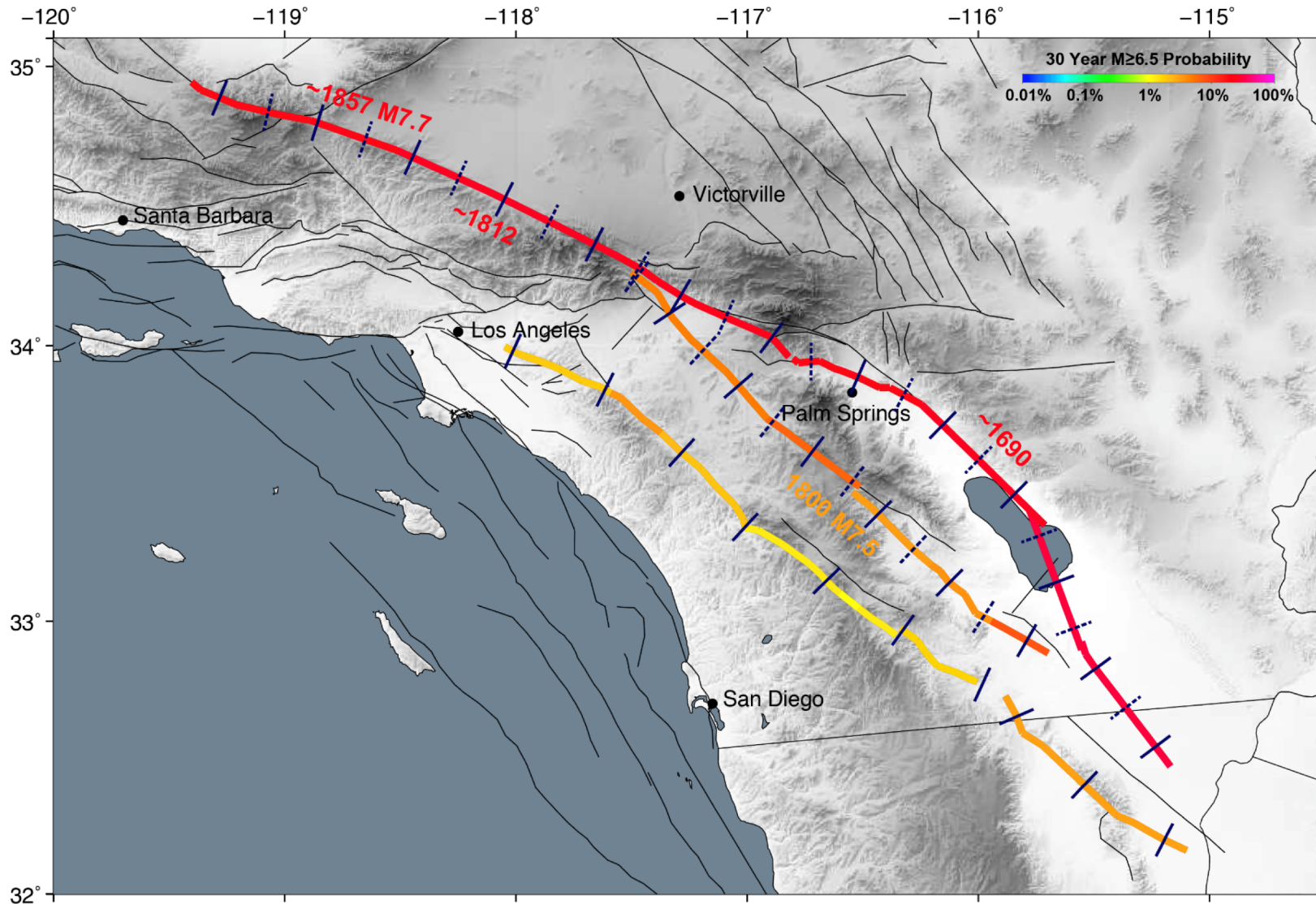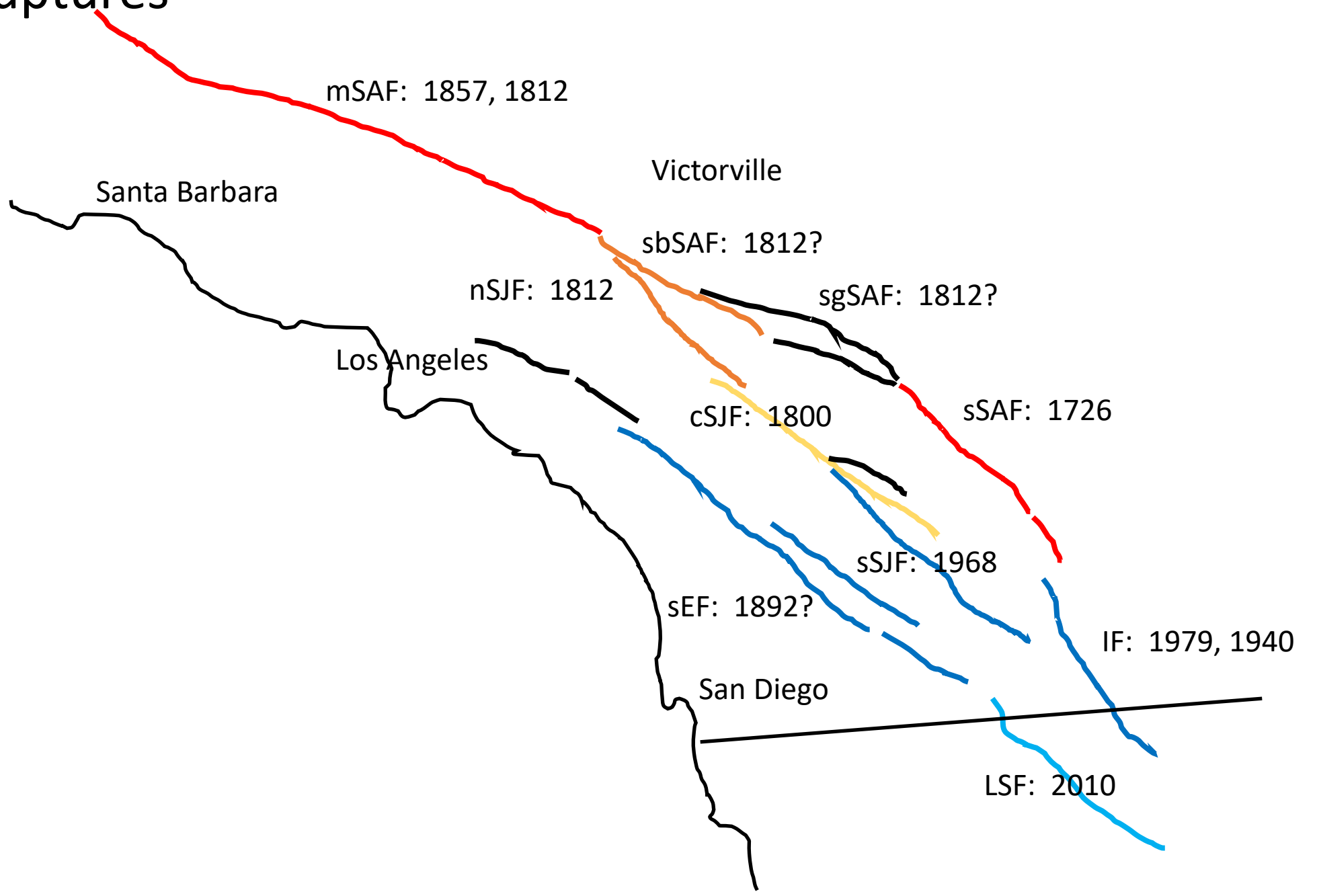# Earthquake geology and paleoseismology considerations for RuFZO

Nate Onderdonk (presenting mostly other people's work!)

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Most Recent Ruptures

Most Recent Ruptures

mSAF: 1857, 1812

Santa Barbara

Victorville

sbSAF: 1812?

nSJF: 1812

sgSAF: 1812?

Los Angeles

cSJF: 1800

sSAF: 1726

sEF: 1892?

sSJF: 1968

San Diego

IF: 1979, 1940

LSF: 2010

Time since last rupture
and
Mean Recurrence Interval

Years since most recent rupture

Average recurrence time

mSAF: 165 > 90

Santa Barbara

sbSAF: 210 > 173

nSJF: 210 > 160

sgSAF: 210 < 1000+ ?

Los Angeles

cSJF: 222 / 230

sSAF: 296 > 180

Current hiatus is longer than average RI

Current hiatus is close to average RI
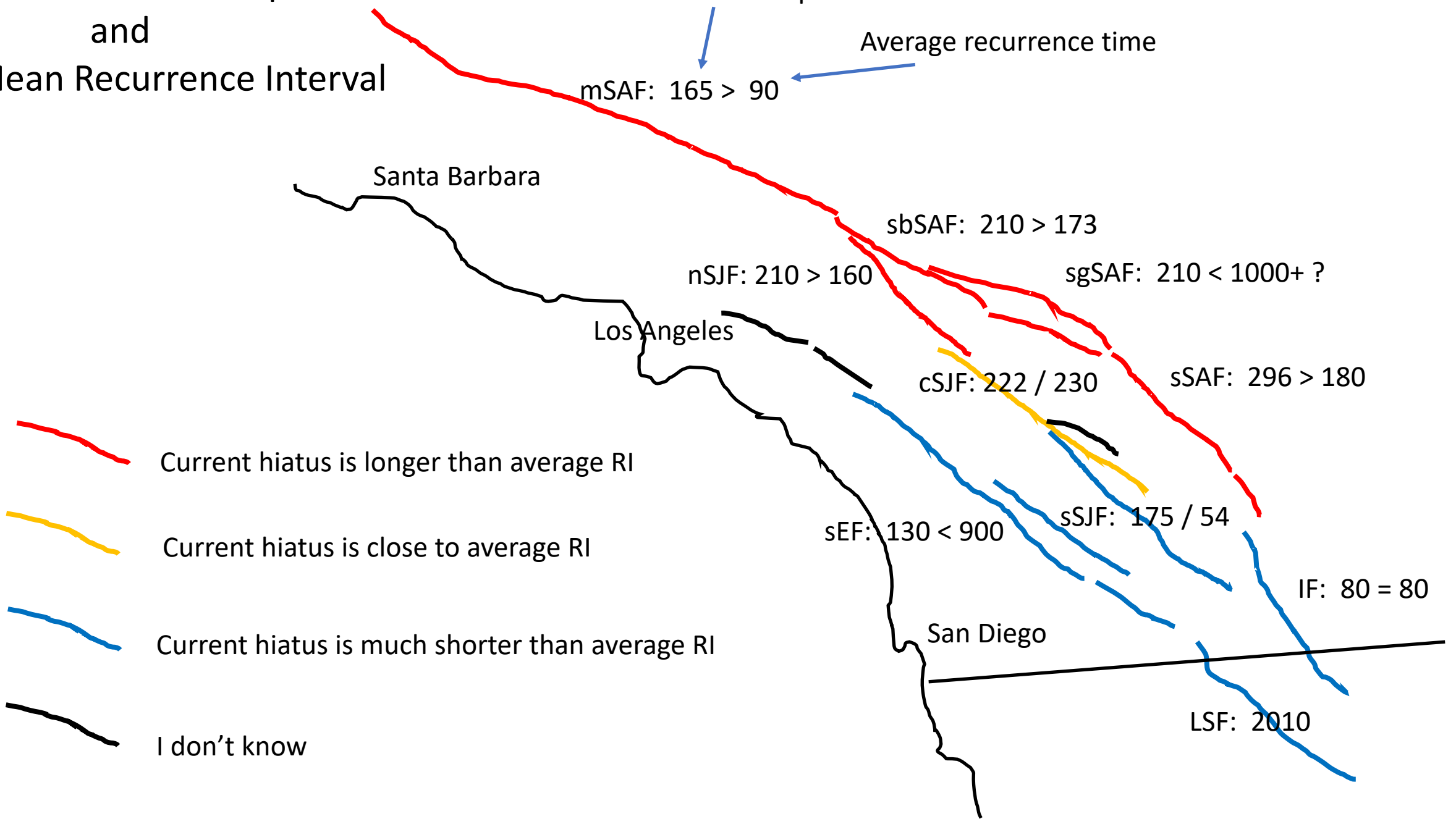
sSJF: 175 / 54

sEF: 130 < 900

Current hiatus is much shorter than average RI

IF: 80 = 80

San Diego

I don't know

LSF: 2010

Many of the faults are "overdue"
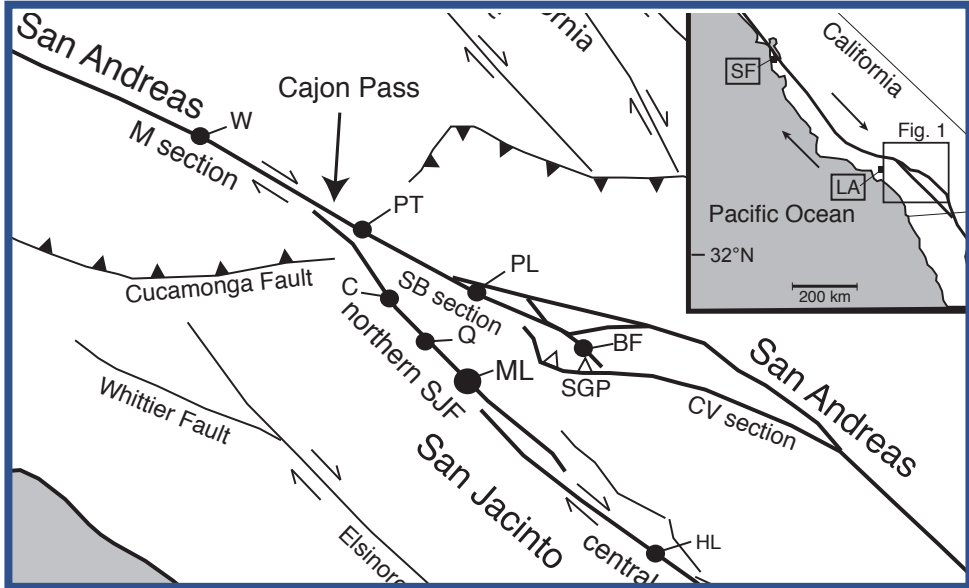
Onderdonk et al., 2018

Many of the faults are "overdue"

But surface ruptures are not regular

Onderdonk et al., 2018
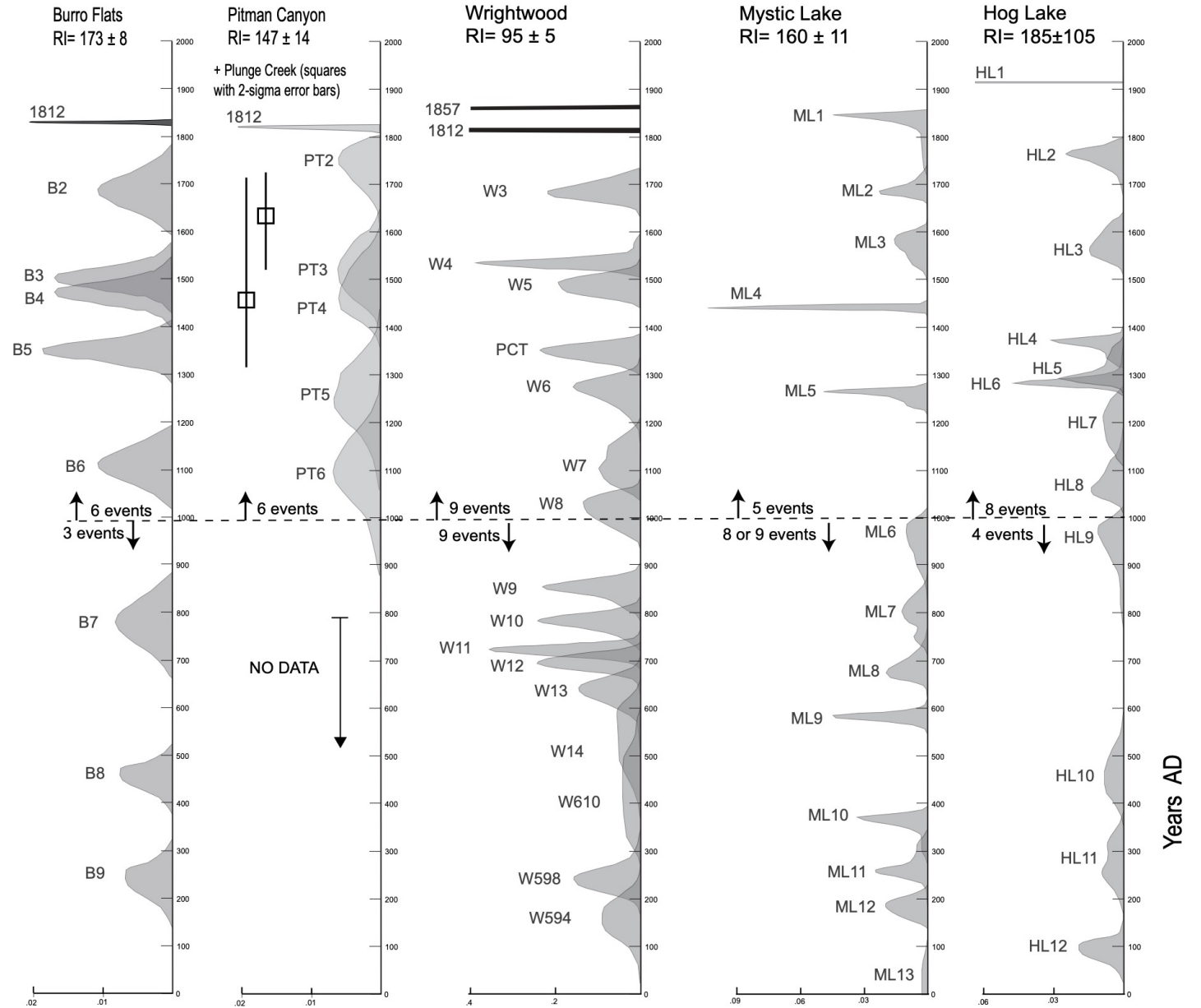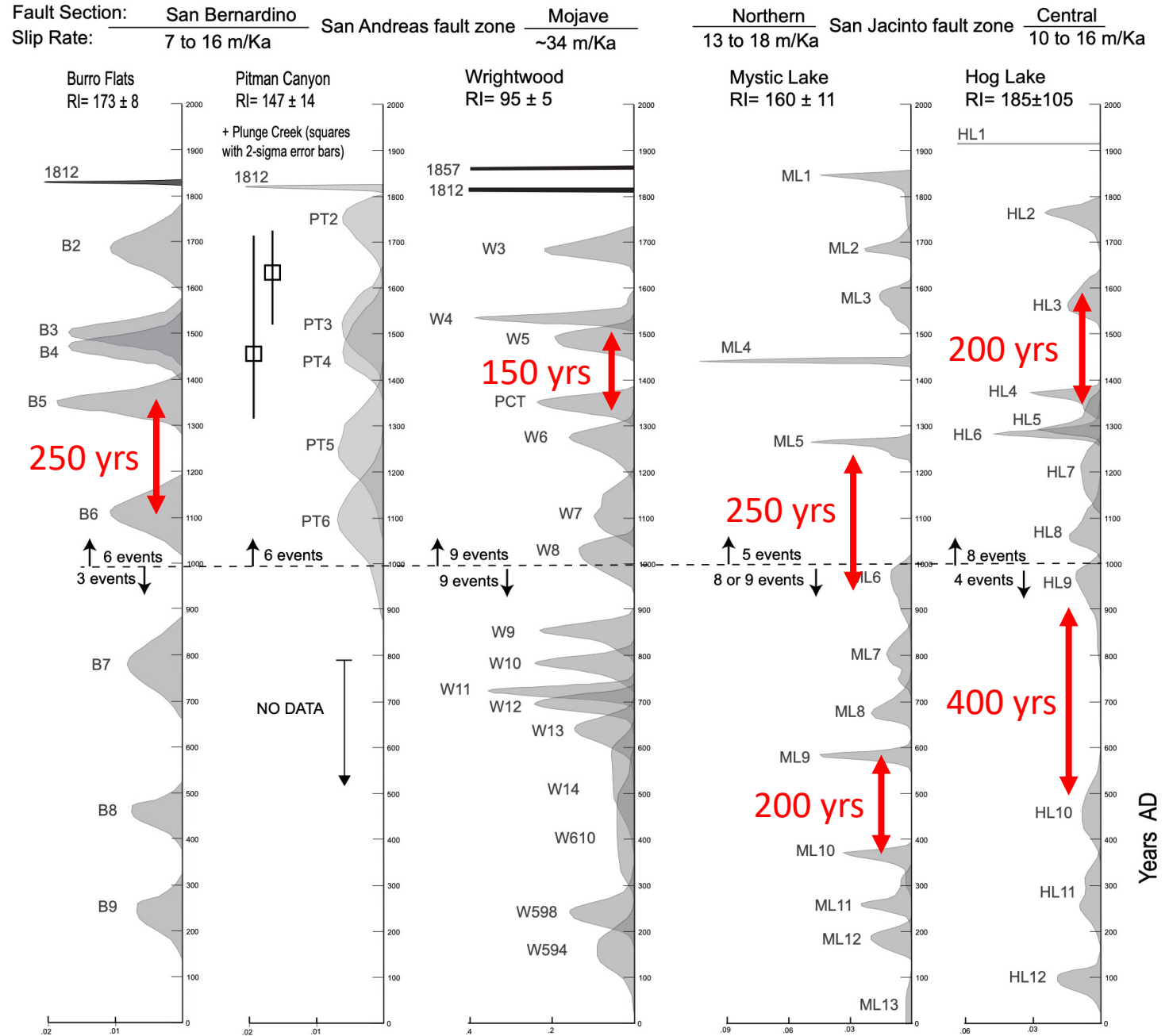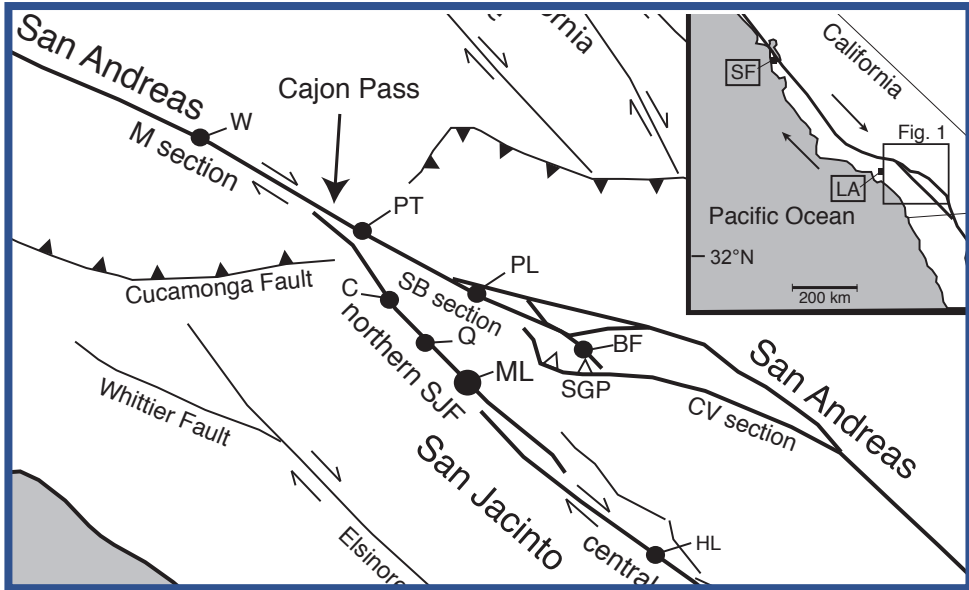
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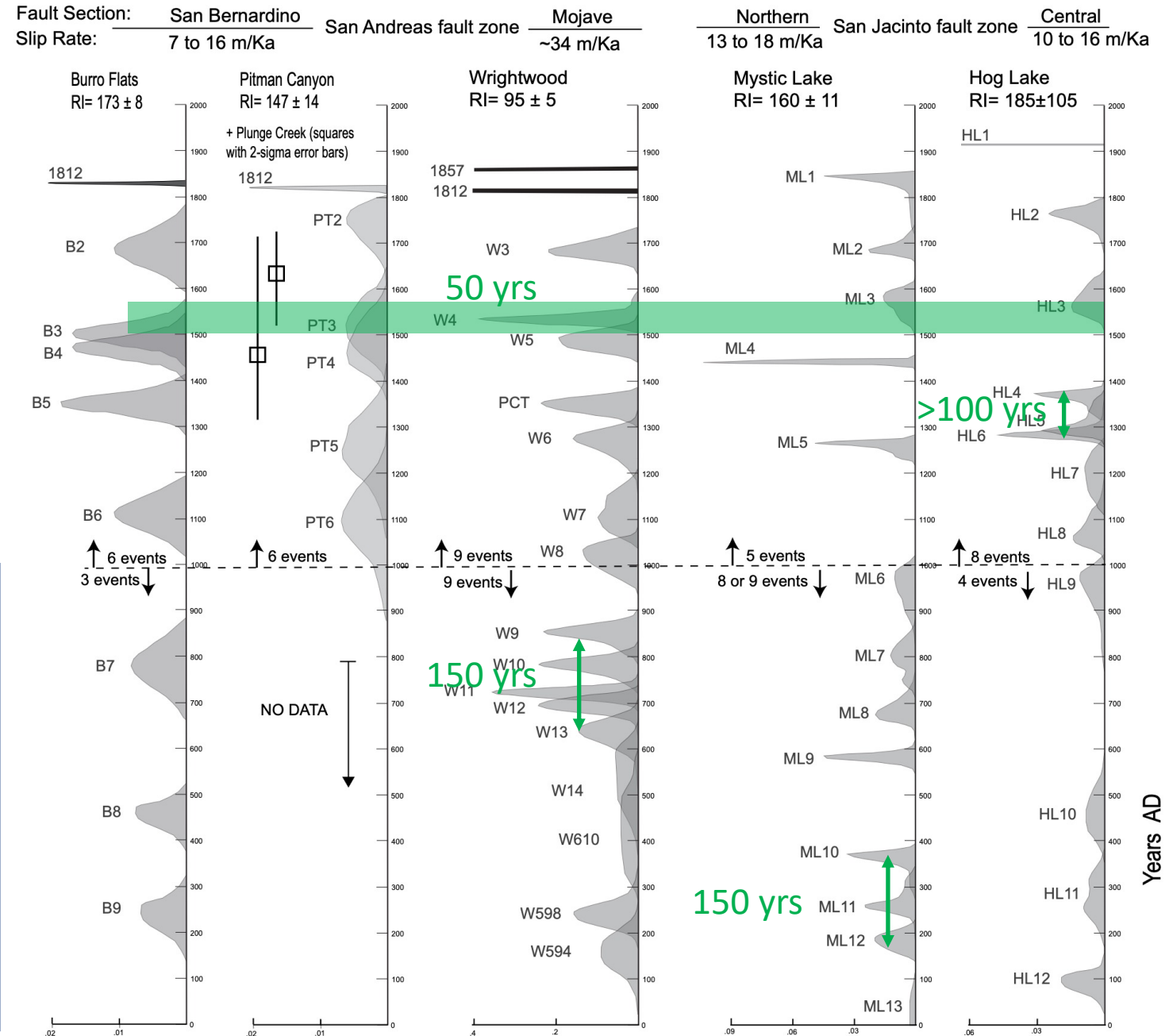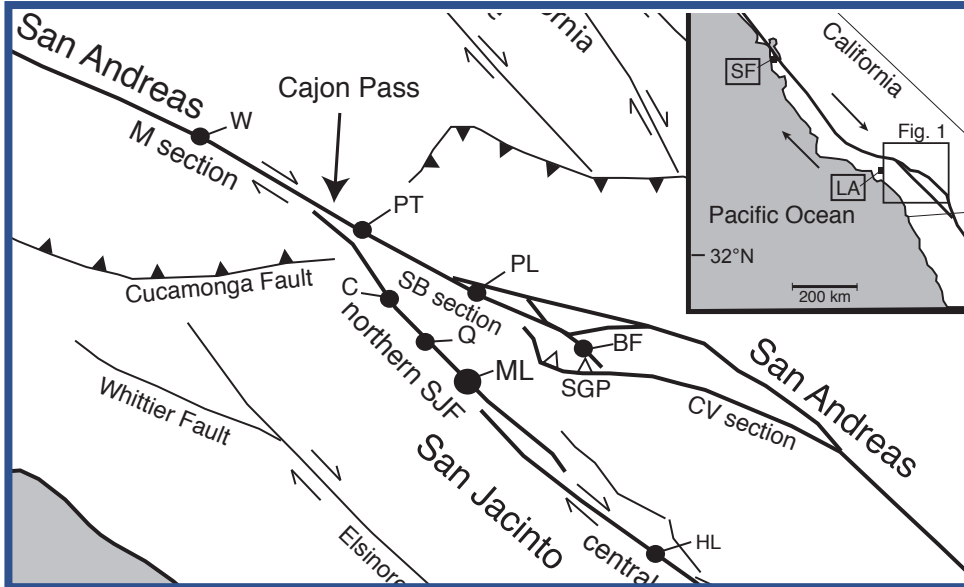But surface ruptures are not regular

However, there are periods where we see
multiple events during a short period of time.

We probably have a better chance of catching
a rupture "cascade" (Scharer and Yule, 2020)
than we do of not catching anything
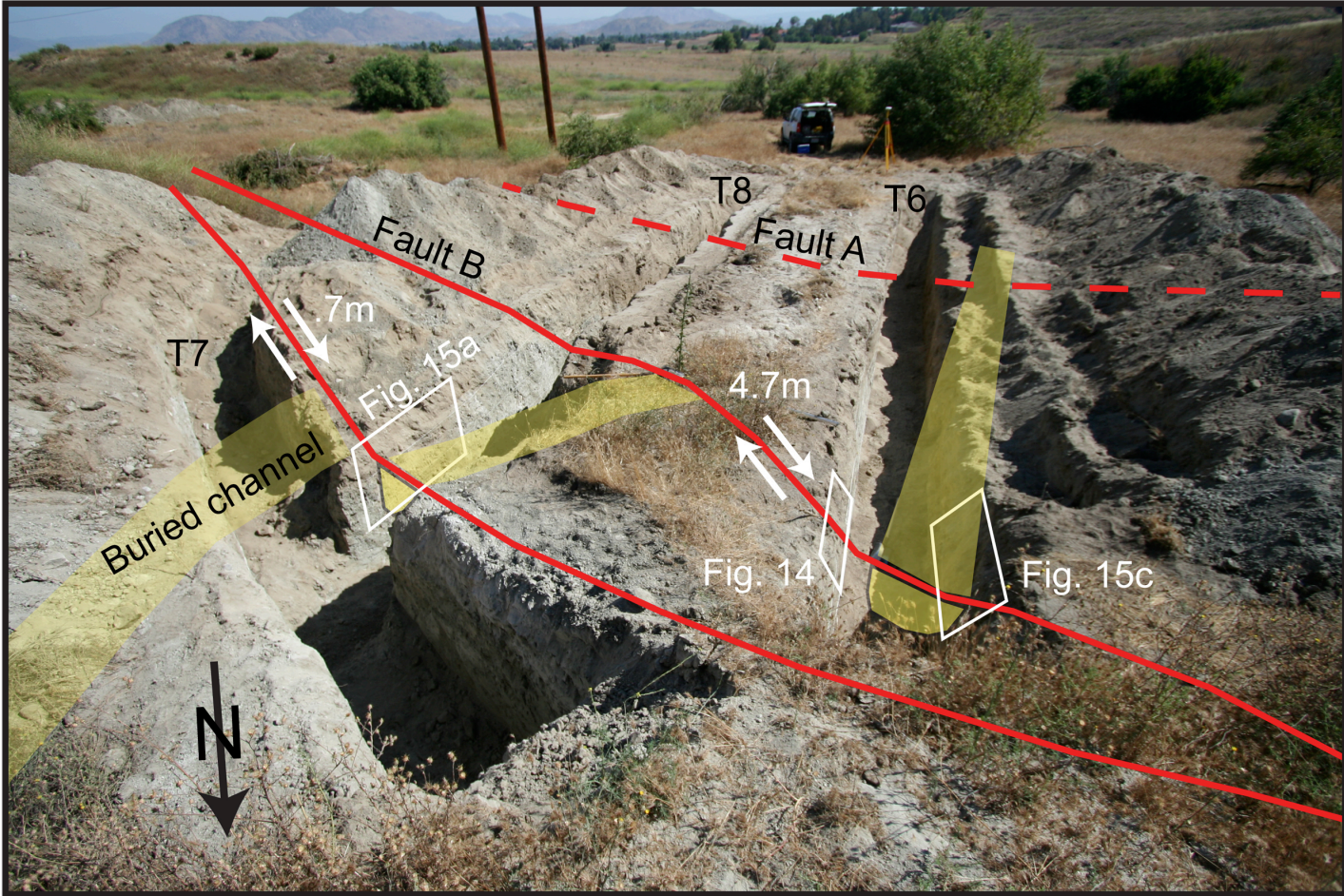

Onderdonk et al., 2018

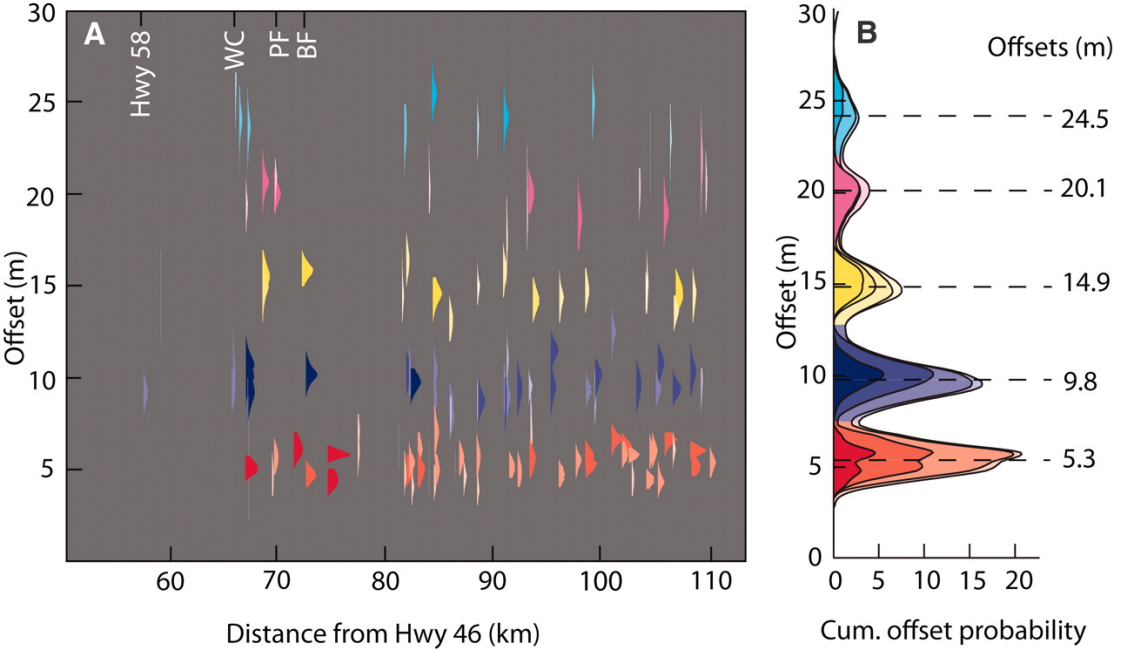# What an (one) Earthquake Geologist would like to get from this project:

1. What is the ratio of co-seismic slip to afterslip?

   Are we over-estimating earthquake magnitudes?

Offset buried channel used to calculate slip-per-event   (Onderdonk et al., 2015)

Offsets on central SAF (Zielke et al., 2010)

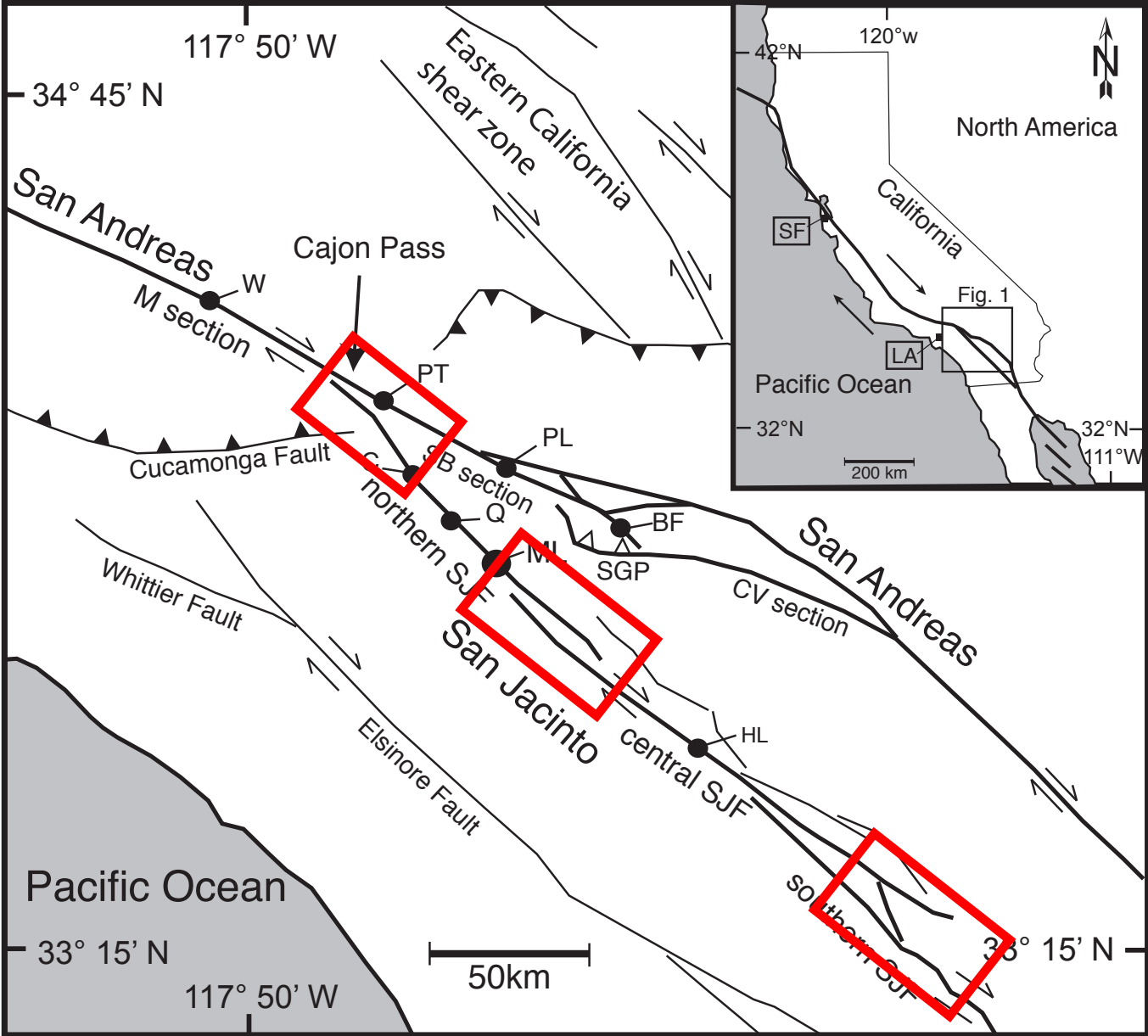# What an (one) Earthquake Geologist would like to get from this project:

1. What is the ratio of co-seismic slip to afterslip?

2. How much do the secondary faults and smaller faults contribute to overall strain?

Mystic Lake trench log. Note main and secondary fault zones
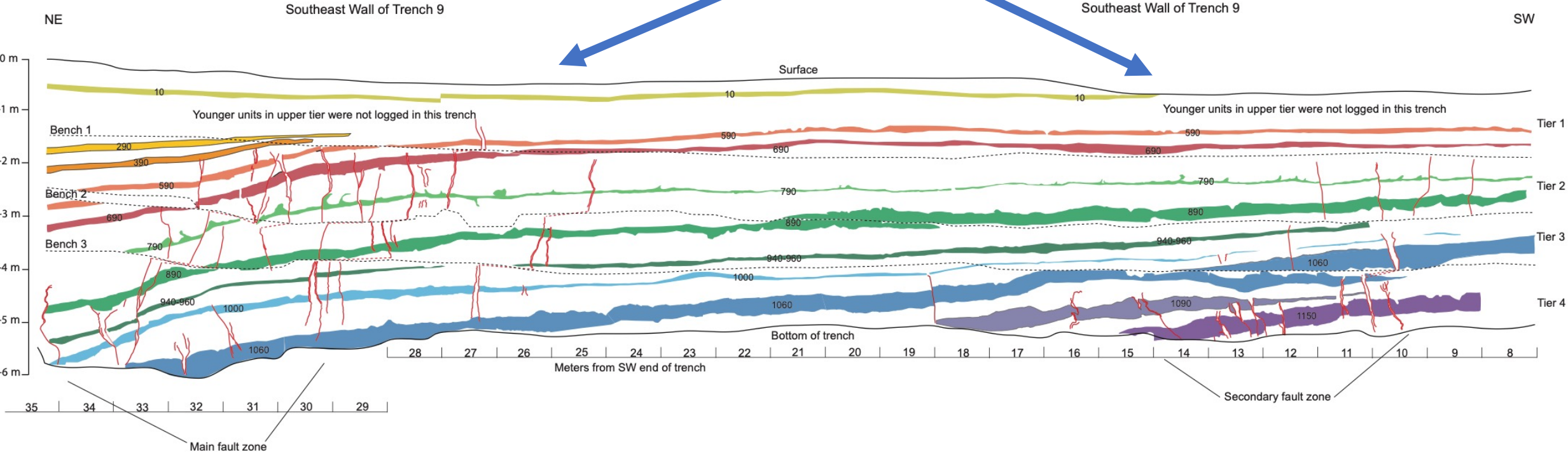
Onderdonk et al., 2018

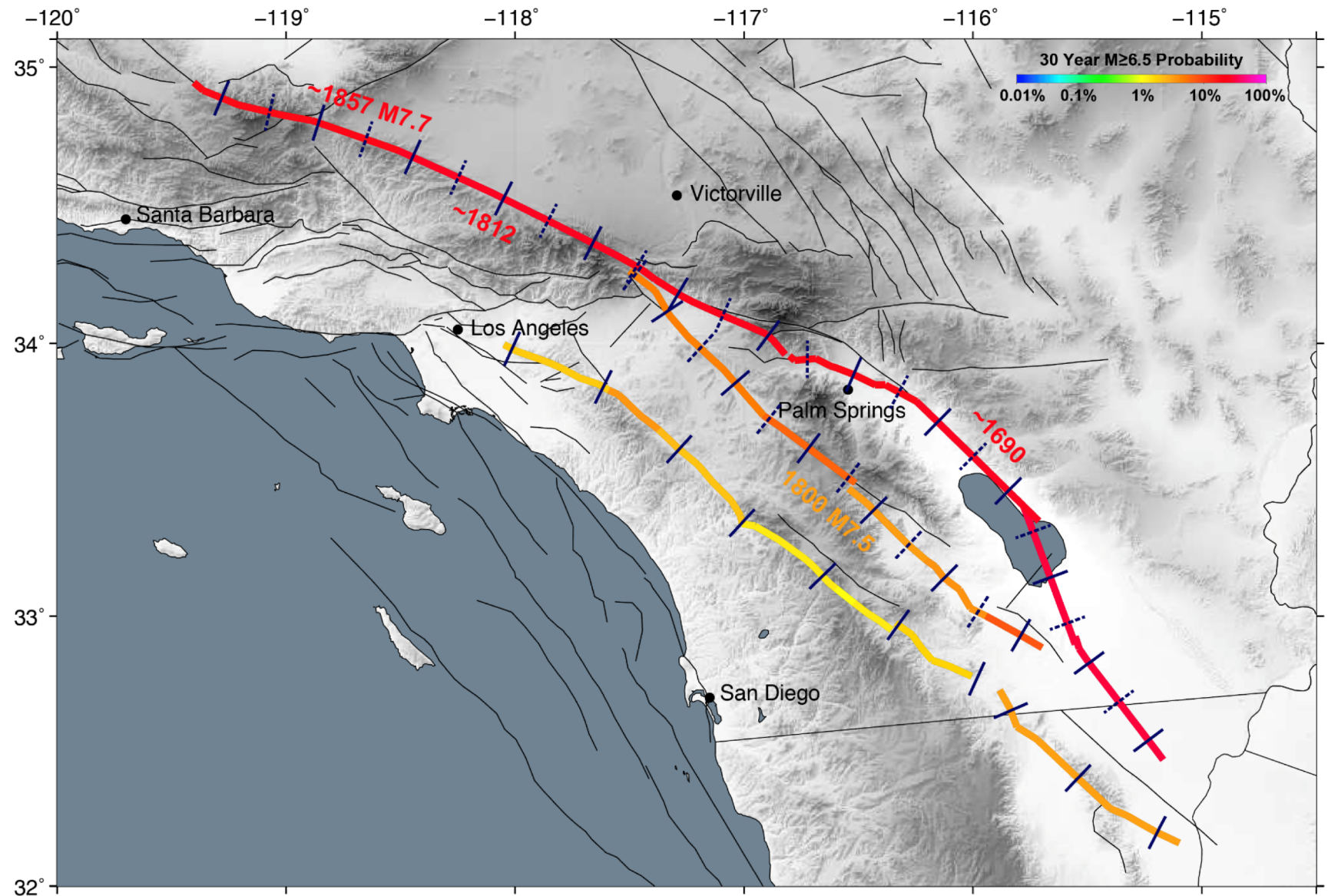# What an (one) Earthquake Geologist would like to get from this project:

1. What is the ratio of co-seismic slip to afterslip?

2. How much do the secondary faults contribute?

3. How do ruptures move through step-overs?
   1. How segmented are these fault zones?

What an (one) Earthquake Geologist would like to see in the project design:

1. Put the arrays in interesting locations. (Not evenly spaced).

What an (one) Earthquake Geologist would like to see in the project design:

1. Put the arrays in interesting locations. (Not evenly spaced).

   -Step-overs
   -Bifurcation (trifurcation) points
   -Parallel strands
   -One or two at well-studied trench sites
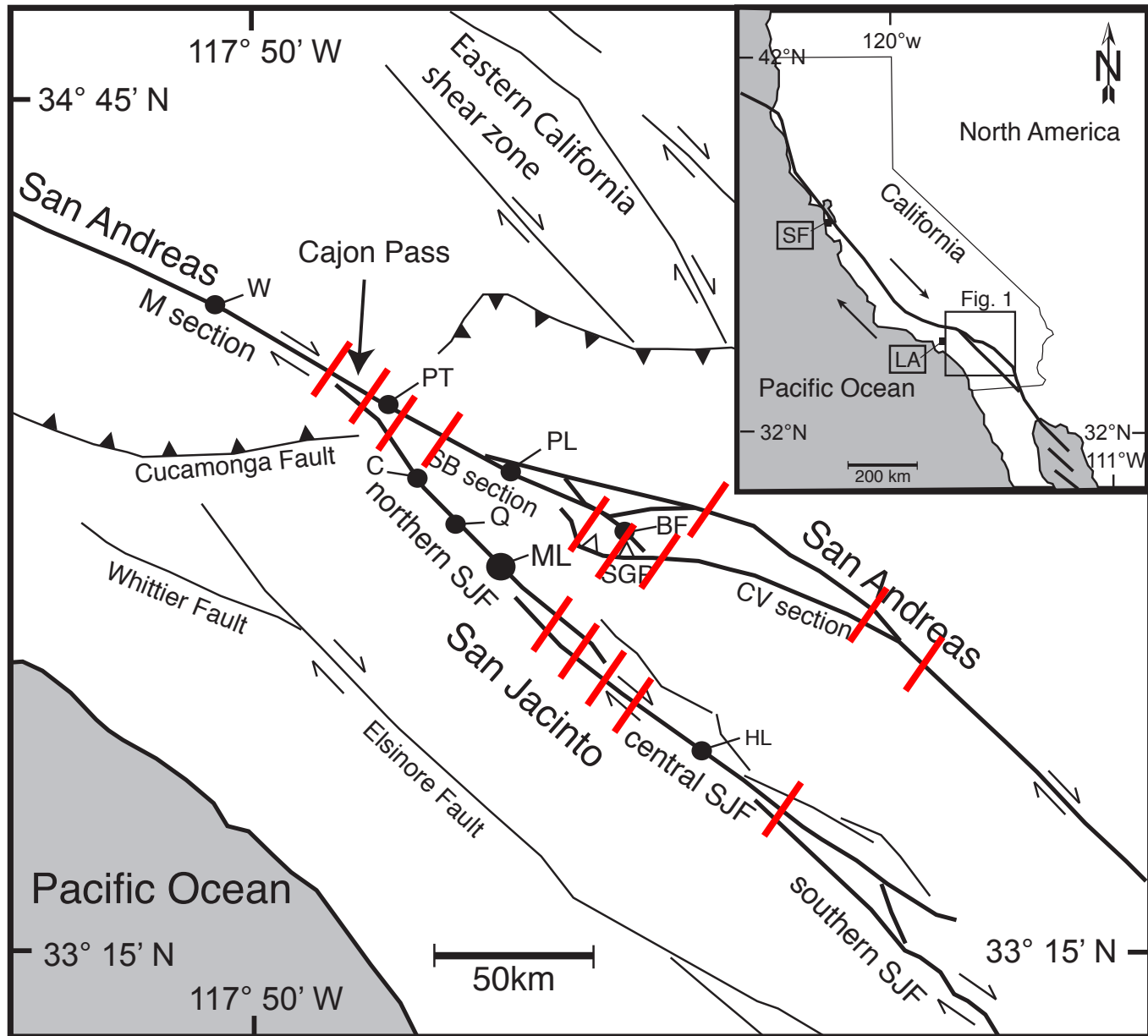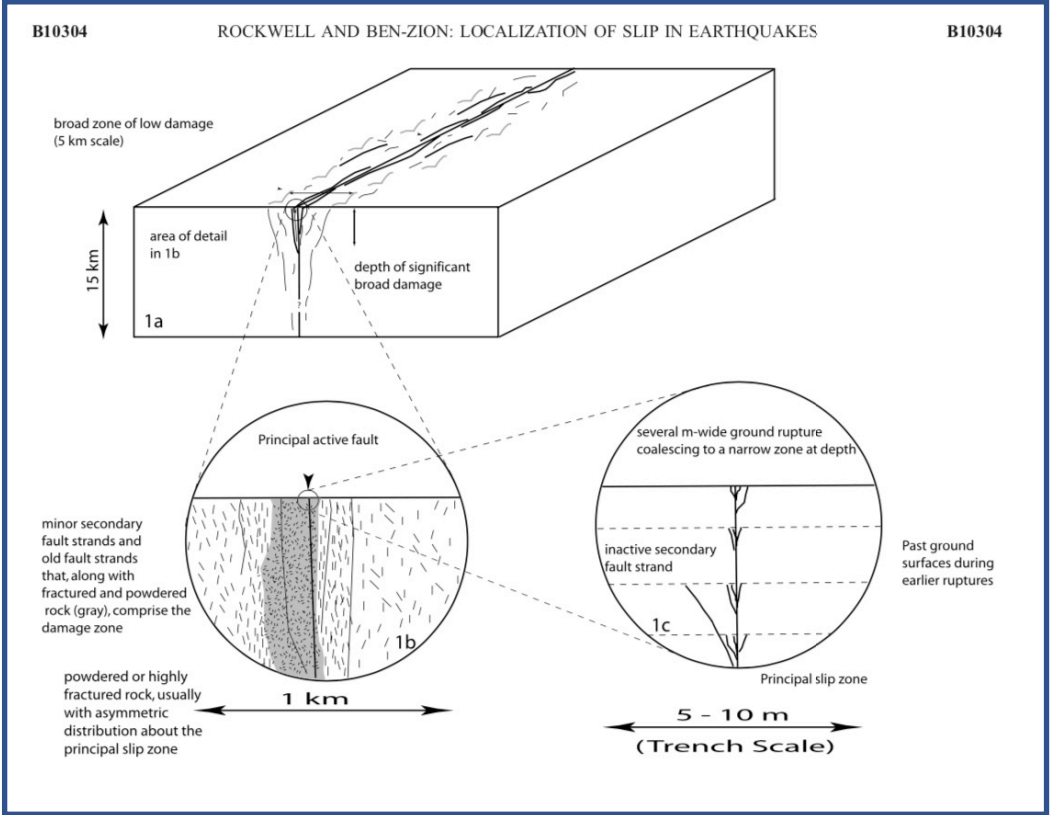   (Wrightwood, Hog Lake, Mystic Lake

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   -Step-overs
   -Bifurcation (trifurcation) points
   -Parallel strands
   -One or two at well-studied trench sites (Wrightwood, Hog Lake, Mystic Lake
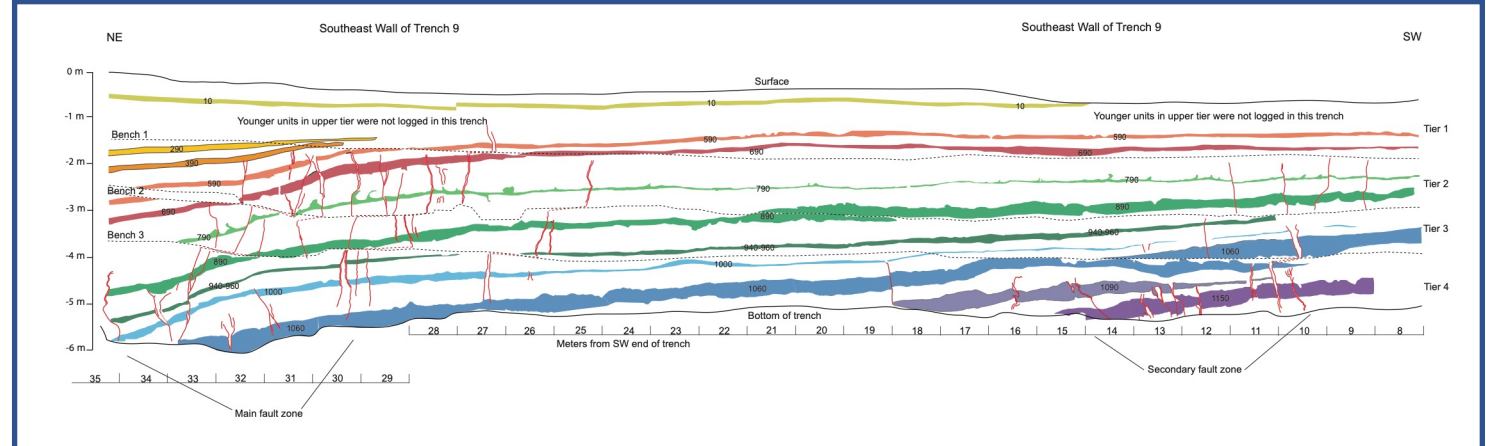
2. Let location dictate width

   -wide arrays at steps and splits
   -narrower arrays are fine for simple segments

   -"mature" faults may have very narrow rupture zones (mm - cm) , whereas evolving faults may have 10's of meters wide zones

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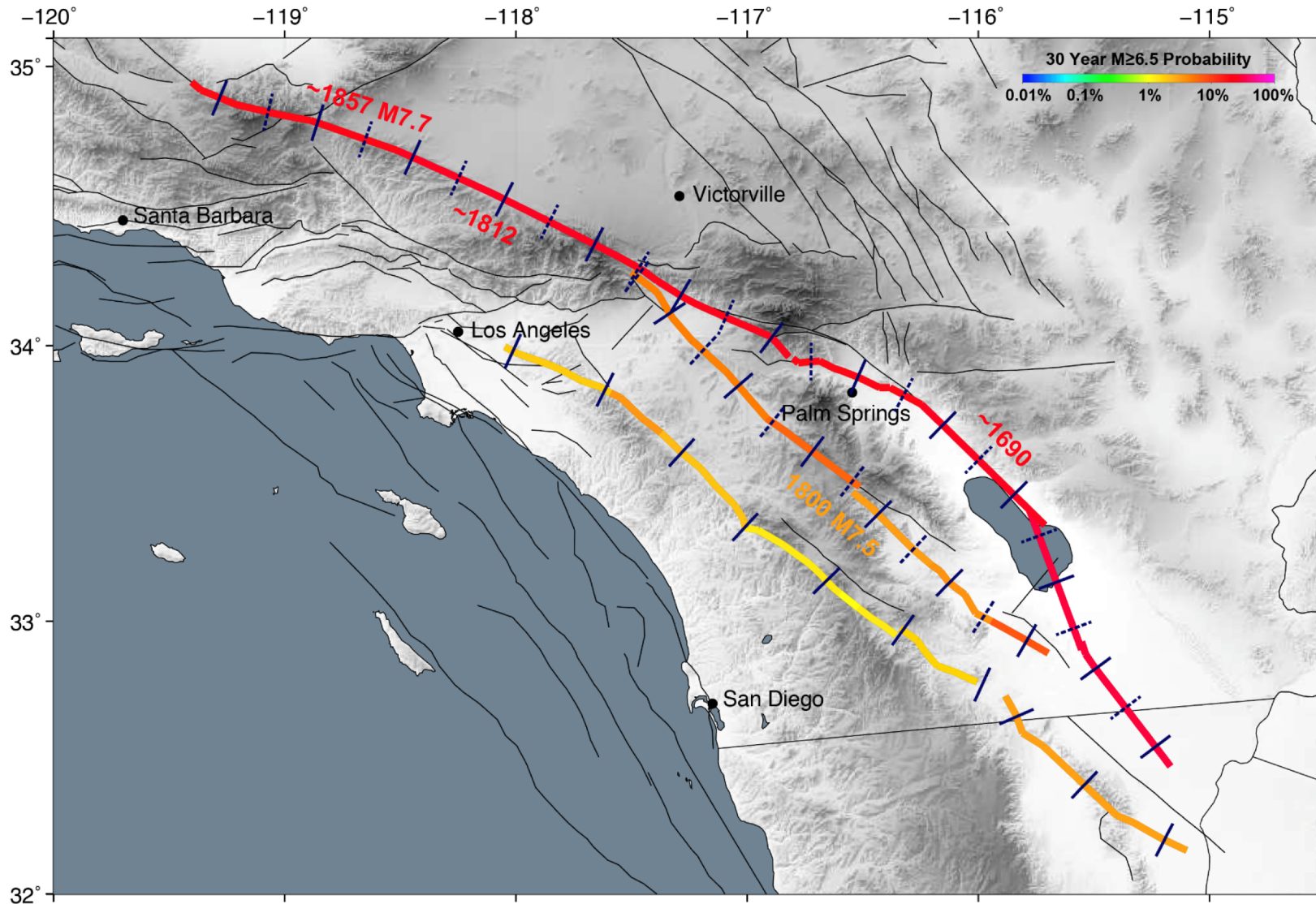
Slip Rates
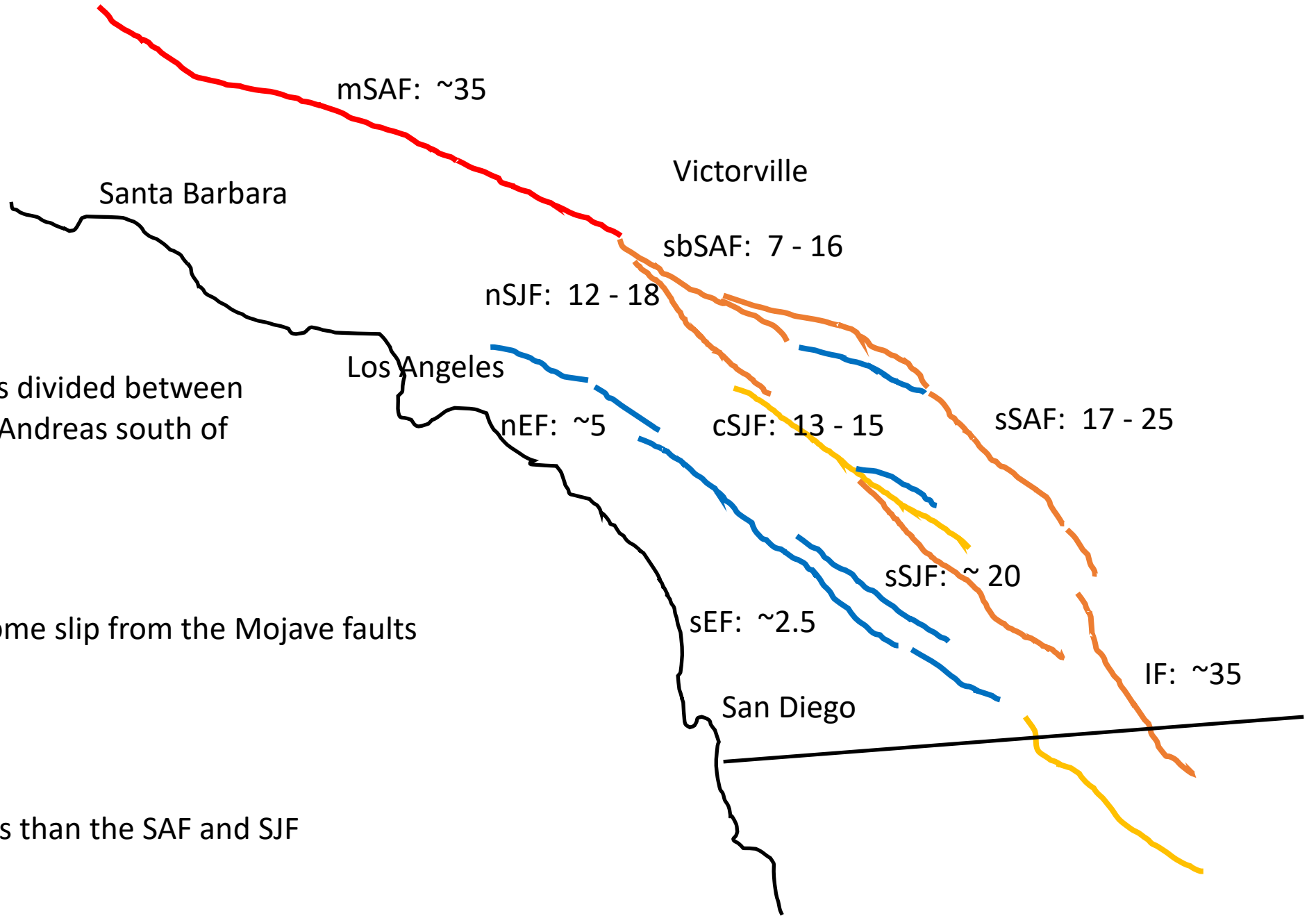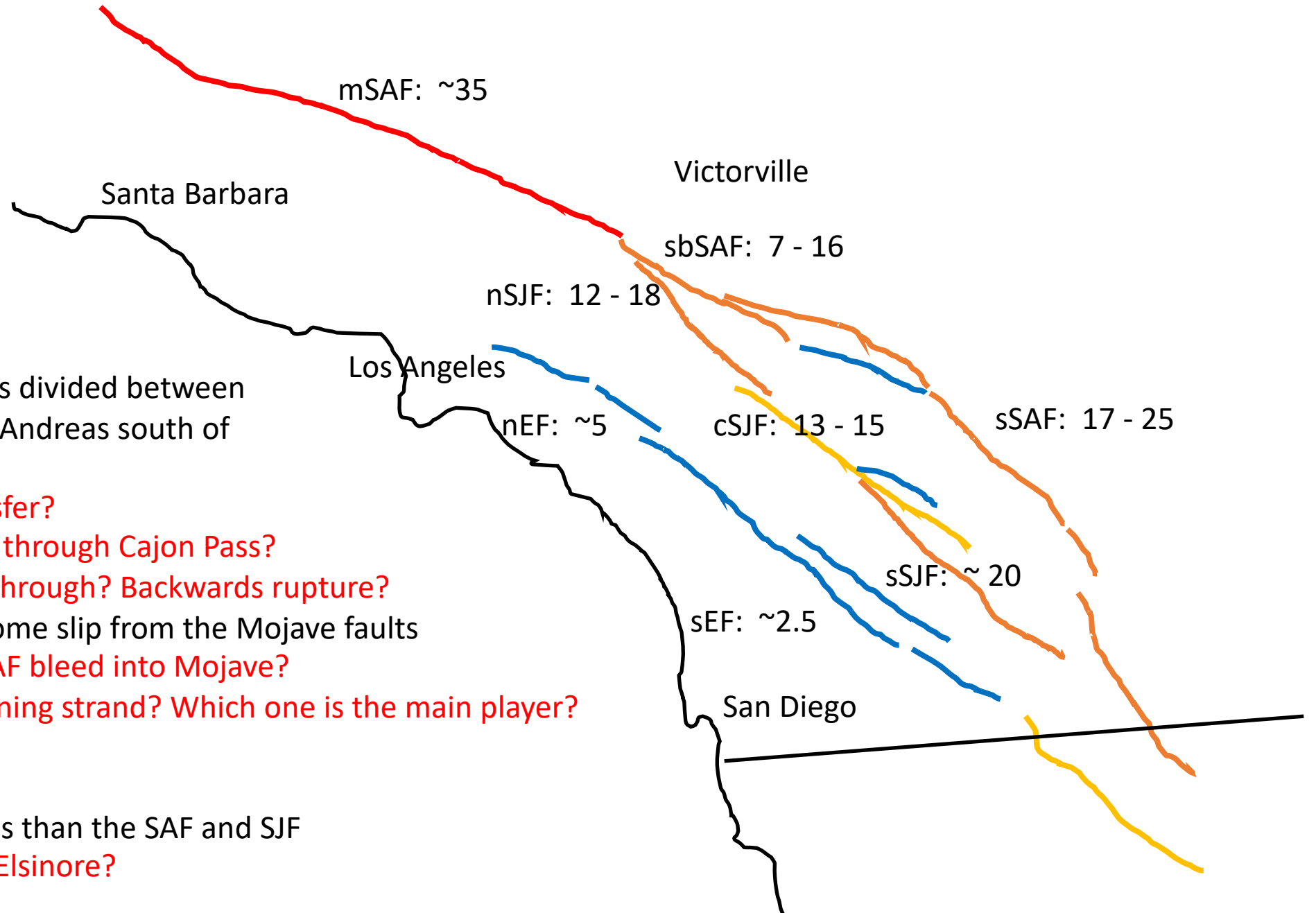

Some observations:

Mojave SAF (mSAF) slip is divided between
The San Jacinto and San Andreas south of
Cajon Pass.

Southern SAF picks up some slip from the Mojave faults

Elsinore rate is 1/3 or less than the SAF and SJF

mSAF: ~35

Santa Barbara

Victorville

sbSAF: 7 - 16

nSJF: 12 - 18

Los Angeles

nEF: ~5

cSJF: 13 - 15

sSAF: 17 - 25

sSJF: ~ 20

sEF: ~2.5

San Diego

IF: ~35

Slip Rates

mSAF: ~35

Santa Barbara

Victorville

sbSAF: 7 - 16

nSJF: 12 - 18

Los Angeles

Some **Questions**:

Mojave SAF (mSAF) slip is divided between
The San Jacinto and San Andreas south of
Cajon Pass.
- Where does slip transfer?
- How does rupture go through Cajon Pass?
  - Jump? Rupture through? Backwards rupture?

Southern SAF picks up some slip from the Mojave faults
- Would rupture on sSAF bleed into Mojave?
- Mission Creek or Banning strand? Which one is the main player?

Elsinore rate is 1/3 or less than the SAF and SJF
- Should we include the Elsinore?

nEF: ~5

cSJF: 13 - 15

sSAF: 17 - 25

sSJF: ~ 20

sEF: ~2.5

San Diego