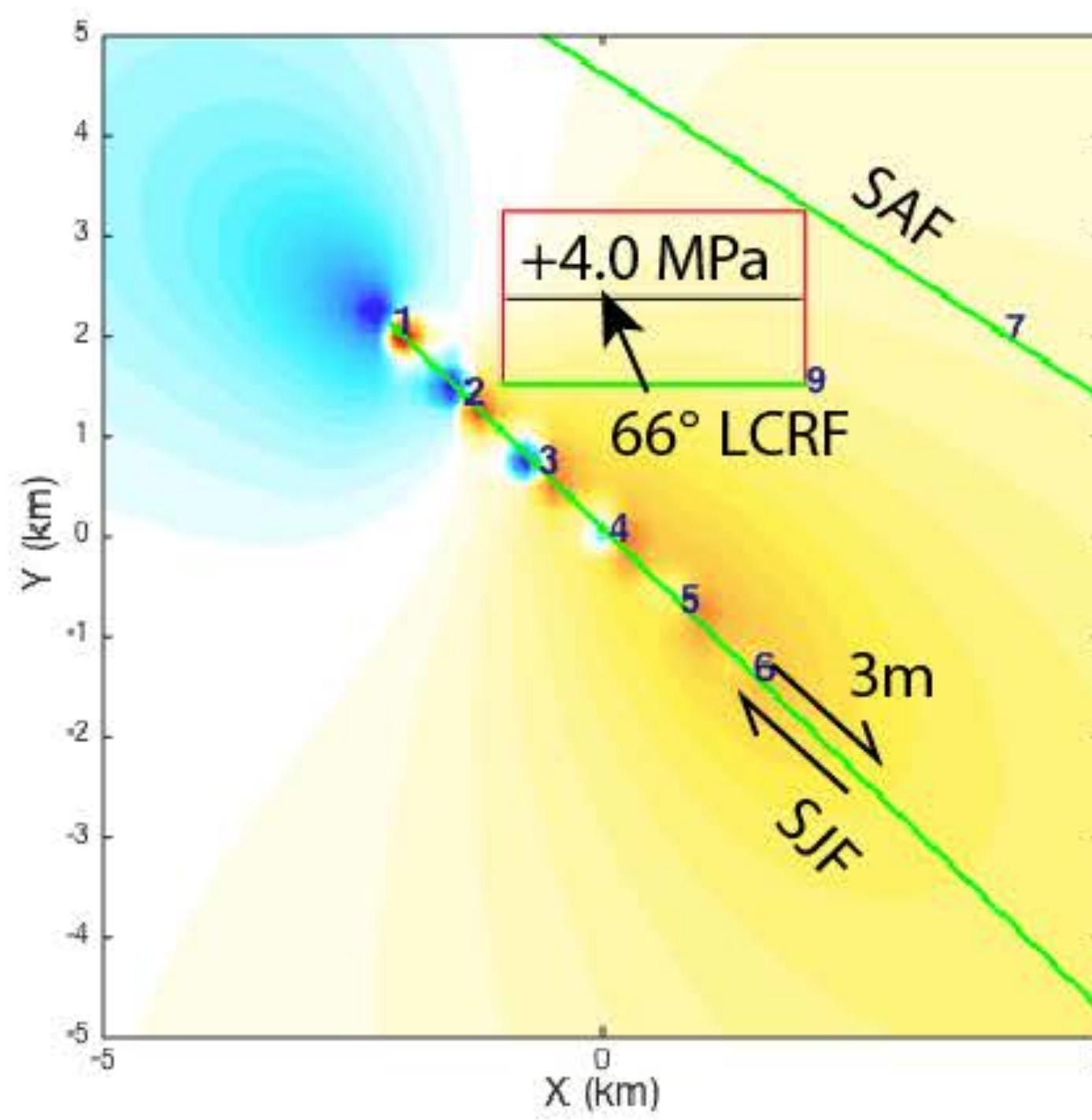


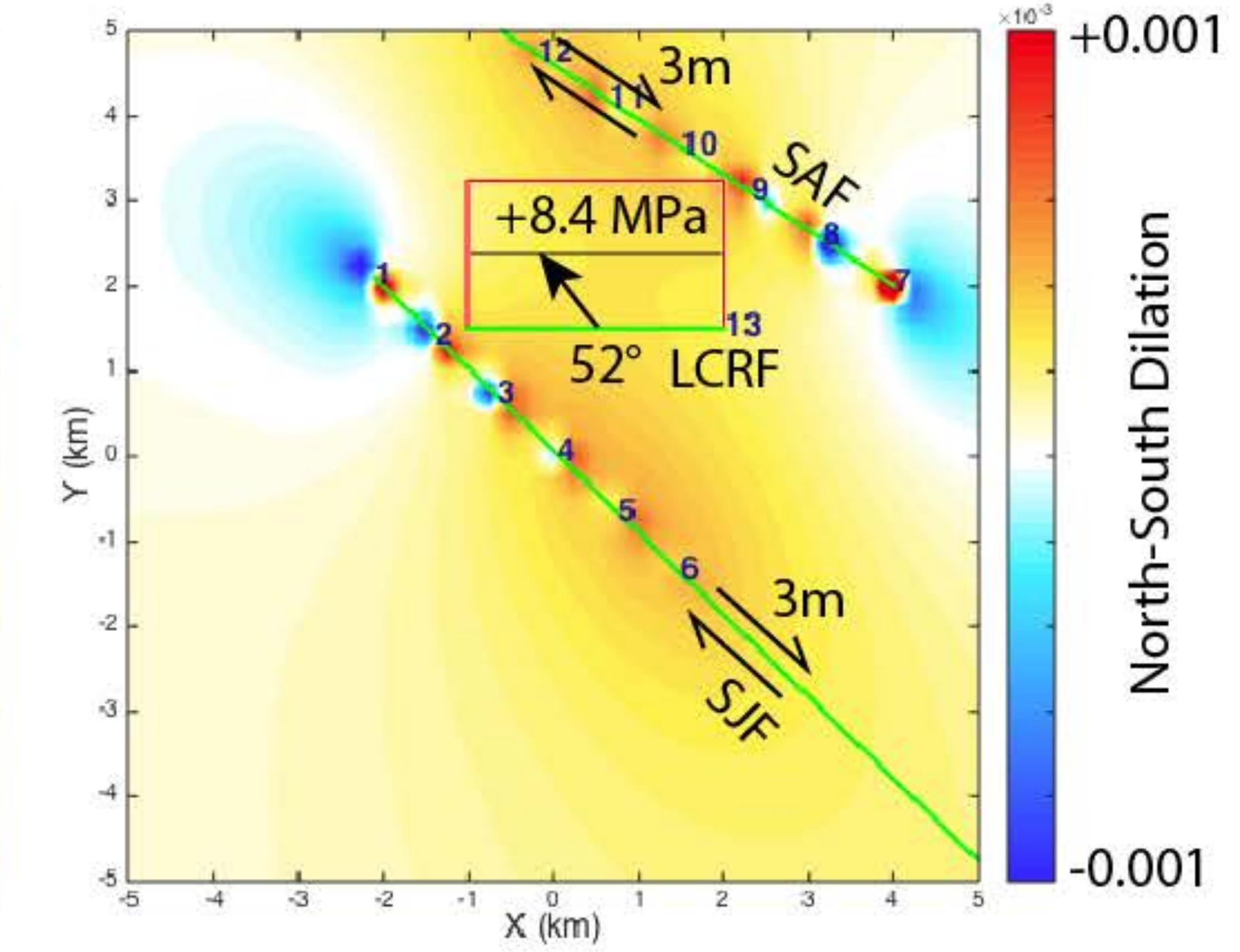
Figure 14: Compilation of earthquake tapers at fault tips. Modified after Scholz and Lawler, 2004.



San Andreas Fault



San Jacinto Fault



San Andreas Fault & San Jacinto Fault

