UC DAVIS
DEPARTMENT OF EARTH AND PLANETARY SCIENCES

Lessons and questions: the distribution of near-field inelastic deformation

Alba M. Rodriguez Padilla

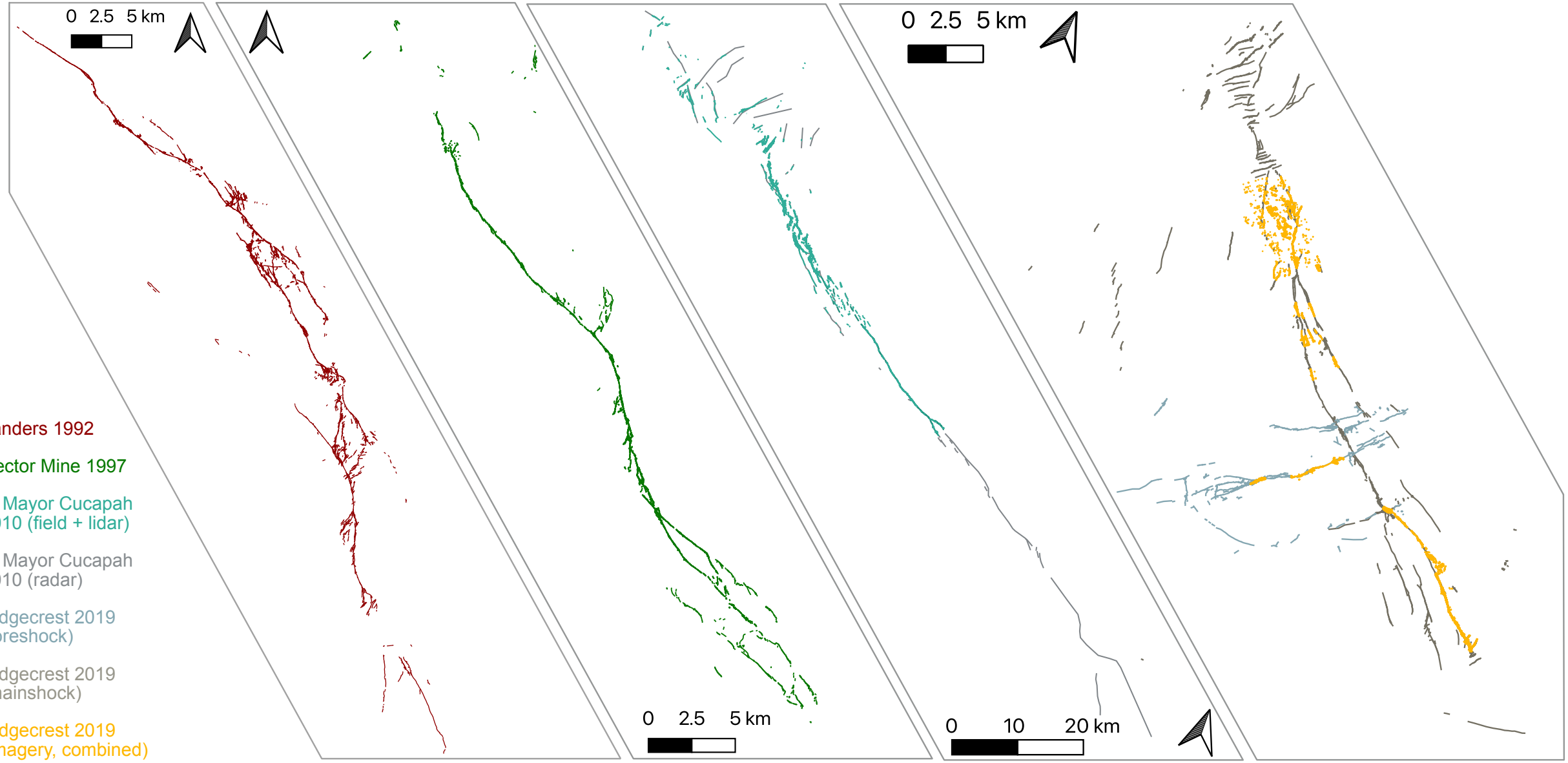
Spatial Variations of Rock Properties and Deformation Processes Across Rupture Zones break-out session

NASA

SCEC
AN NSF+USGS CENTER

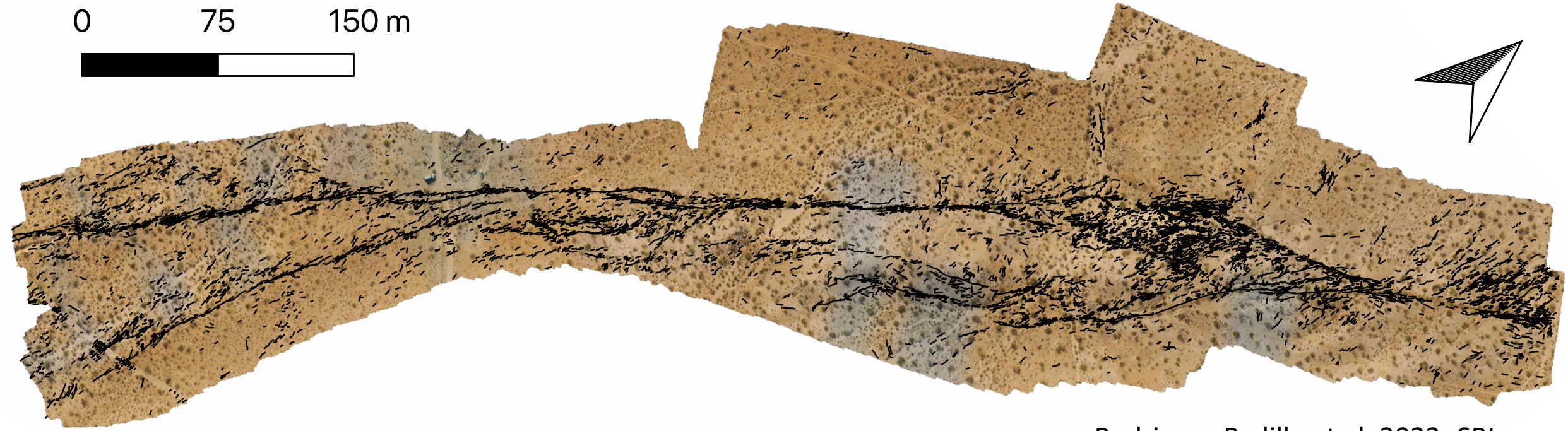
With contributions from Michael E. Oskin, Christopher Milliner, Andreas Plesch, Mercedes Quintana, Lupita Bravo, Ruth Prado, Tom Shea, Brian Castillo, Leslie Garcia

What do rupture maps tell us about the distribution of coseismic inelastic deformation?



Rodriguez Padilla and Oskin, *under review in BSSA*

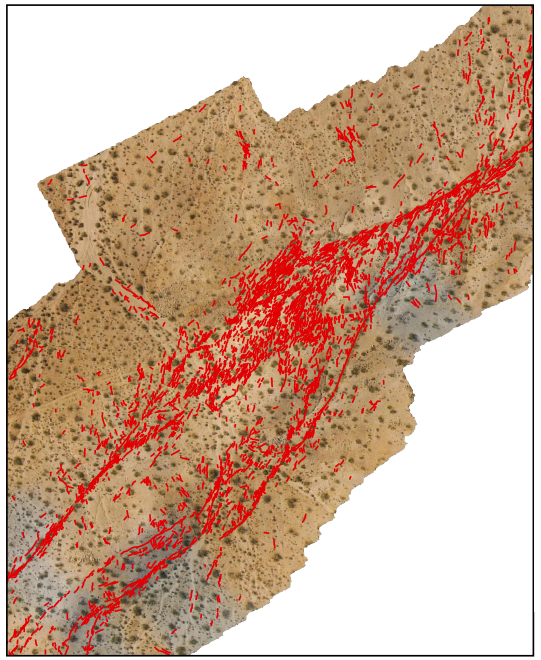
2-20 cm per pixel UAV imagery reveals complexity of rupture fabric

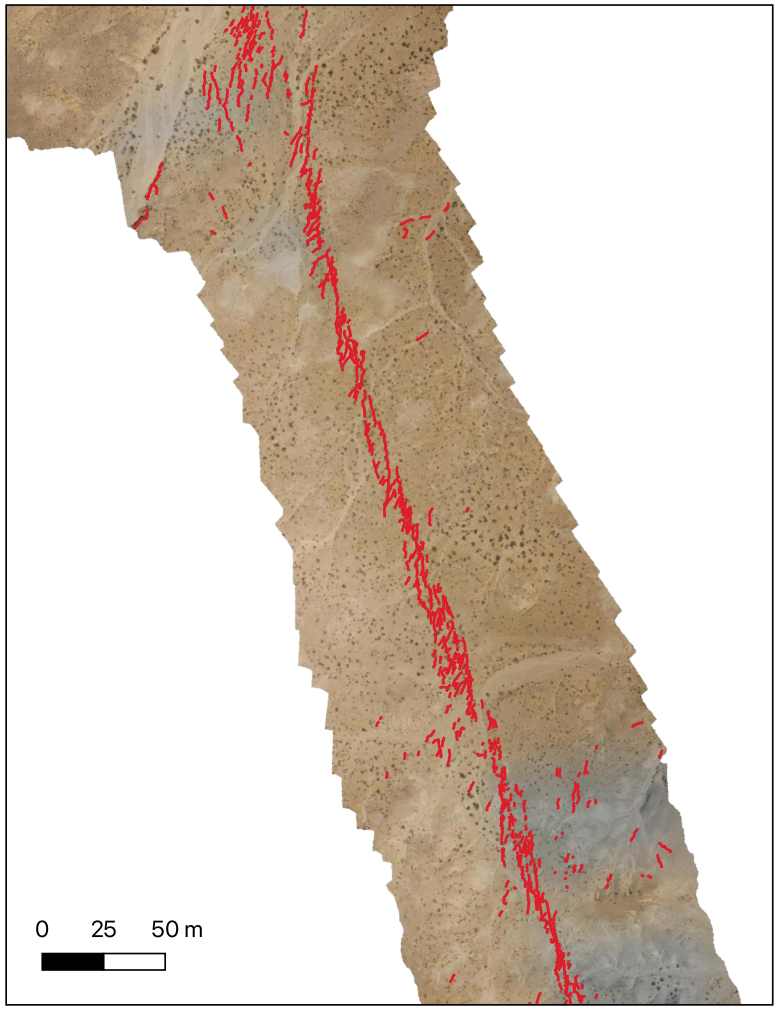


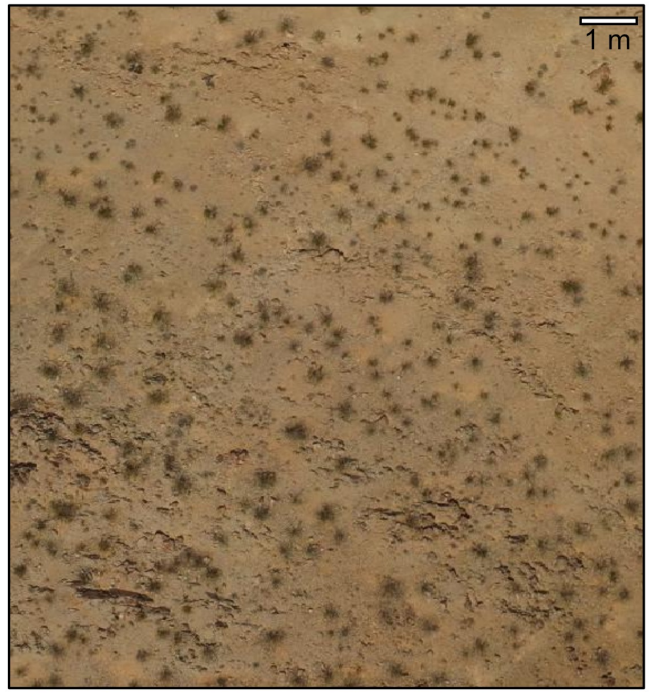
Rodriguez Padilla et al. 2022, *SRL*.

Drone imagery from
Pierce et al., 2020, *SRL*.

Different processes… many fractures



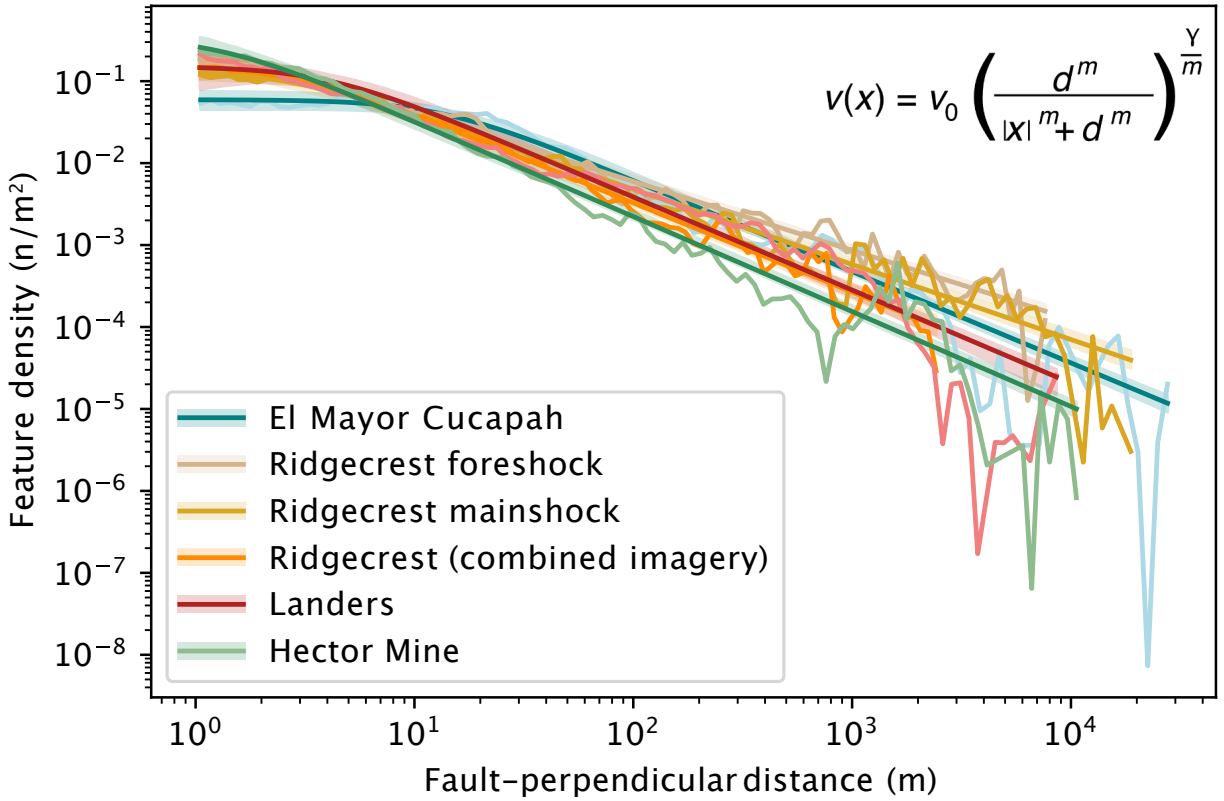


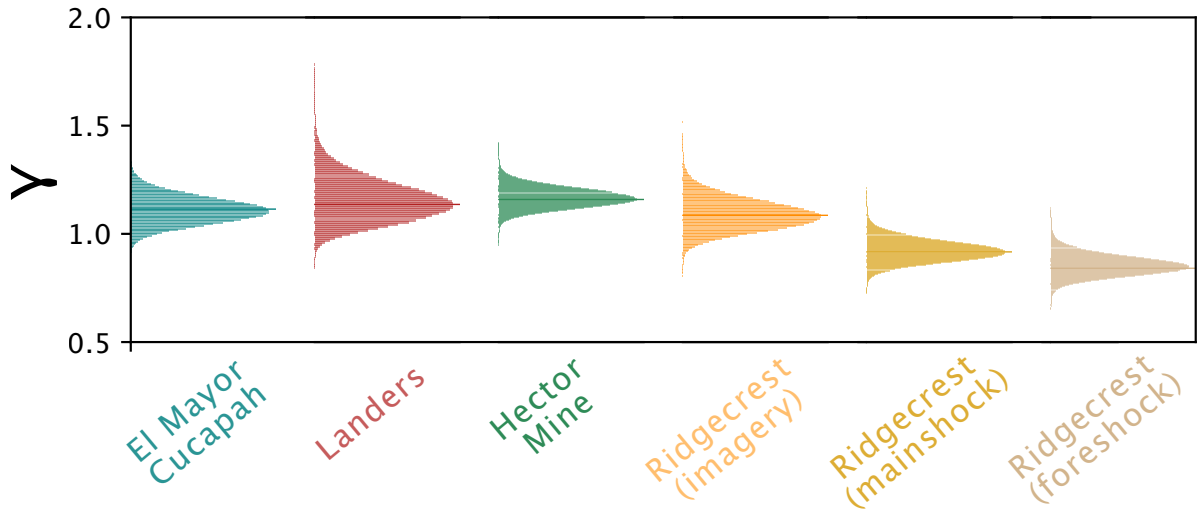


Rodriguez Padilla et al., *SRL.*, 2022

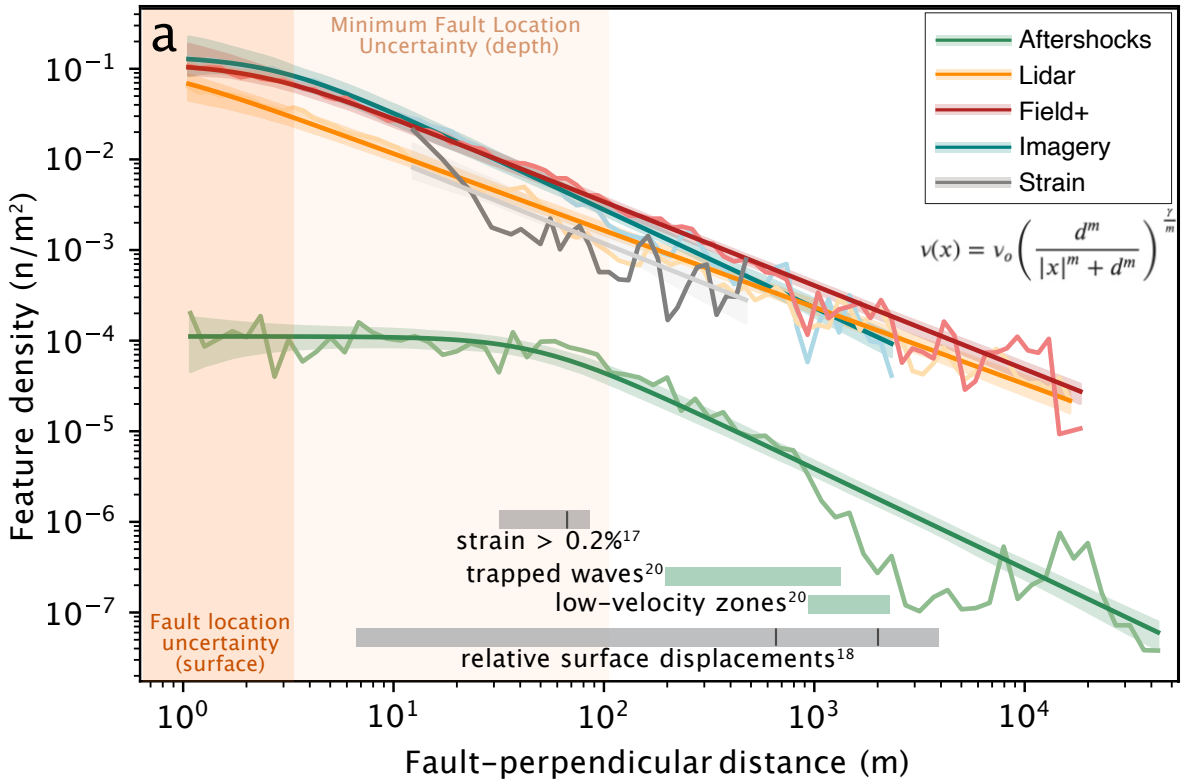
Fracture maps, strain maps, and aftershock catalogs reveal that inelastic deformation is widespread* and decays non-linearly with fault-perpendicular distance

* But very heterogeneous locally, requiring averaging over large areas to generalize



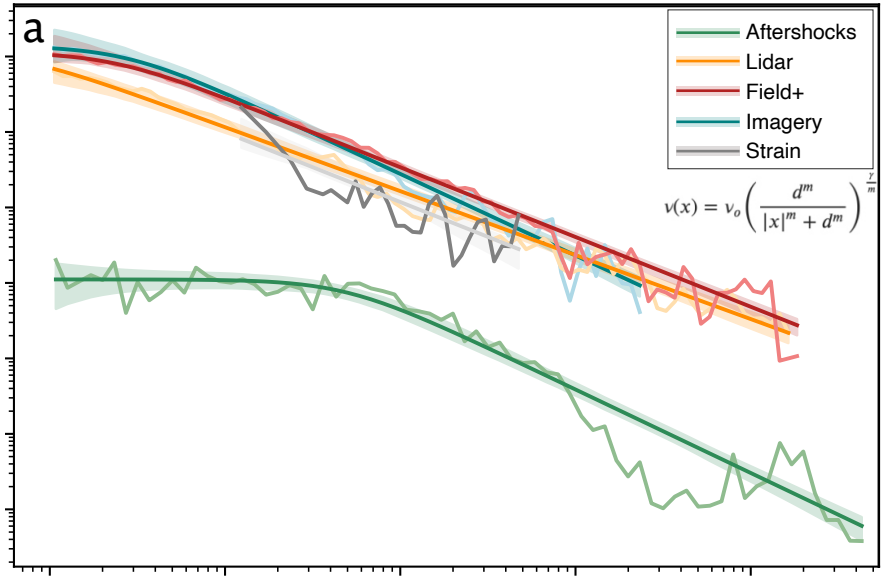


Rodriguez Padilla and Oskin, *under review in BSSA*



Rodriguez Padilla et al., *Nat. Geosci.,* 2022

Coseismic decrease in shear rigidity from fracturing



Damage distribution

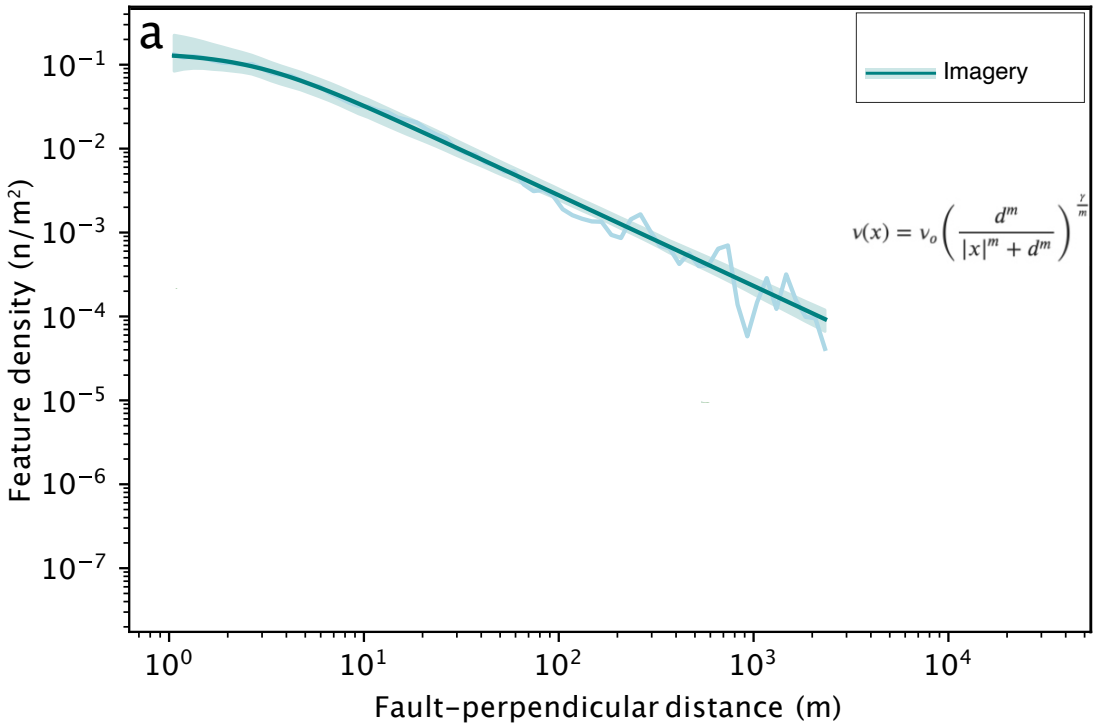
?

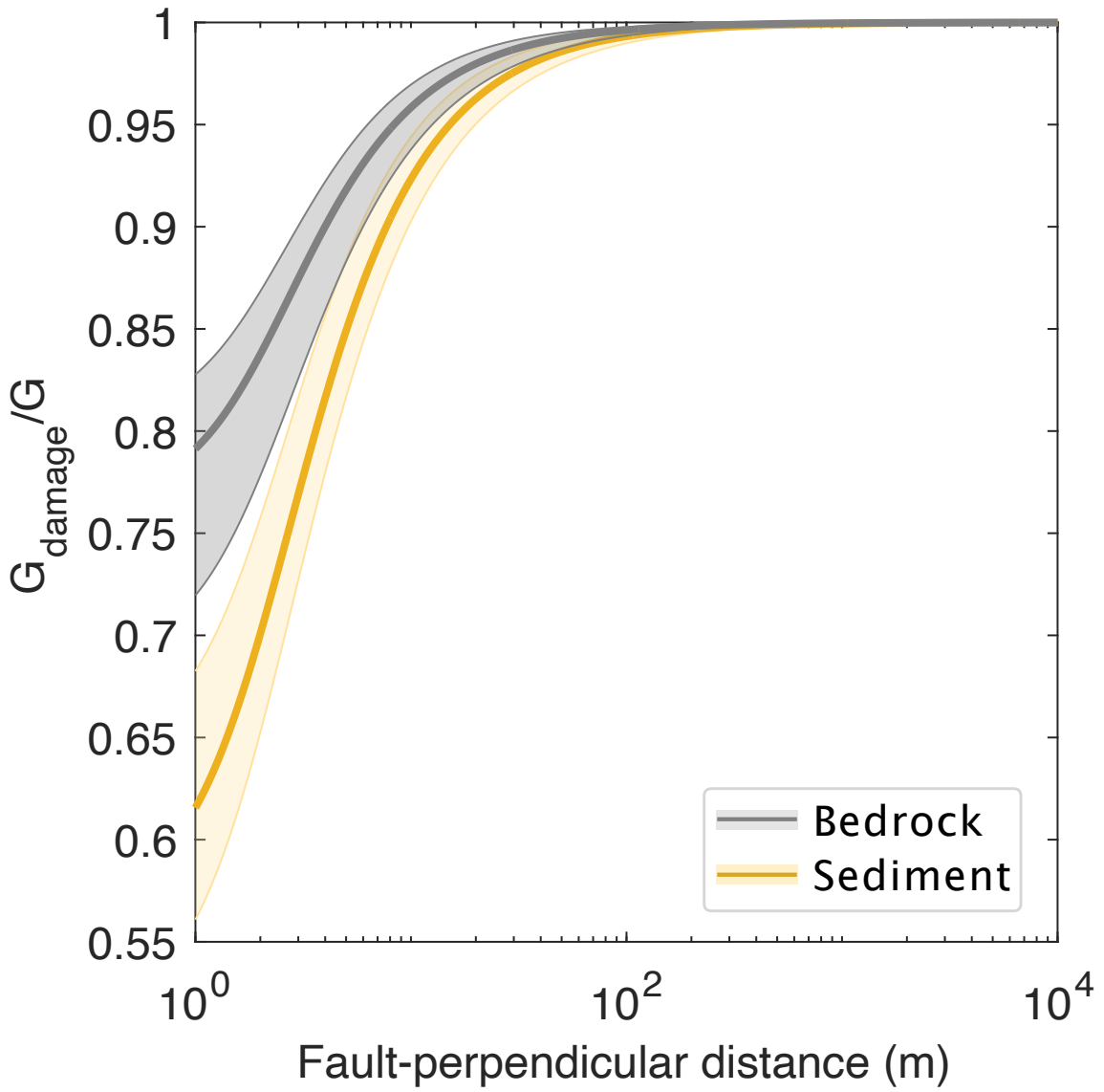
$\frac{G'}{G}$

Physical properties?

Rodriguez Padilla et al., *Nat. Geosci.,* 2022

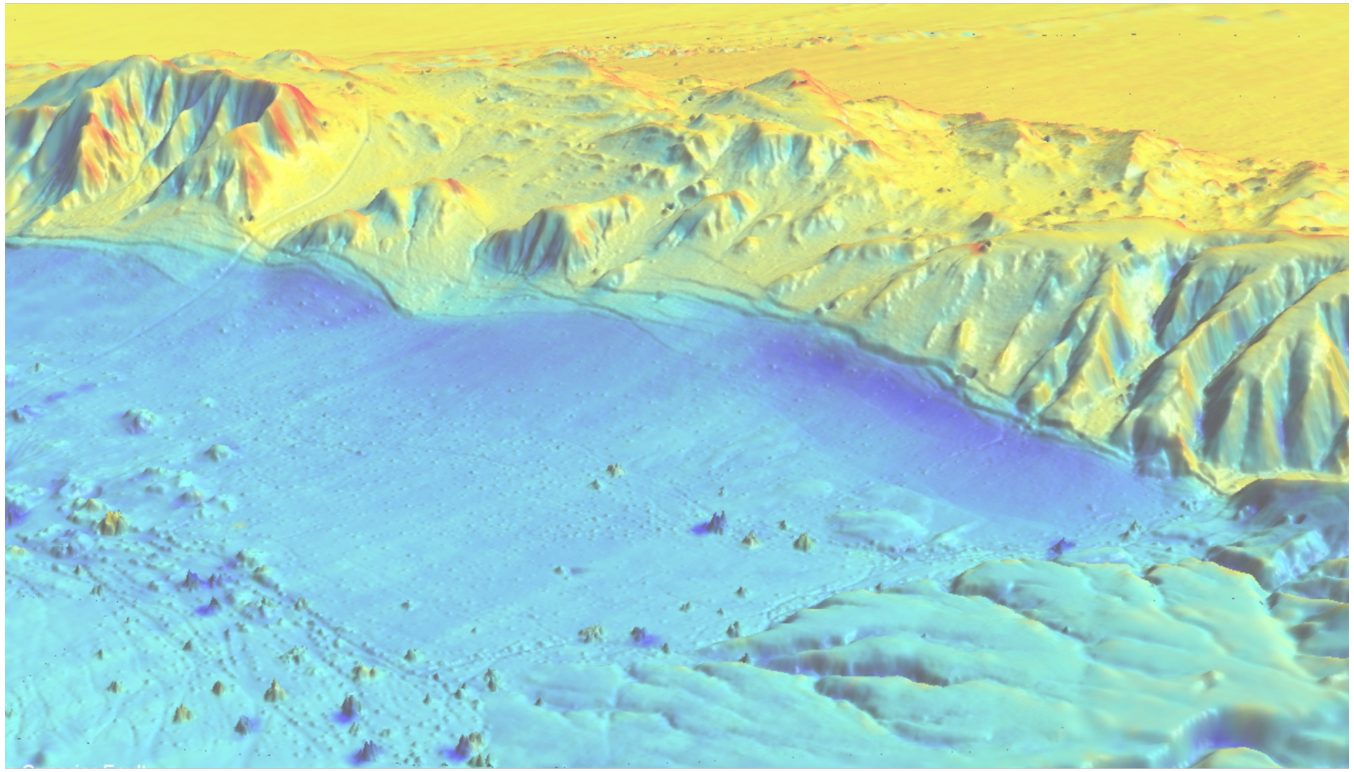
Coseismic decrease in shear rigidity from fracturing





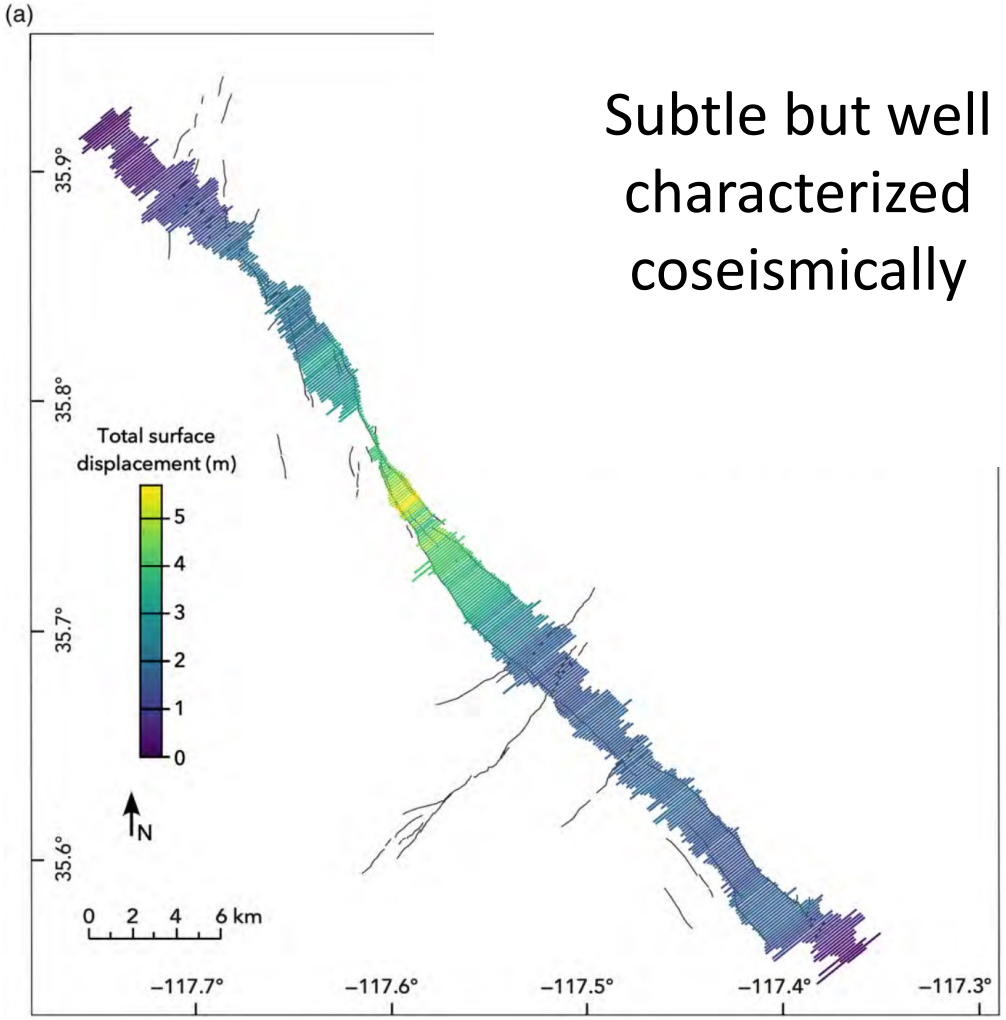
Rodriguez Padilla et al., 2022, *Nat. Geosci.*

Different processes… and wavelengths: deflections



Blue = down
Yellow = up

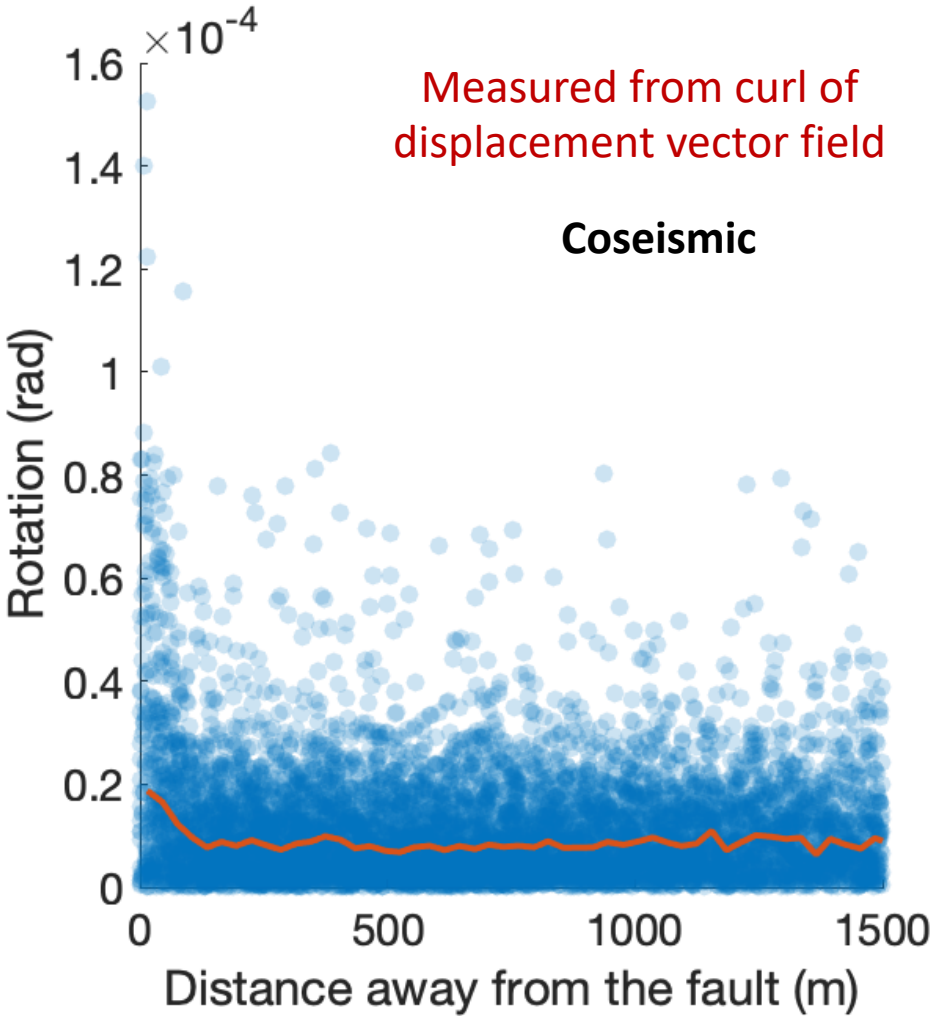
Oskin et al., 2012, *Science*



Subtle but well characterized coseismically

Antoine et al., 2021, *BSSA*

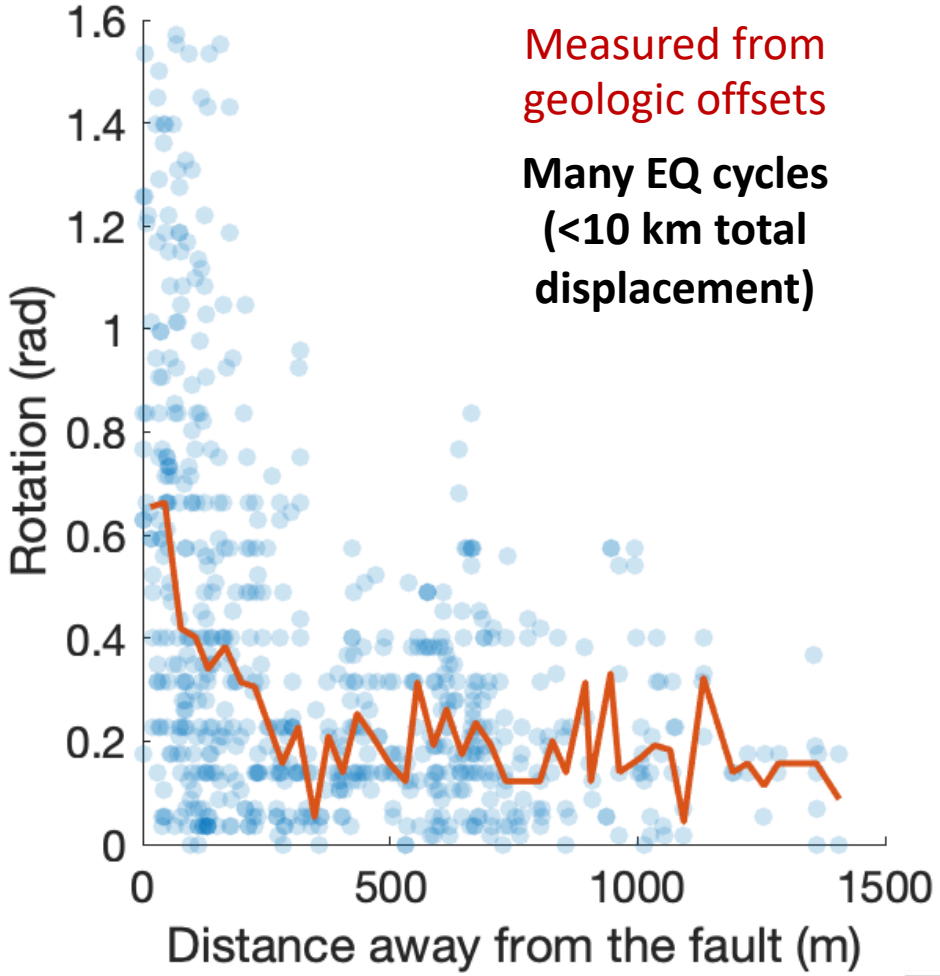
Different processes… and wavelengths: rotations



Measured from curl of displacement vector field

Coseismic

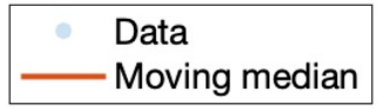
Milliner et al., 2021, *JGR*



Measured from geologic offsets

Many EQ cycles (<10 km total displacement)

Shelef and Oskin, 2010, *JGR*



Outstanding questions

Coseismic

- What processes are responsible for the different fractures observed?

Postseismic/interseismic

- How much of the damage we map coseismically is 1) inherited 2) recovered/healed postseismically, 3) produced interseismically? Bedrock vs sediment?
- What happens to long-wavelength deformation postseismic/ interseismic?

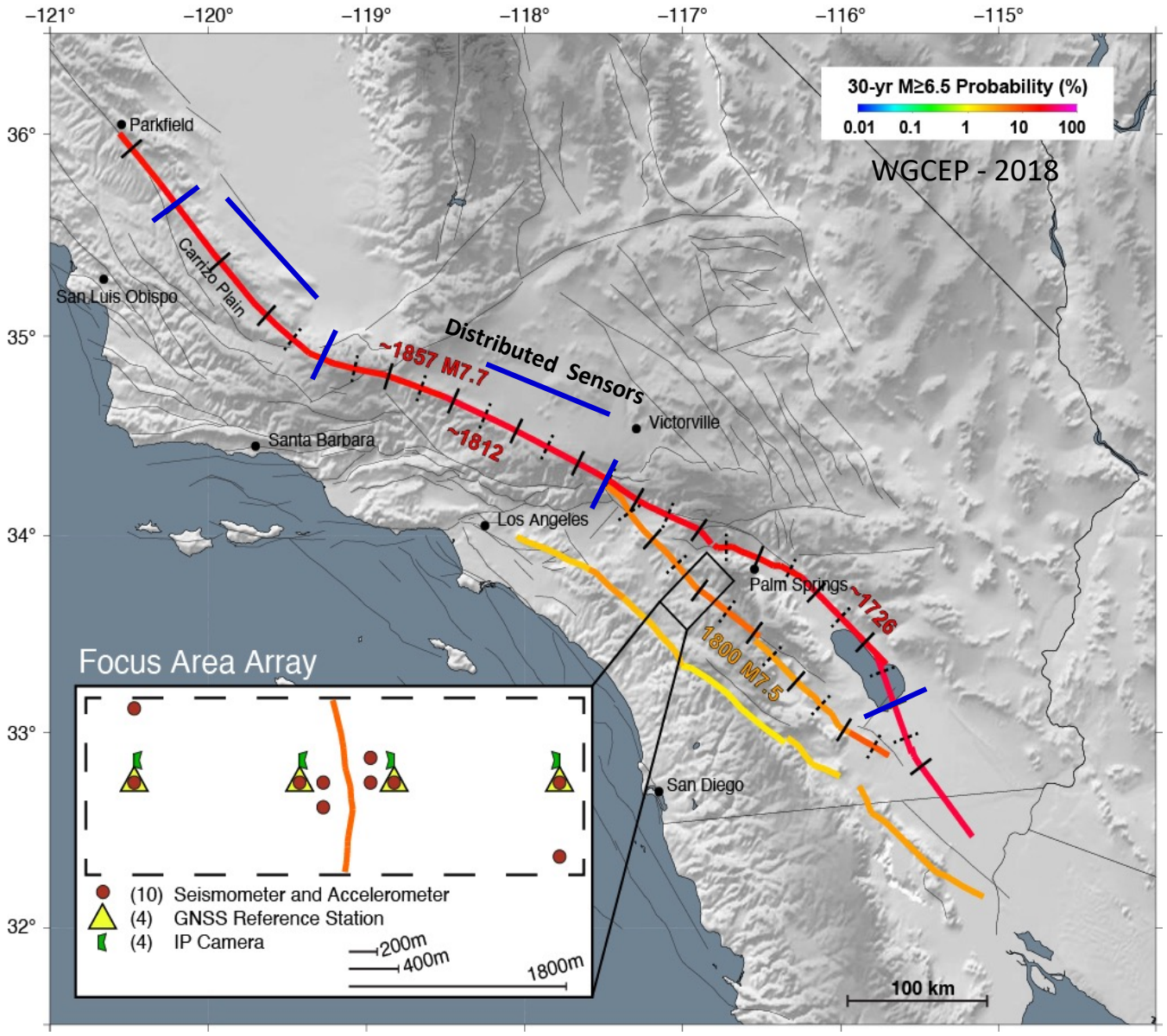


Figure courtesy of Yehuda Ben-Zion

What observations/ constraints are needed for RuFZO to answer these questions?

- Coverage < 100 m from the fault everywhere (very heterogeneous, lots of coverage needed to generalize and capture diverse physics)
- Coverage of bedrock and sediment, and different degrees of geometrical complexity in the fault zone
- Long-wavelength coverage in some locations?
- Cameras at angle that enable image differencing and pre-EQ fault zone mapping

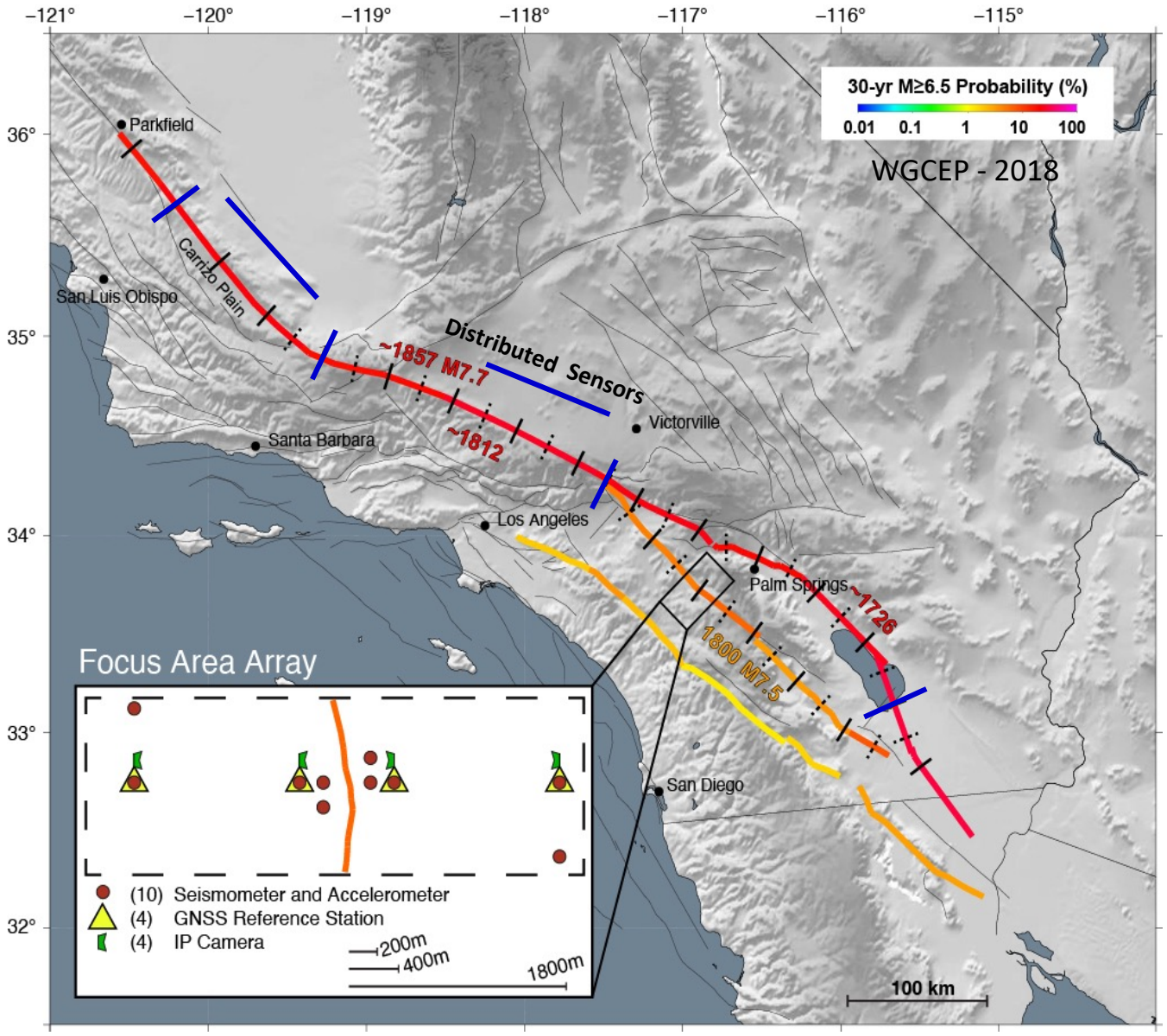


Figure courtesy of Yehuda Ben-Zion