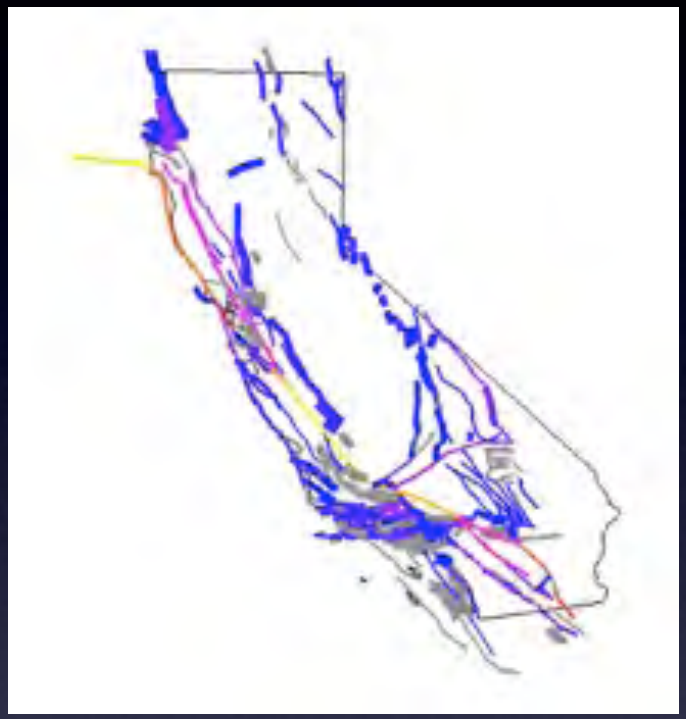
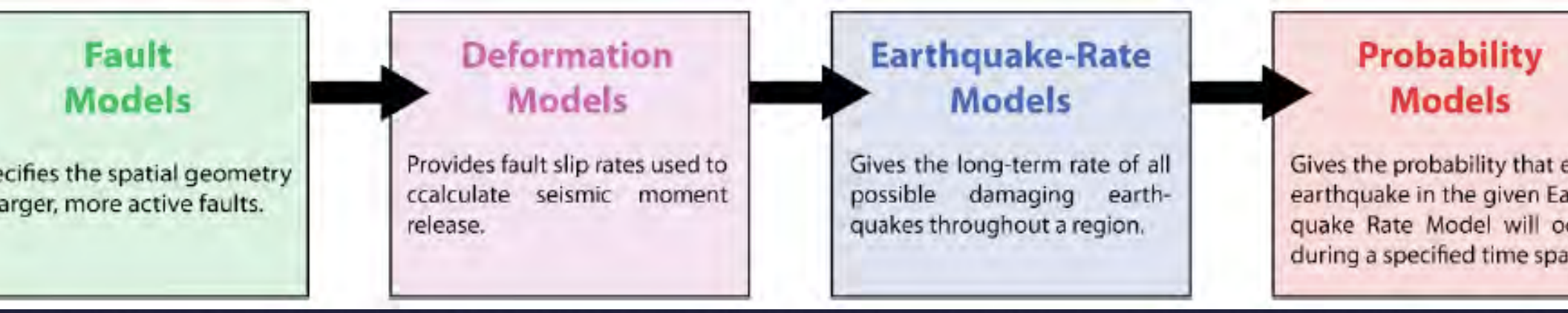
UCERF3:
ew Fault Models and Geologic Slip Rat



Tim Dawson (California Geological Survey)
Ray Weldon (University of Oregon)

Workshop on Use of UCERF3 in the USGS National Seismic Hazard Map
October 17 - 18

UCERF3 Fault Model

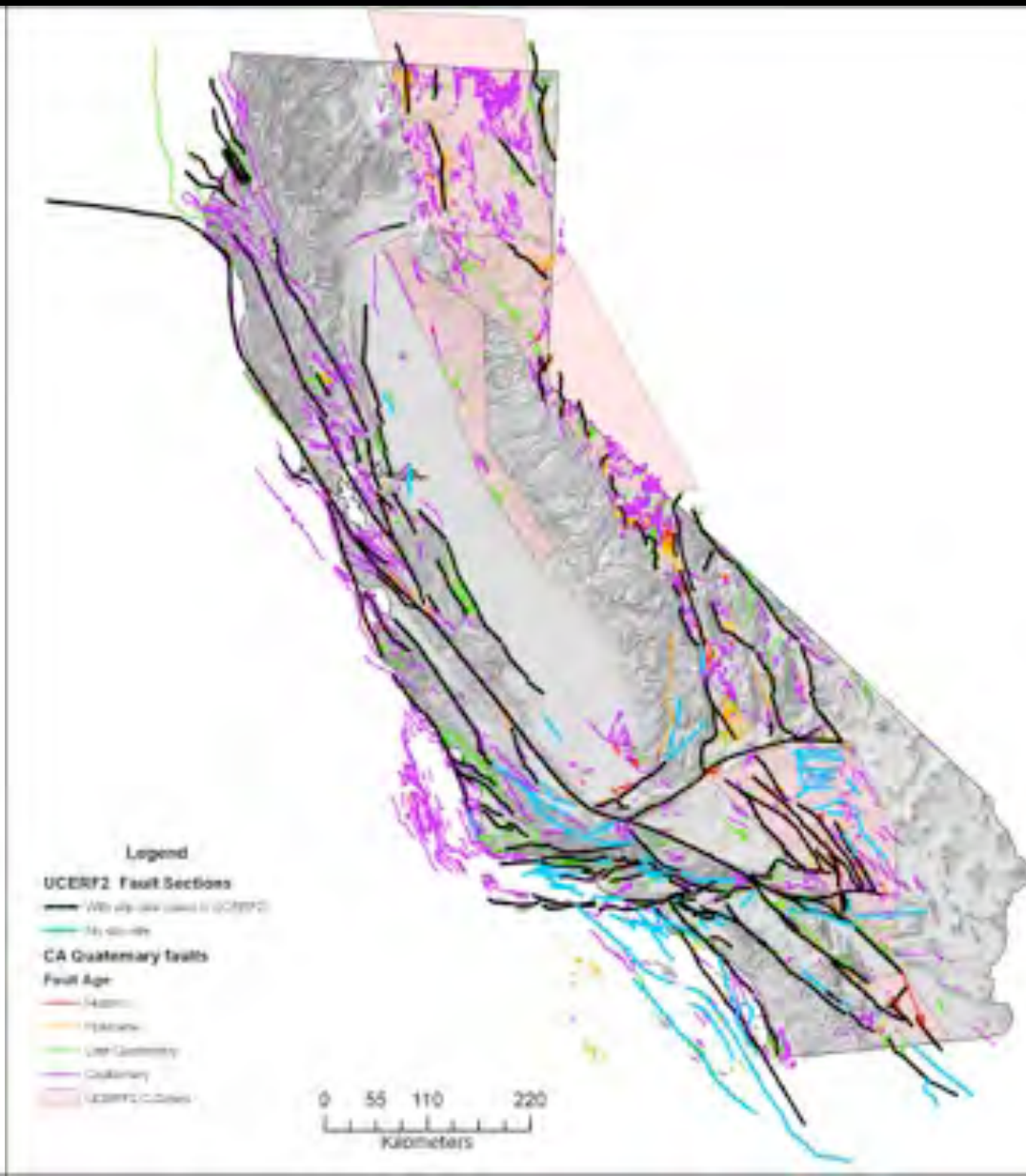


Fault parameter database stores:

- Latitude-longitude coordinate pairs of fault trace
- Upper and lower depth
- Average dip
- Rake
- Fault zone width (new parameter for UCERF3)

UCERF2 Fault Model

UCERF2 faults

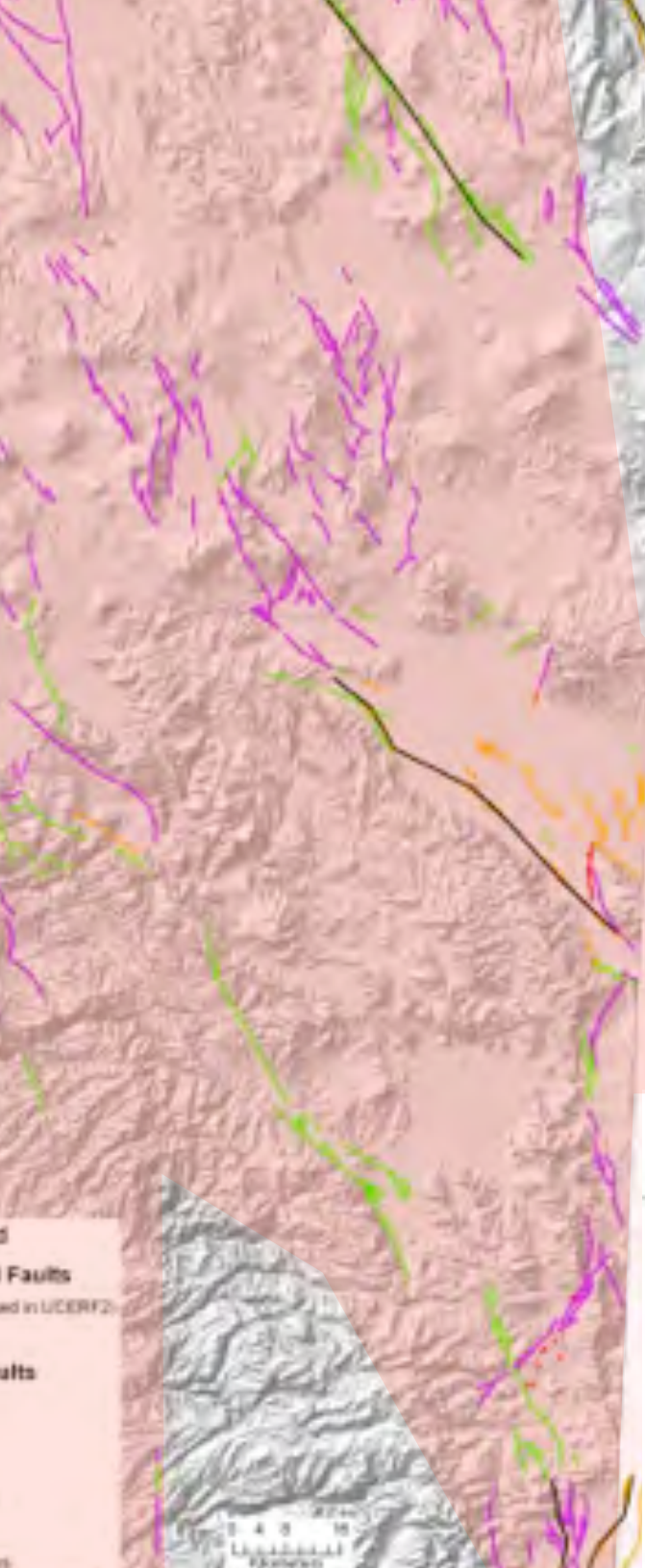


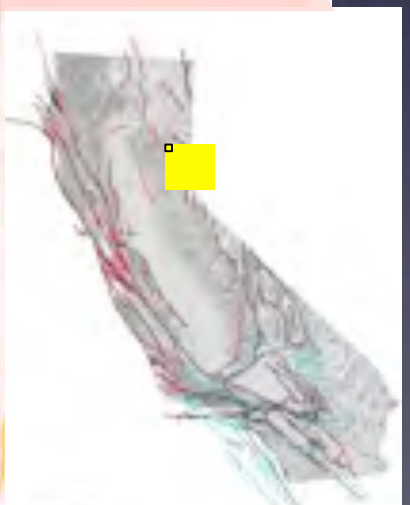
UCERF2 faults
(relative to mapped Quaternary fault

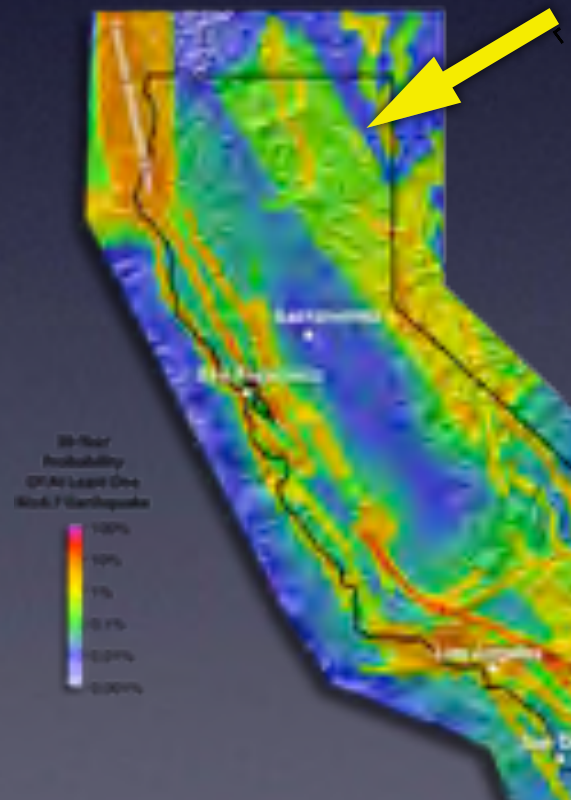
distributed shear, where known geologic slip rates don’t add up the geodetic rate across the regi

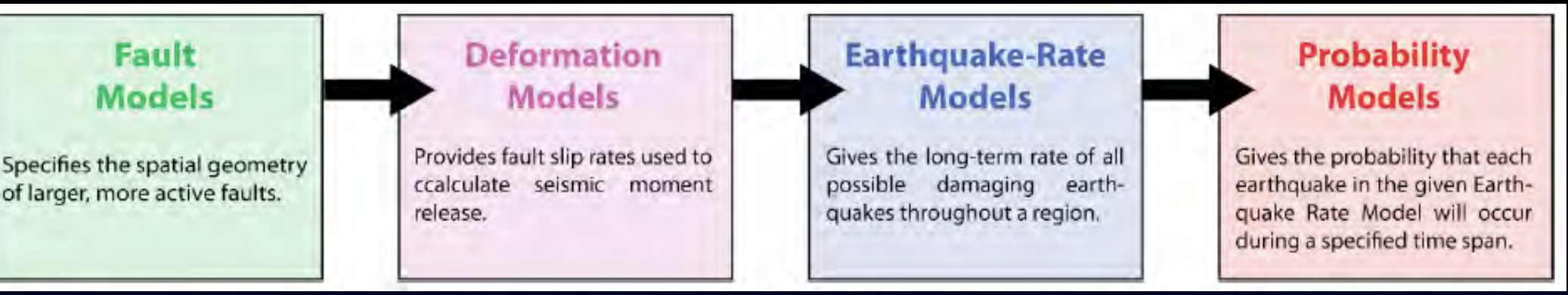
Also, areas have mapped faults unknown geologic slip rates.

Use of C-zones produced notice artifacts UCERF2 model









ates include:

ration of additional faults and revision of existing faults from rece
es.

ration of the Statewide Community Fault Model (SCFM) into the
RF3 fault model.

elopment of a geologically-based block model for geodesy-based
rmation models.

valuation of fault endpoints (for fault to fault jumps).

involves the
ion of SCFM rectilinear
ntations into UCERF
rameter database

s more detailed
ntation of faults used
RF2, plus additions to
ventory

dditions prioritized
on location of block
ries used by
ation modelers

onsiders potential fault
tions for fault to fault

	Clayton	Block boun
	Contra Costa Shear Zone	Block boun
	Franklin	Block boun
	Joy Woods	Block boun
	Las Positas	Block boun
	Nacimiento	Block boun
	Pilarcitos	Block boun
	Southhampton	Block boun
	Alexander Redwood	Connect
	Bennett Valley	Connect
	Mission	Connect
S. Coast Ranges/San Joaquin Valley		
	2003 San Simeon earthquake/Oceanic flt	Block boun
	East Huasna	Block boun
	La Panza	Block boun
	San Luis Range-W Huasna	Block boun
	San Luis Range-W Huasna/Avila Beach	Block boun
	San Luis Range-W Huasna/Oceano	Block boun
	San Luis Range-W Huasna/Olson	Block boun
	San Luis Range-W Huasna/Pecho	Block boun
	San Luis Range-W Huasna/San Luis Range	Block boun
	San Luis Range-W Huasna/Wilmar Ave	Block boun
	San Benito	Connect
N. Coast Ranges/Sacramento Valley		
	Briceland	Block boun
	Eaton Roughs	Block boun
	King Range	Block boun
	Spenceville	Block boun
	Swain Ravine	Block boun
	Wight Way	Connect
Cascadia/Klamath Mountains		
	Rocky Ledge	Block boun
	Russ Faultzone	Block boun

rn California faults
ewide Community
lodel (SCFM)

representations
lly accepted “as
dips averaged for
lt sections

tions include
the SCFM fault is
tailed than the
F2 modeled fault
me individual
ons on a case by
asis.

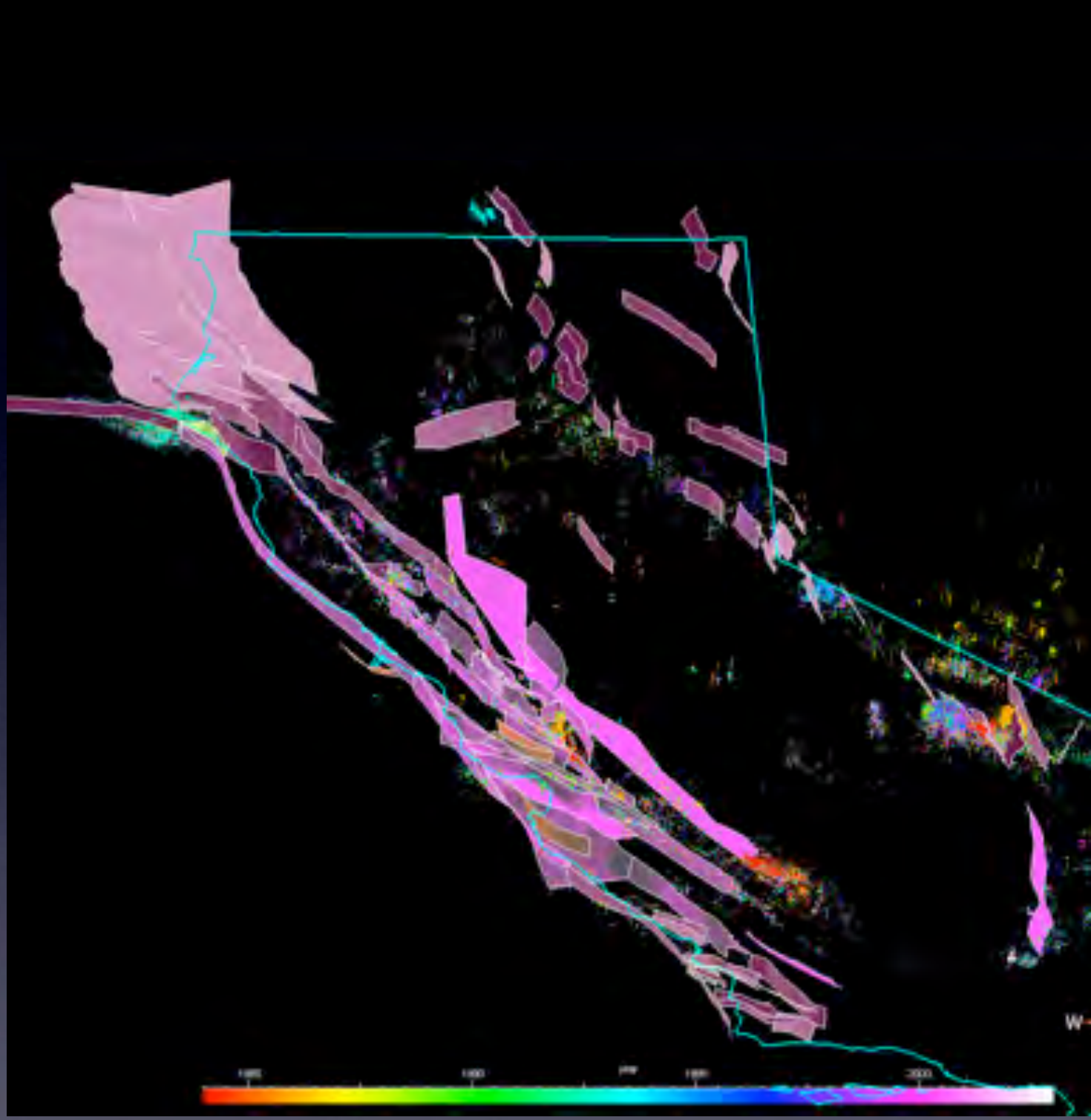


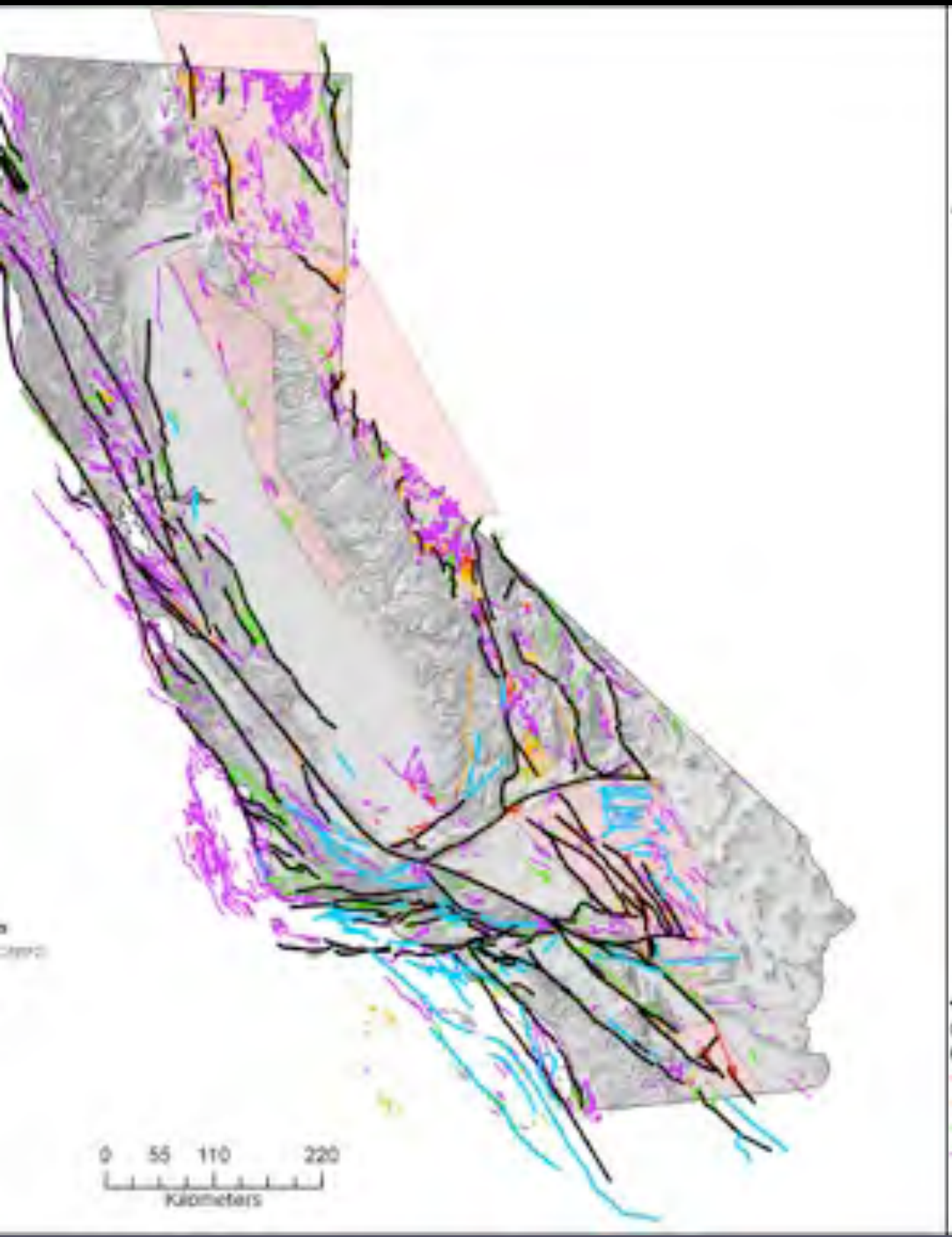
Image courtesy of Andreas Plesch (Harvard U.)

UCERF3 Block Model

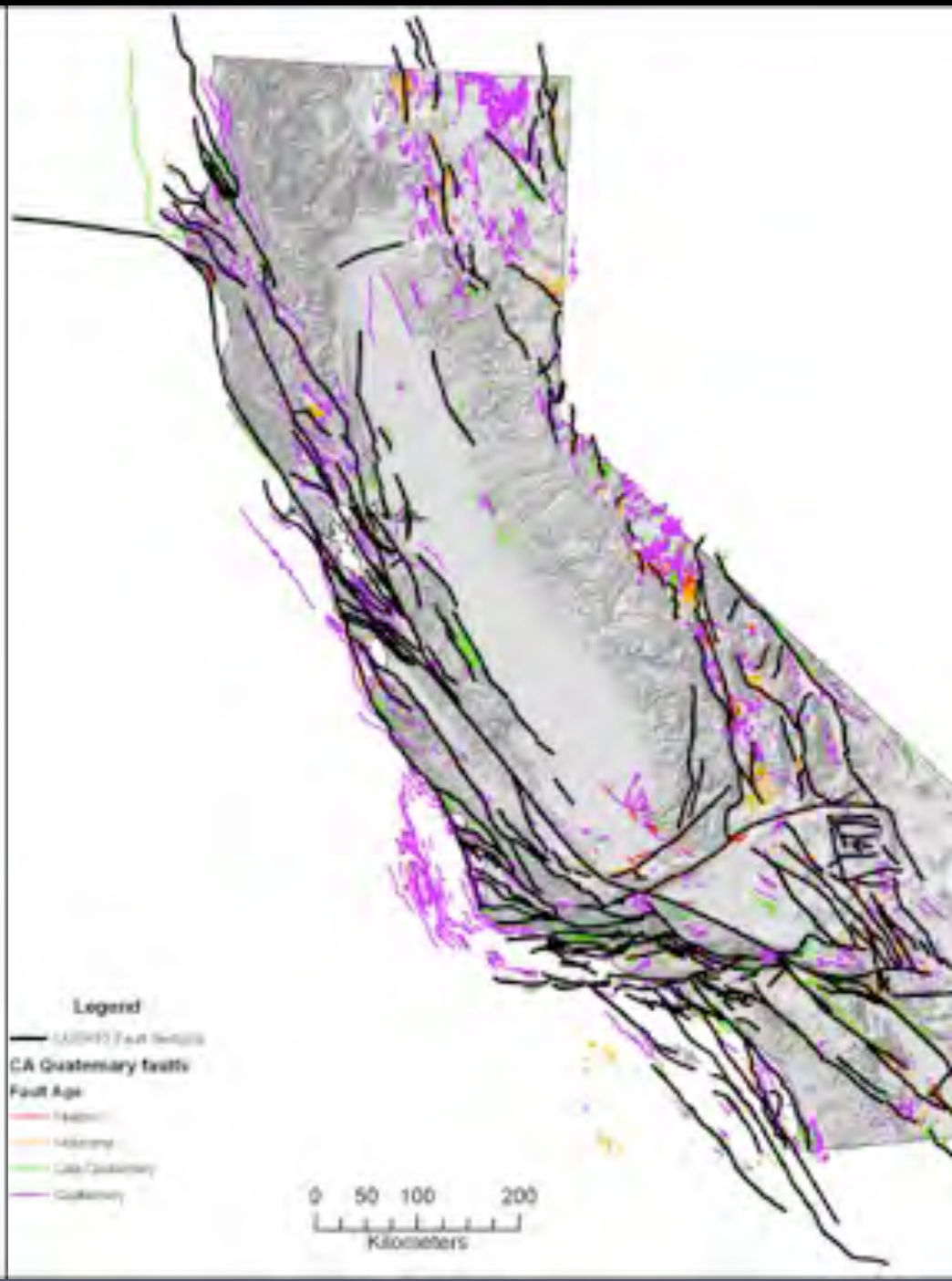
eodesy-based block
mation models, a
vide block model
efined by the
gists and
cists.

boundaries were
ally defined by
ng the major, most
faults, as well as
Quaternary-active
and fault zones.

UCERF2

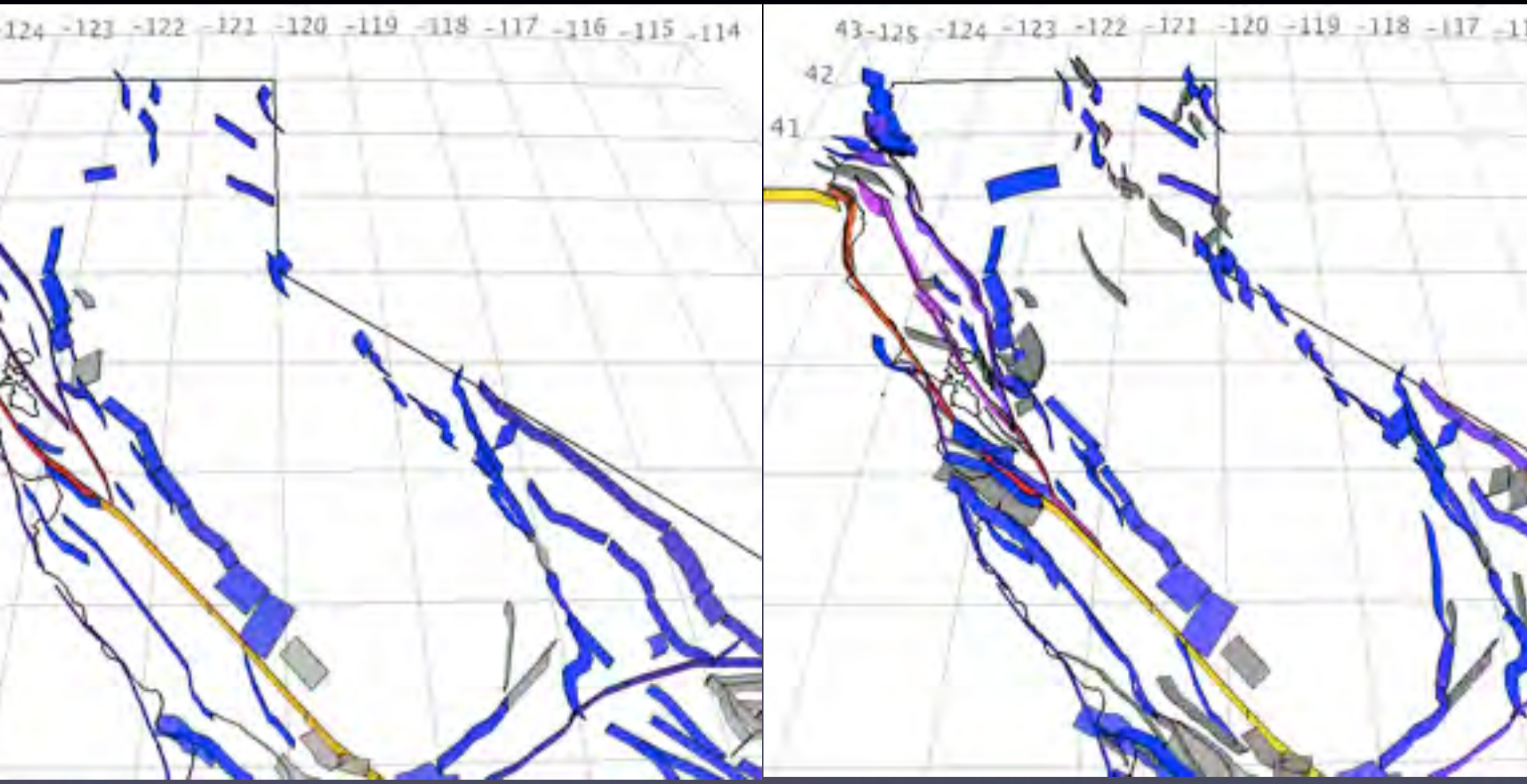


UCERF3



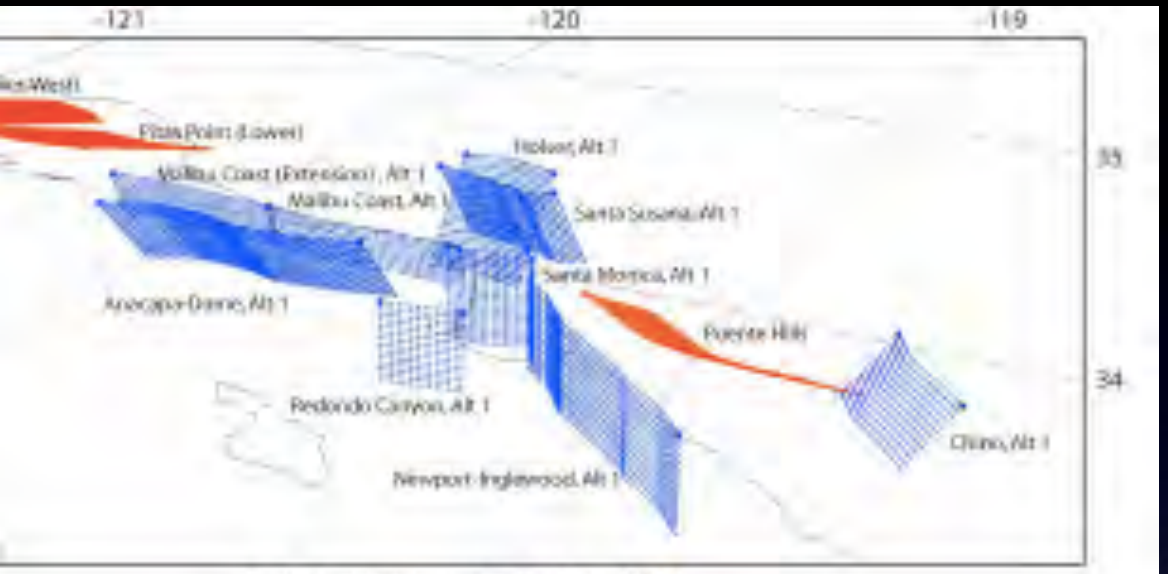
UCERF2

UCERF3

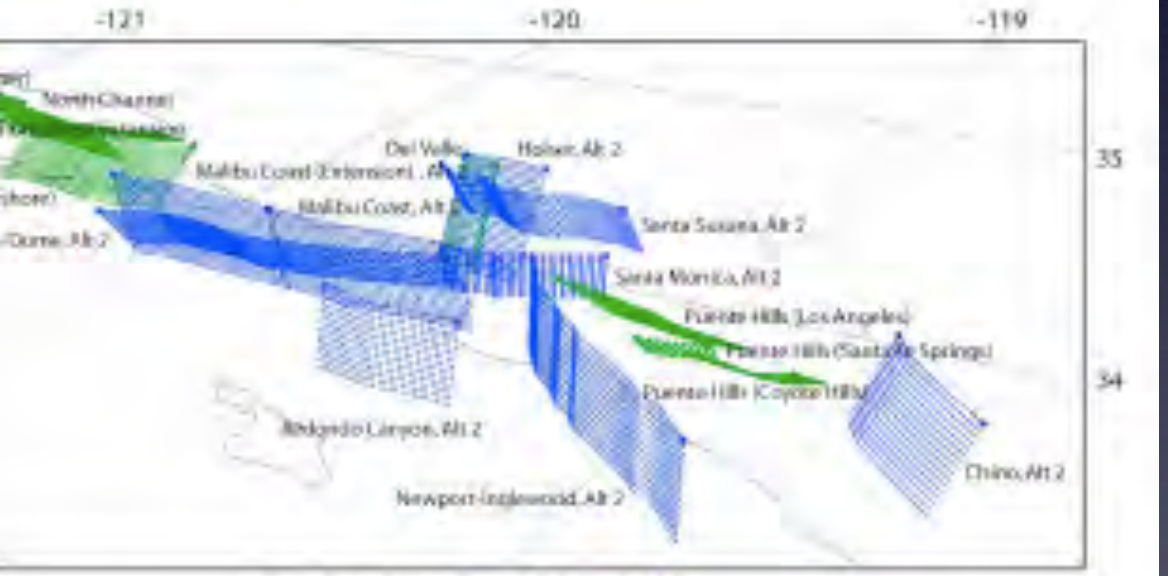


Perspective view of fault sections in northern California

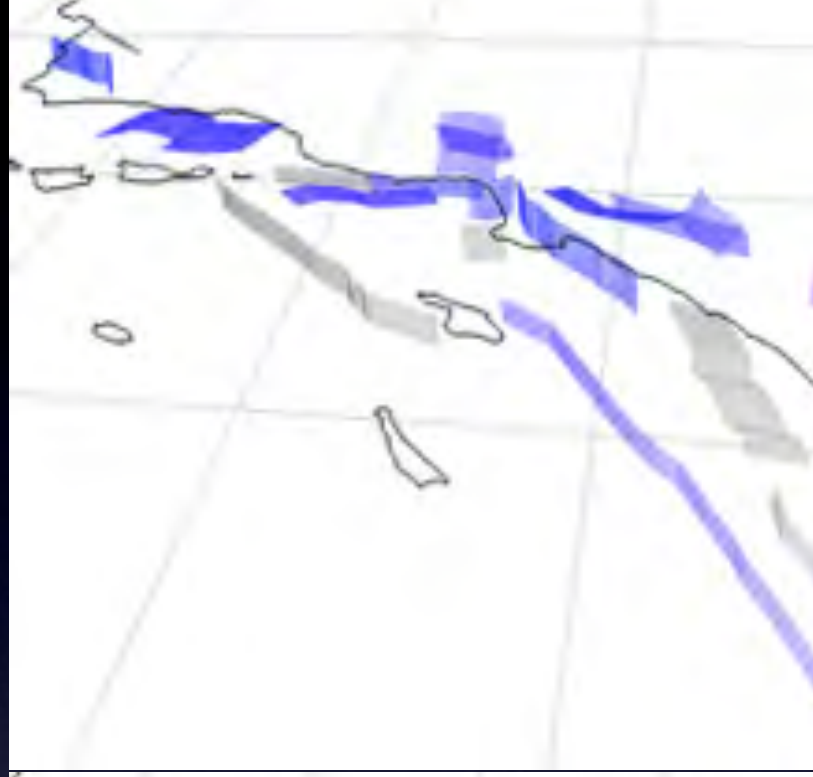
ternative fault models

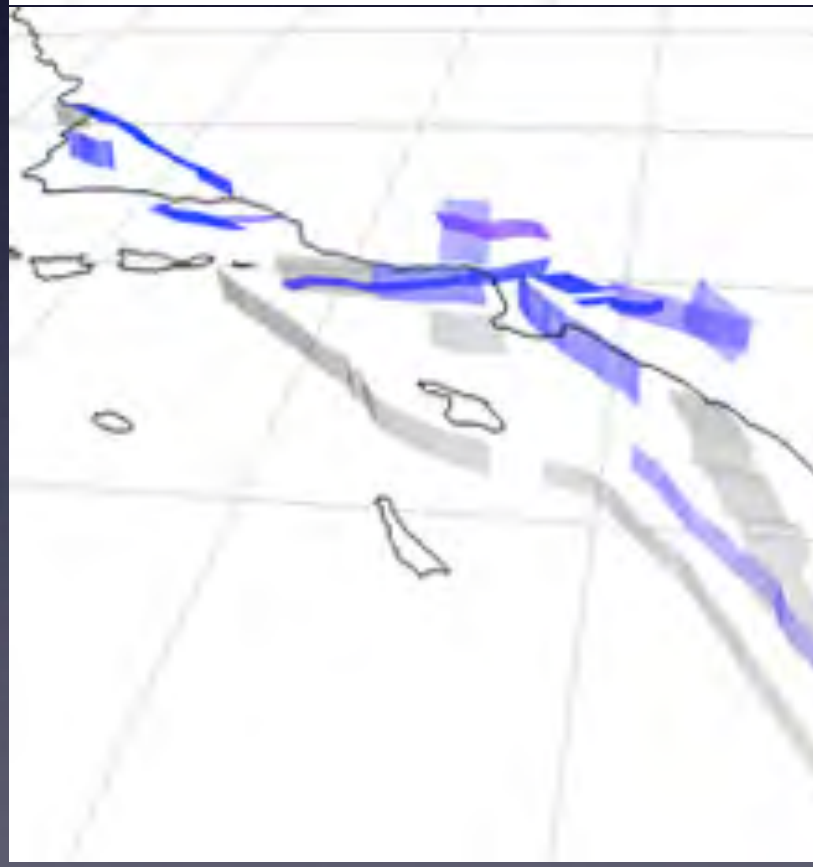


Fault Sections Unique to Fault Model 2.1



Fault Sections Unique to Fault Model 2.2





retains alternative fault models developed in

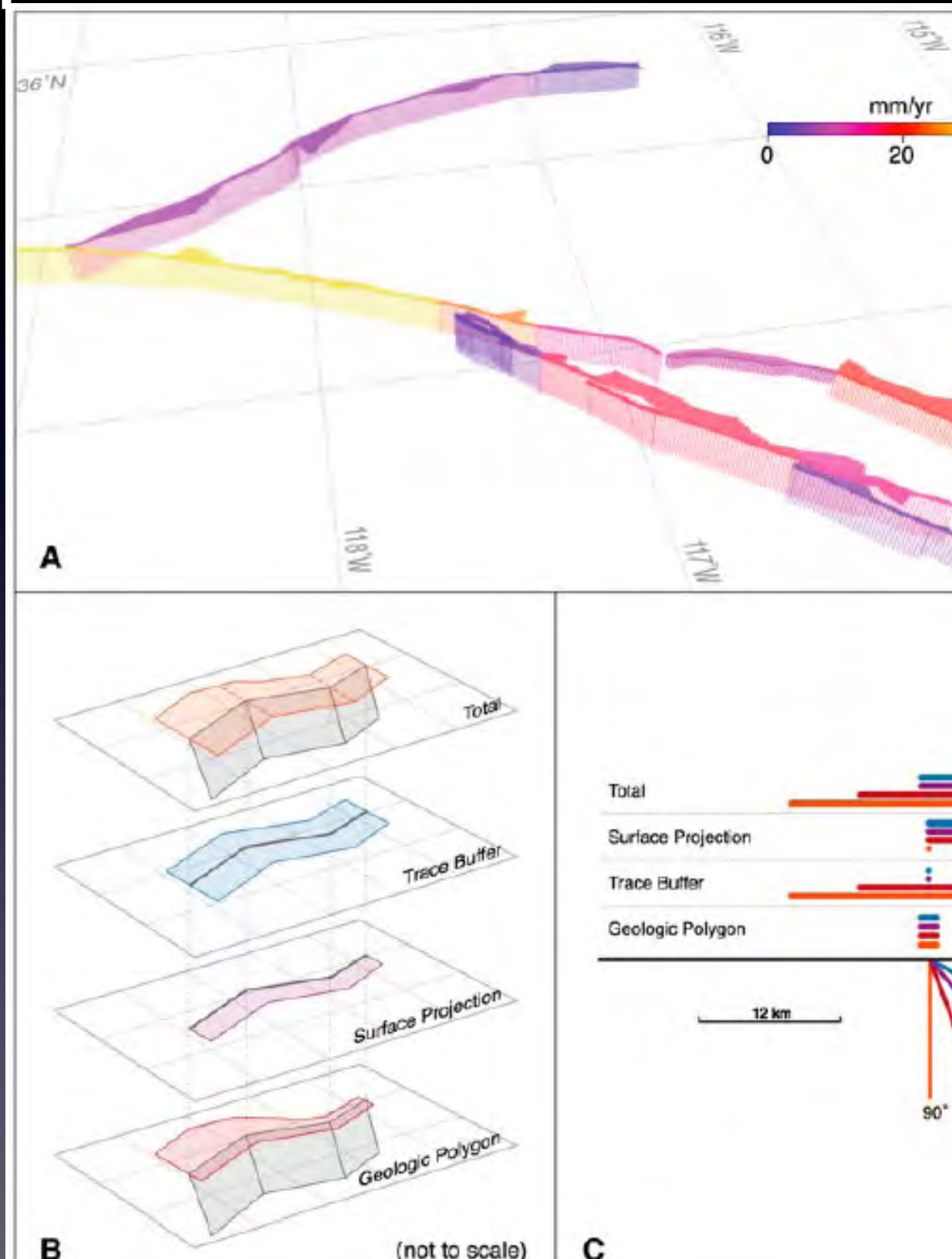
es whether fault section
ple surface, or a braided
of related faults

er which the
ation model rate applies

o which micro-
ty is applied

er which elastic
d-based probability
ons are applied

ment of future ruptures to
RF3 modeled fault



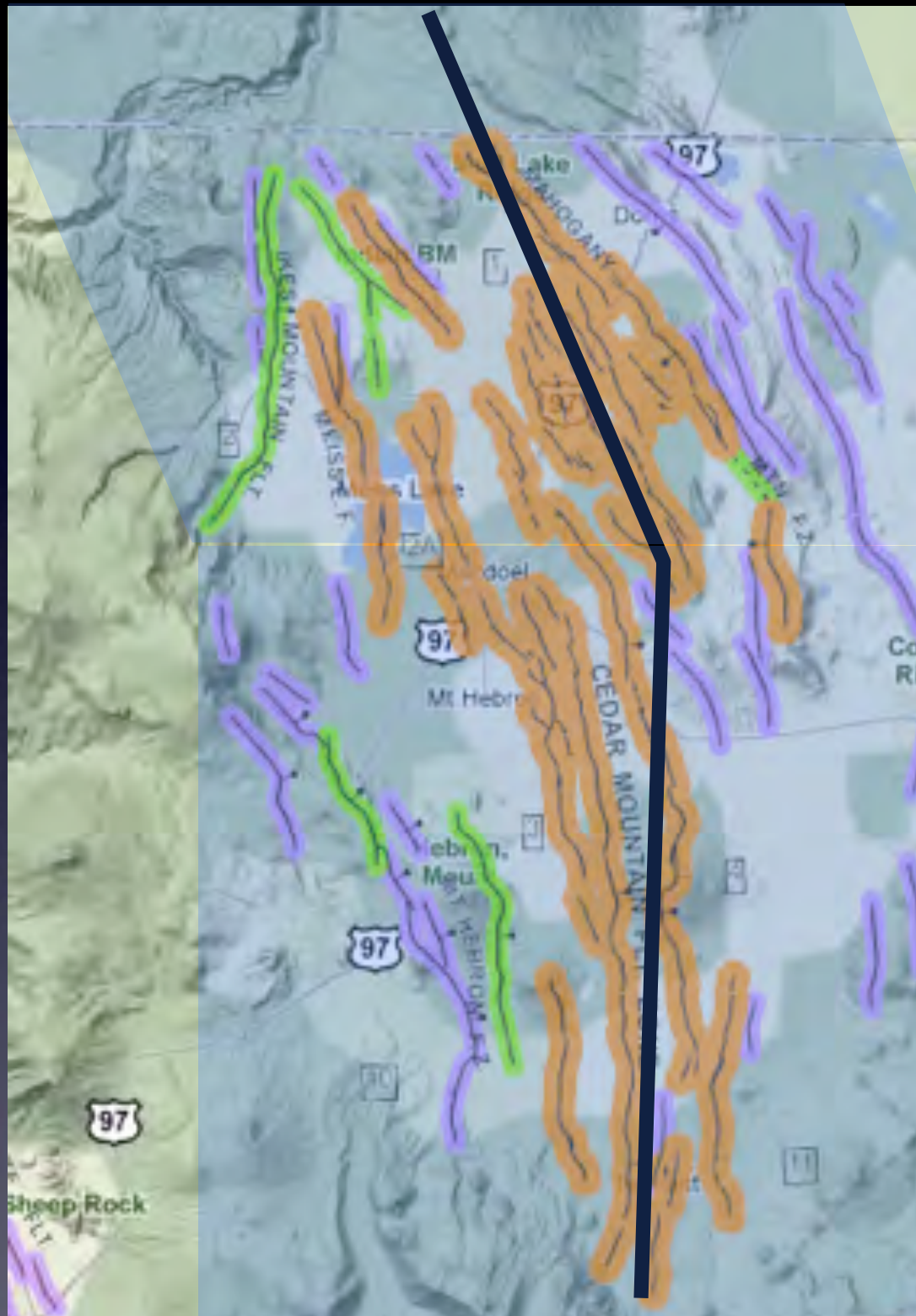
cifies whether fault section
simple surface, or a braided
em of related faults

over which the
rmation model rate applies

ts to which micro-
micity is applied

over which elastic
und-based probability
ctions are applied

gnment of future ruptures to
CERF3 modeled fault



ckground:

CERF2 relied on consensus slip rates for the deformation
odels.

argely based on geologic rates, but modified by
ormation from geodesy and plate rate constraints.

onsensus rates developed over several generations of
orking Groups (NSHM 1996, WG99, WG02, WG08).

eologic rates in various compilations (e.g. Petersen and
esnousky (1994), WGNCEP (1996), McCrory (1996), etc
atewide updated table not compiled for UCERF2.

RF3 approach of including geodetically-based deformatio
ls required an updated Statewide compilation of geologi

pilation of “pure” geologic slip rates (no geodetic inferen
erences based on assumptions of recurrence and slip pe
) as basis for a geologically-based deformation model.

ogic slip rates compiled for point constraints in the geode
ls.

geologic bounds developed for use in subset of the
mation models (e.g. Zeng model).

lation focused mainly on Quaternary slip rates used by prior Wo
s, plus newer published rates.

ase includes UCERF3 best estimate slip rates as well as:

ocation

feature data (amount, sense, uncertainties (if reported), feature

ata (age of feature, uncertainties, dating method)

ncy of activity for each UCERF3 fault section (CGS FAM/USGS
databases)

ned USGS Q-faults slip rate category for UCERF3 fault section

nents

supporting information (see Appendix B for complete description

vas to compile as much quantitative and qualitative infor

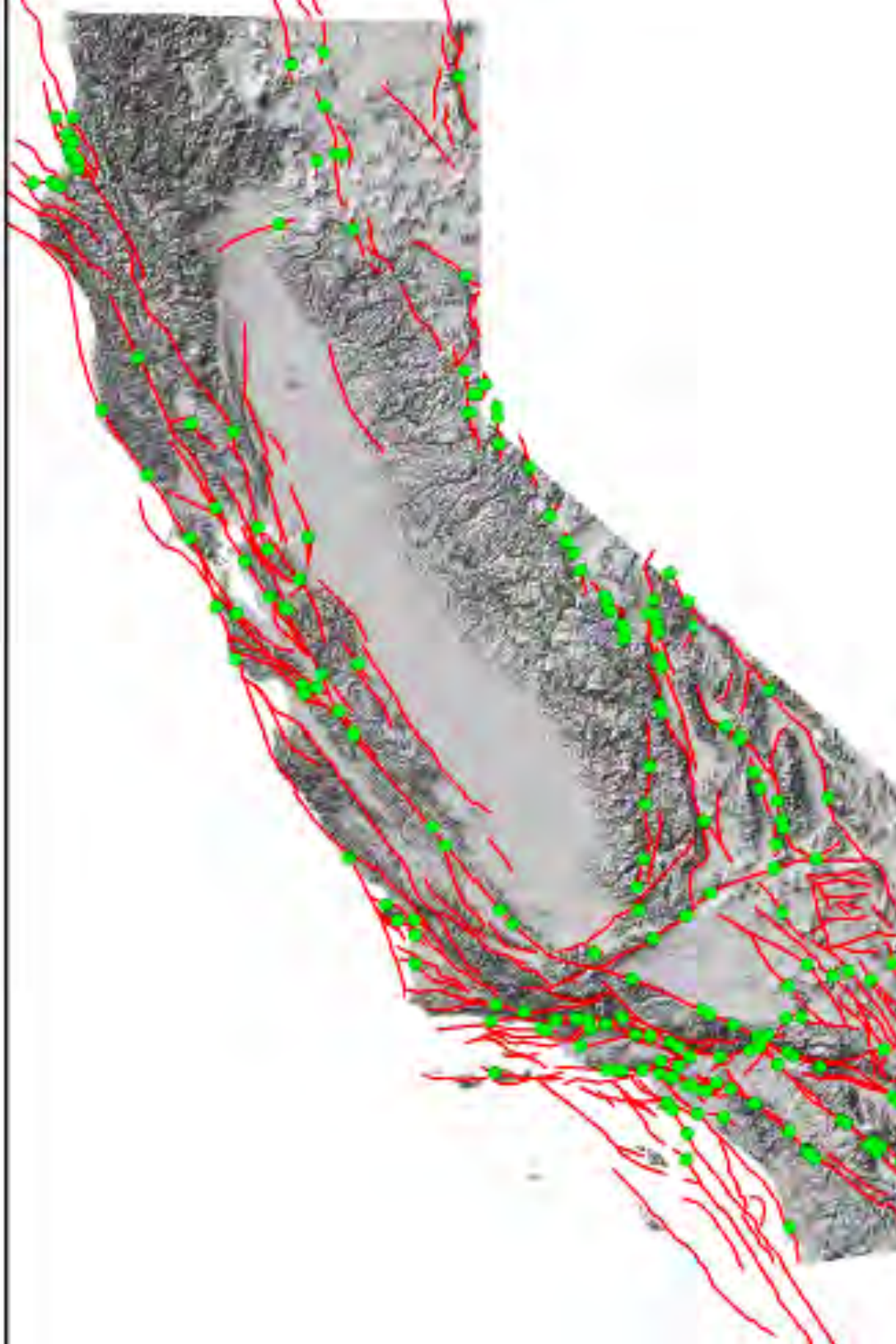
13 reported geologic
tes in compilation

73 UCERF3 fault
ections with a reported
eologic rate (out of
350)

nly 62 fault sections
ith multiple reported
eologic slip rates

0 fault sections with slip
tes over different time
tervals

prisingly, dataset is relatively



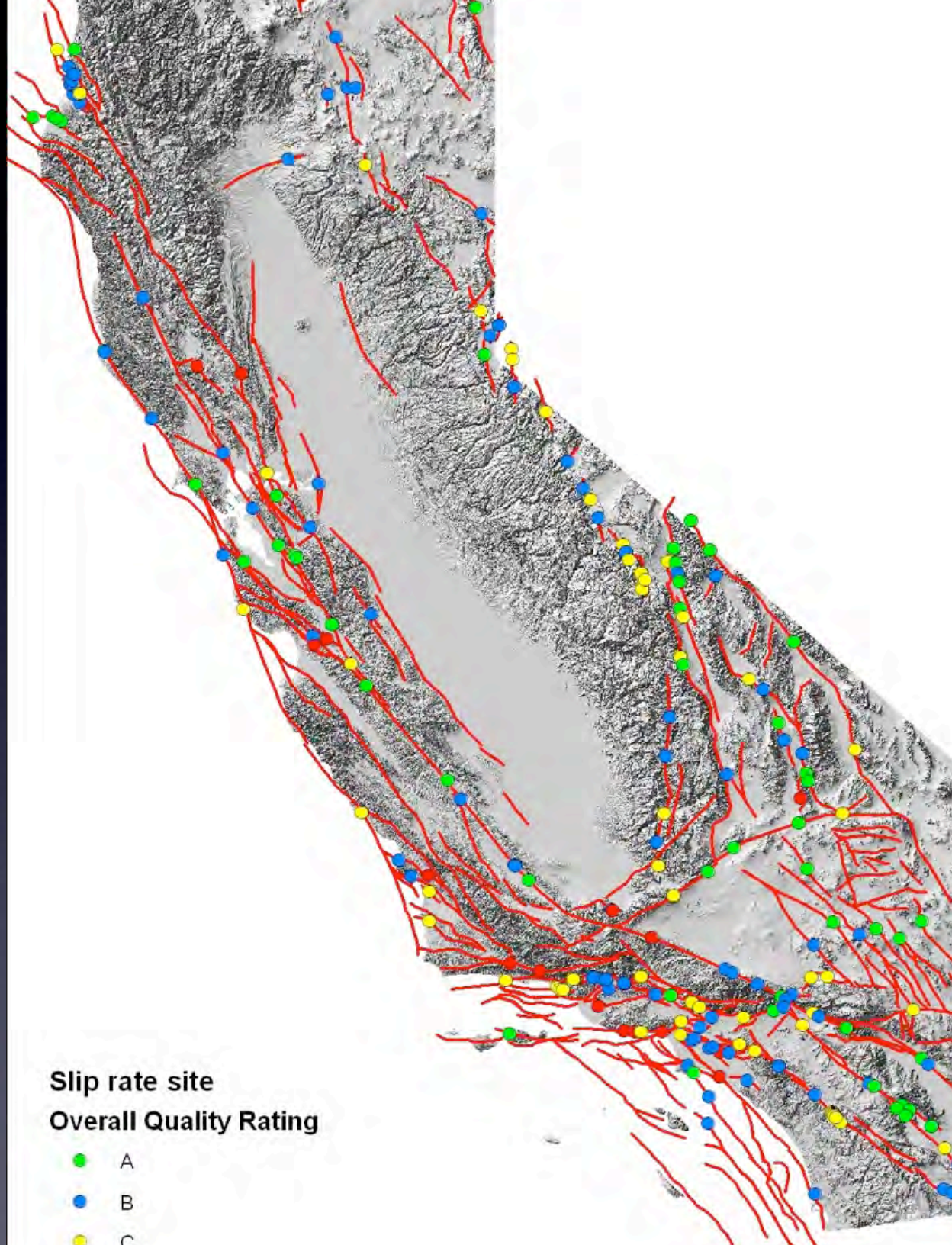
se was used to
qualitative quality
s for:

feature

constraints

l rating for reported slip

ies:
constrained
erately constrained
ly constrained
eliable”



quality rankings:
down by fault section

lt sections with geologic
nstraints

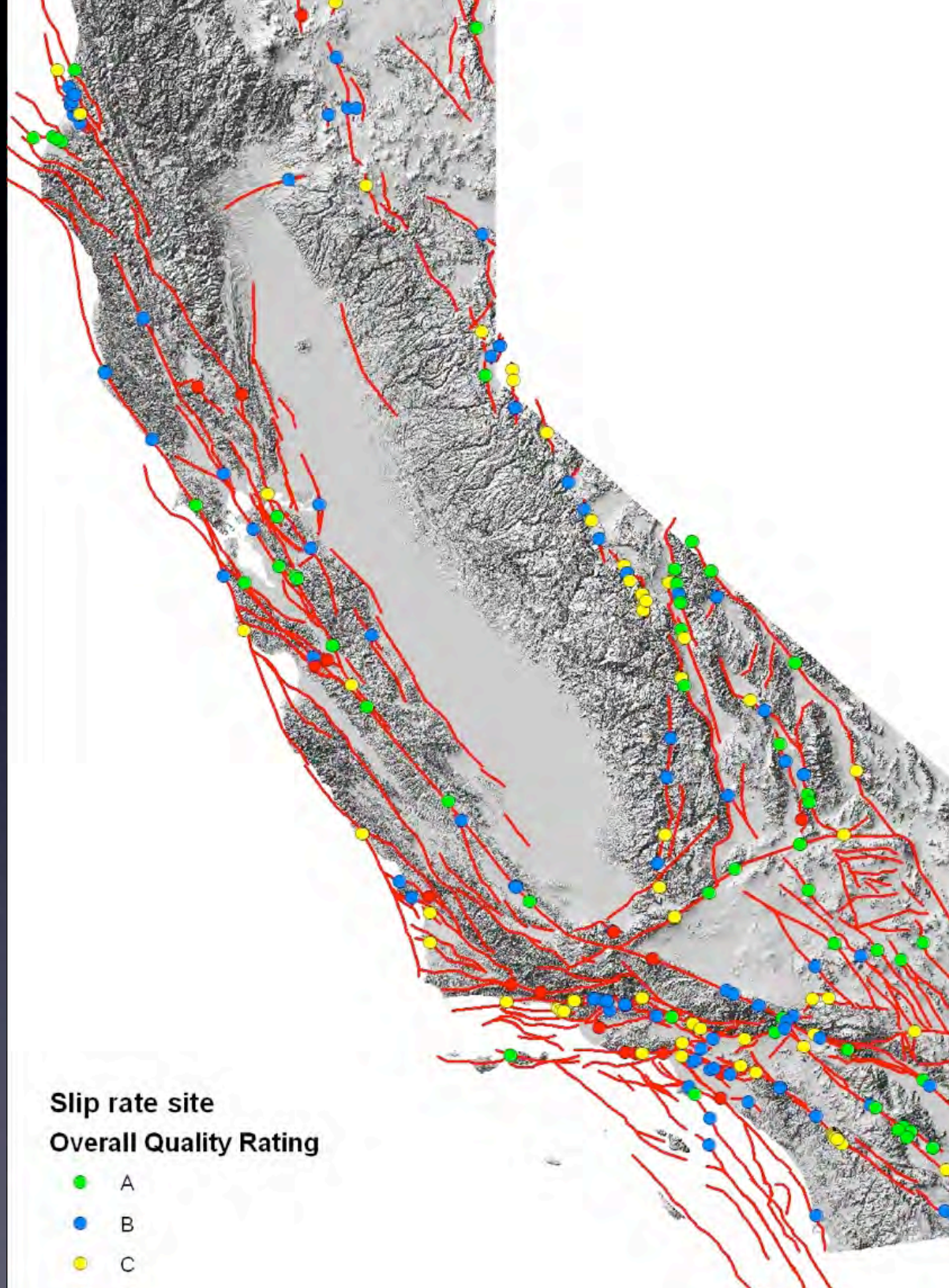
category "A"

category "B"

category "C"

category "D"

et of geologic slip rates
ided to geodesy-based



ormation Model built from geologic data, without
sideration of geodetic and plate-motion models
nceptually, adding up all fault slip rates should add
he plate rate, or at least tell us something about ho
stributed system works over longer time intervals).

ery UCERF3 fault section assigned a geologically based
.

e reported slip rates and quality rankings were examined
sistency with other reported rates, USGS slip rate catego
ency of activity and UCERF2-assigned rates in order to
gn a UCERF3 best estimate rate for each fault section.

lem: About 177 UCERF3 have no direct geologic
constraints.

gning slip rates to faults sections without measured
:

apolated from adjacent contiguous (or near-
guous) sections (e.g. SAF offshore)

igned USGS slip rate categories (if available)

o USGS rate category available, used correlation
een recency of activity and slip rate

Q-faults age category	USGS Q-faults Rate ca
nary active (<1.6 M)	<0.2 mm/yr
eistocene (<130 ka)	0.2 to 1.0 mm/yr
Pleistocene and Holocene (<15 ka)	1.0 - 5.0 mm/yr

tion: How consistent are the reported rates in our
base with the rate categories assigned by the USG

er: 83% of the time the reported slip rates fall with
S-assigned rate category

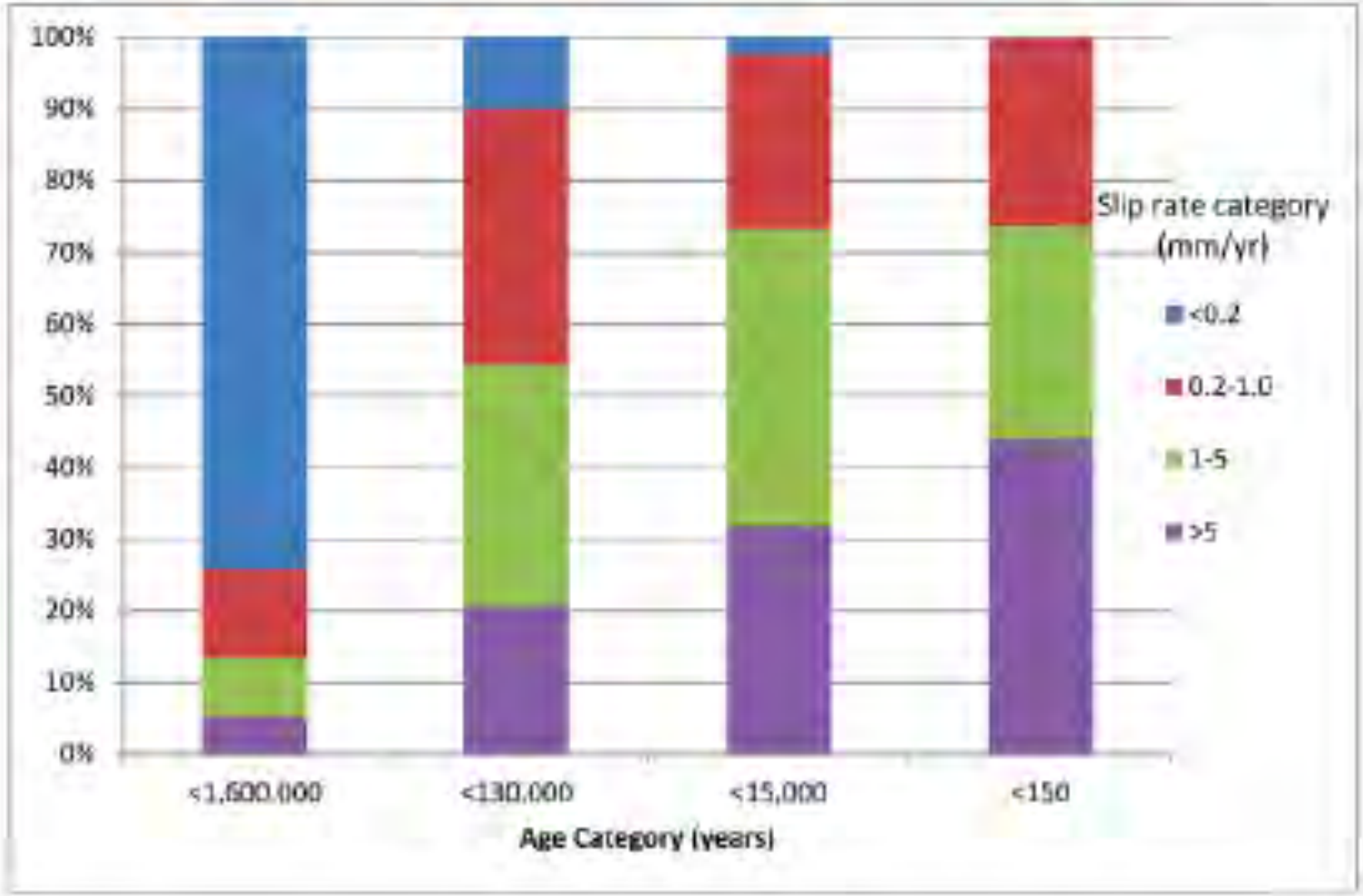


Figure 2. Histogram of California faults with USGS QFFD assigned slip rate categories binned by USGS QFFD age categories. In general, the assigned slip rate category correlates with the recency of activity, with the slowest faults in the oldest age category and the fastest faults having moved more recently.

egory

ary active (<1.6 M)

istocene (<130 ka)

leistocene and Holocene (<15 ka)

Rate category

<0.2 mm/yr

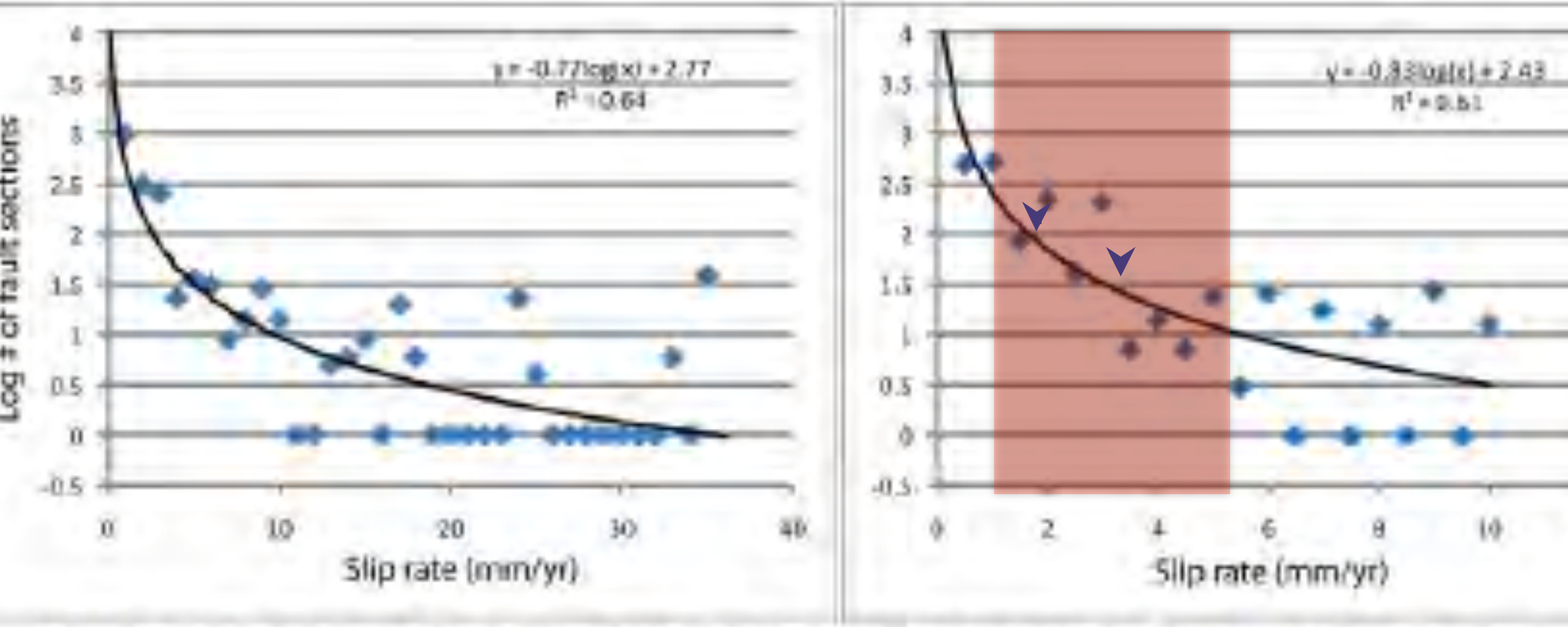
0.2 to 1.0 mm/

1.0 - 5.0 mm/y

d-mean frequency approach to assign best-estimate slip rate to slip rate ca

Median for 1 - 5 mm/yr category

rate for known slip rates in 1 - 5 mm/yr category



Geo-deformation
l features:

m tapers for high slip
aults with long overlaps
rial - Cerro Prieto,
ers Creek - Maacama)

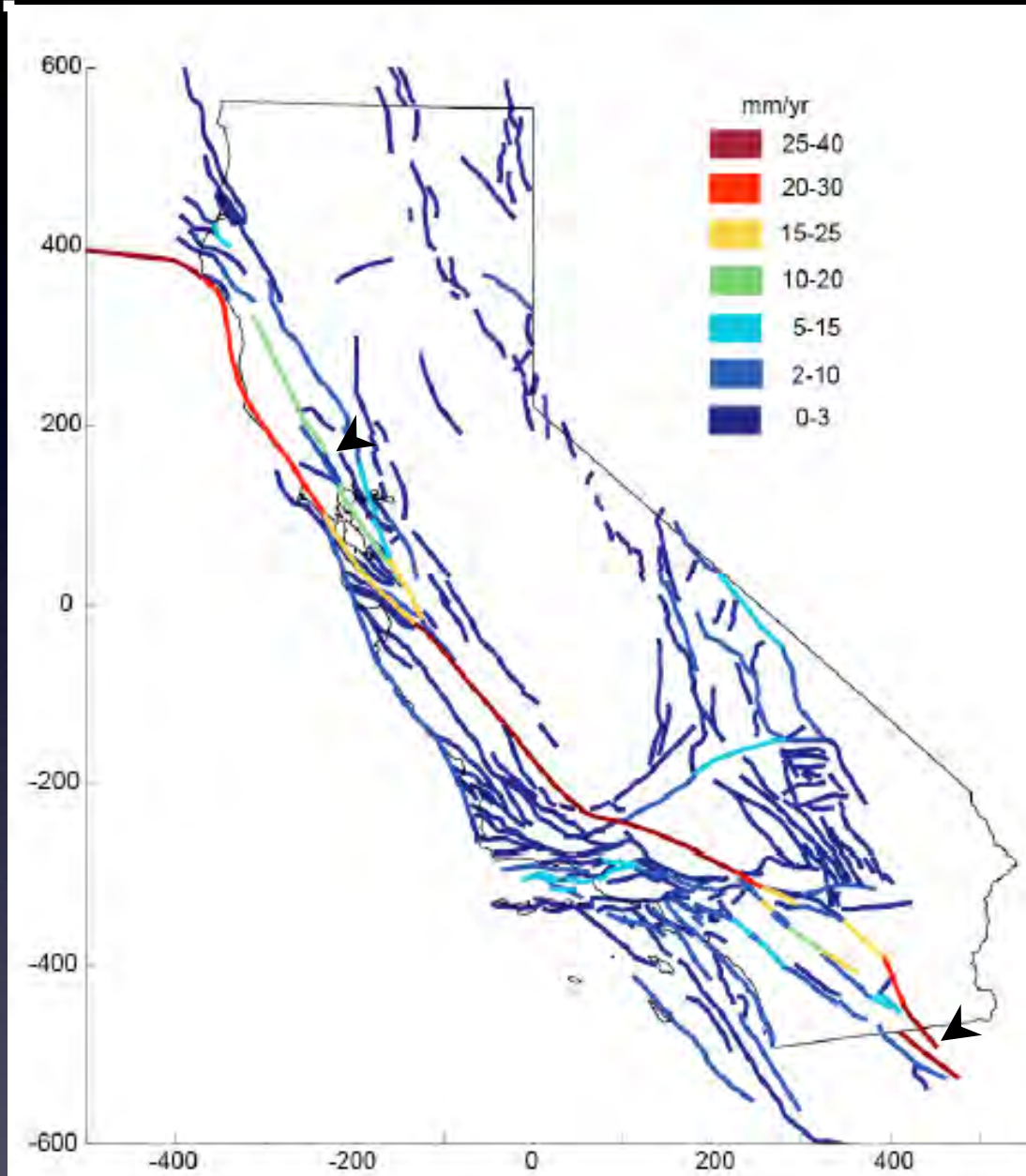


Figure 3. Summary of geologic bounds (Dawson and Weldon) u
the Geologic Block Model.