3D Fault Geometry and Coupling at the Junction of the San Andreas and San Jacinto Fault Systems, Cajon Pass

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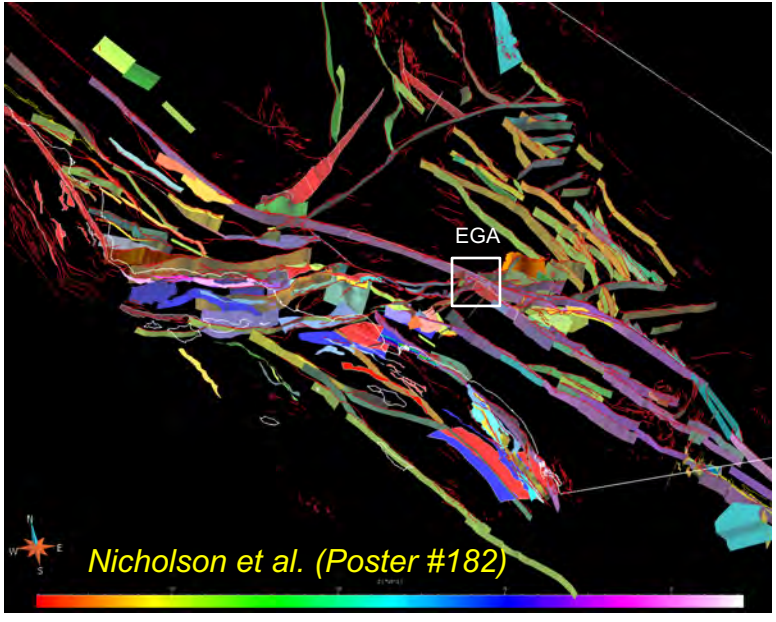
Updated SCEC CFM 5.3 Fault Representations for 2020



Google 'SCEC CFM'

SCEC CFM webpage:
https://www.scec.org/research/cfm

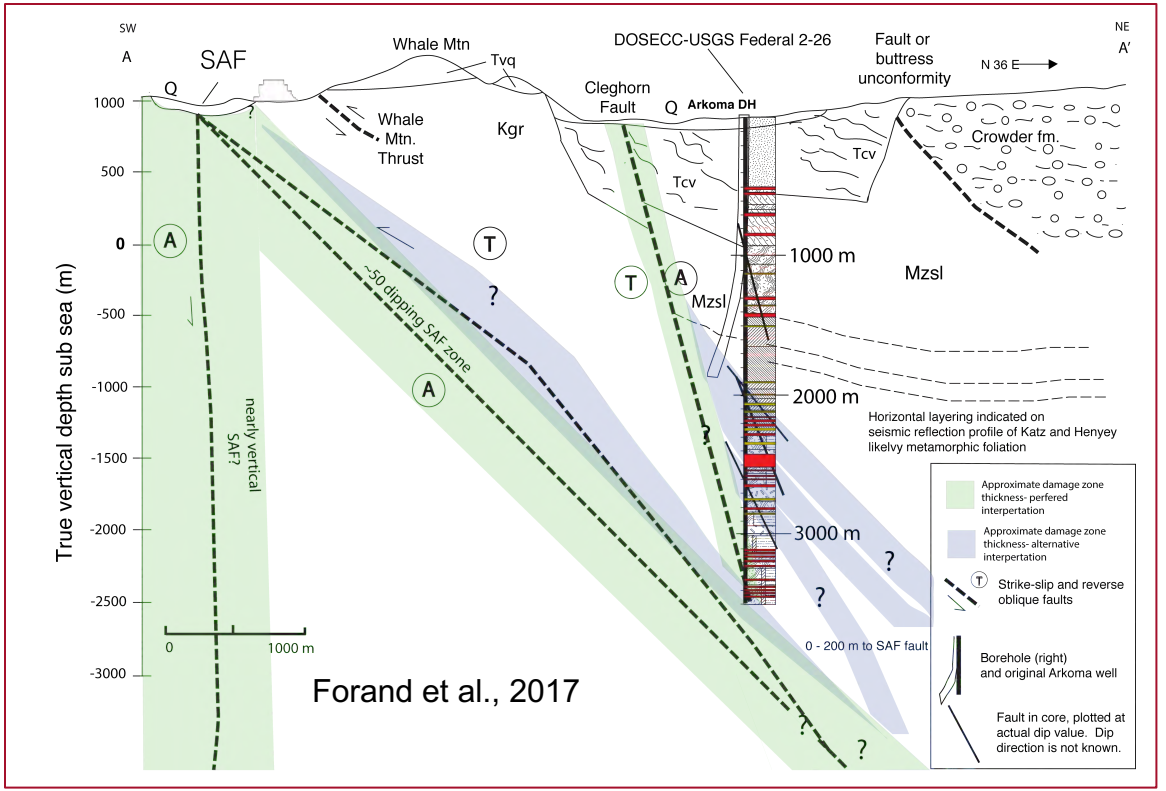
SCEC CFM 2D & 3D Viewer:
https://www.scec.org/research/cfm-viewer/

CFM Posters at upcoming SCEC 2020 Annual Meeting:
Nicholson et al., Poster 182
Plesch et al., Poster 184

What is the active 3D fault geometry?

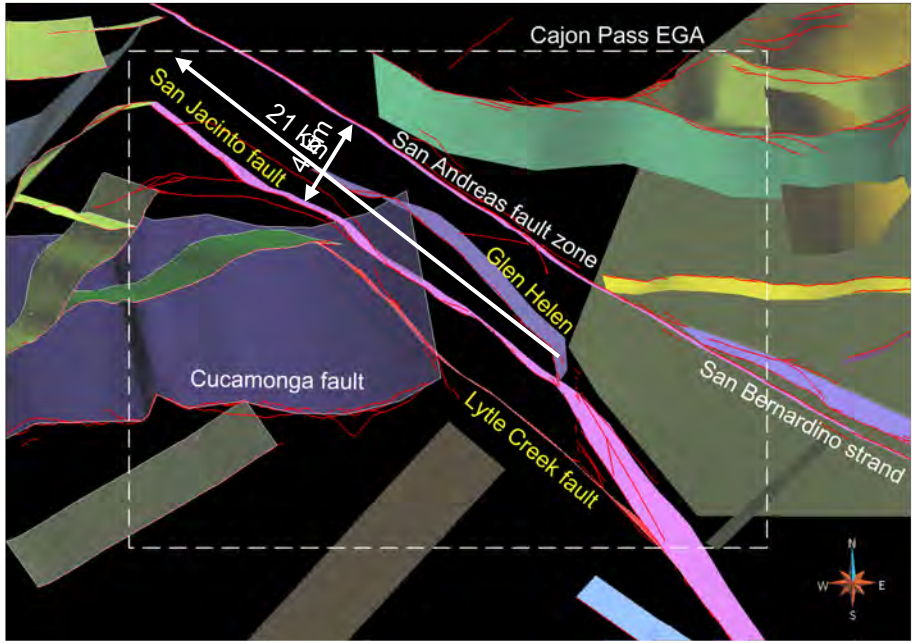
- **What is the dip of the San Andreas fault?**
  (nearly vertical)

SW-NE vertical geologic cross section through Cajon Pass that includes the Cajon Pass deep drillhole.



What is the active 3D fault geometry?

- **What is the dip of the San Andreas fault?**
  (nearly vertical)
- **Do the San Andreas and San Jacinto faults merge at depth?**
  (nearest active fault strands do not)



Oblique 3D map view of CFM 5.3 faults. Mapped surface fault traces (red lines) of San Jacinto and Glen Helen faults approach but do not intersect the San Andreas fault.

What is the active 3D fault geometry?

- **What is the dip of the San Andreas fault?**
  (nearly vertical)
- **Do the San Andreas and San Jacinto faults merge at depth?**
  (nearest active fault strands do not)
- **Can CFM 3D fault representations be independently evaluated, and can they benefit from being updated and improved?**
  (yes)

  San Jacinto fault, Glen Helen fault – updated 2011
  San Andreas fault (Mojave-San Bernardino section) – updated 2012

What do earthquake nodal planes reveal?

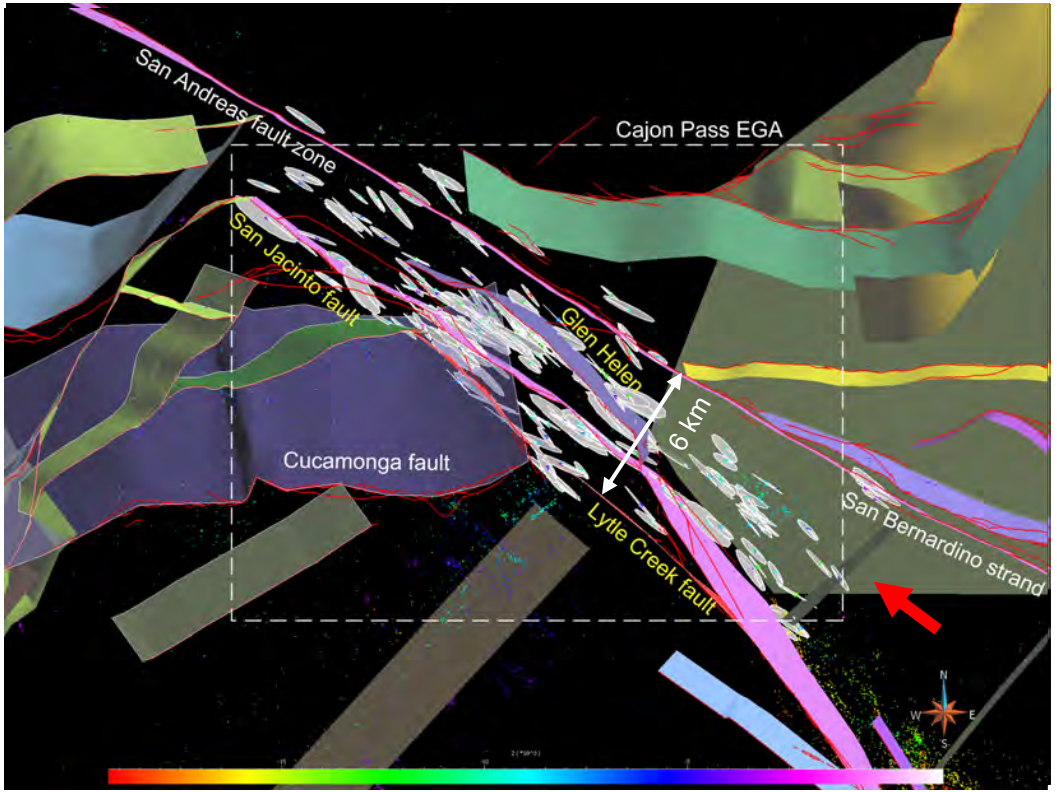
Relocated hypocenters using 3D velocity model + cross correlation travel-times + advanced grow-cluster algorithm

Selected earthquakes with focal mechanisms in Cajon Pass EGA

Focal mechanisms with nodal planes parallel or nearly parallel to SAF or SJF

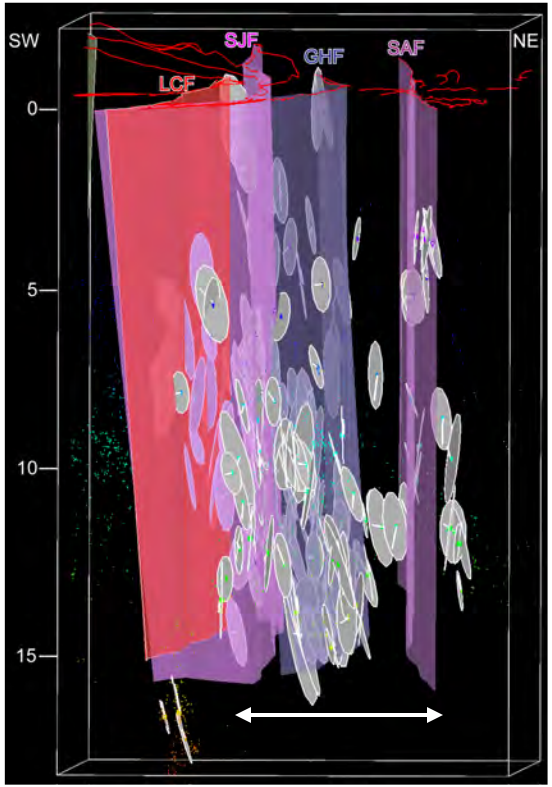
with predominant steep dips -- >70°

Preferred nodal planes that exhibit predominant strikes parallel or nearly parallel to SAF or SJF and predominant steep dips

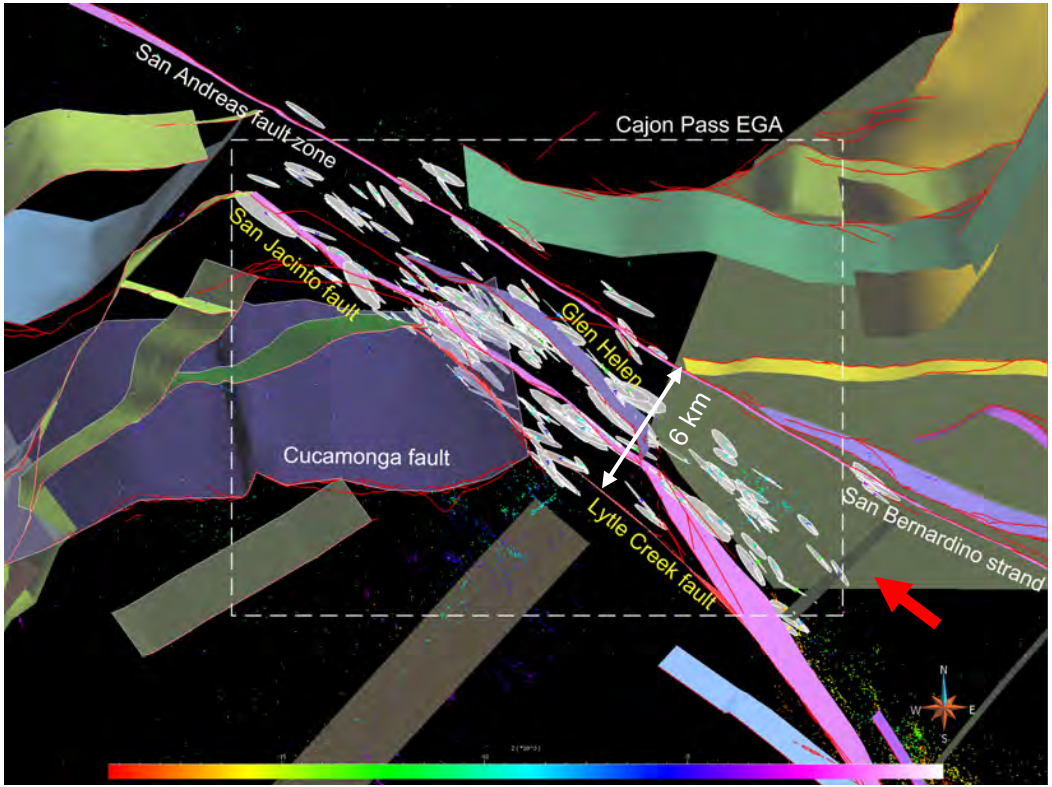


Oblique 3D map view of CFM 5.3 fault surfaces looking down-dip of revised Lytle Creek fault. Relocated hypocenters and revised focal mechanism nodal planes from Hauksson et al., 2012+updates. Hypocenters color-coded by focal depth (color bar).

What do earthquake nodal planes reveal?



Oblique 3D cross section view looking NW along San Andreas fault.



Oblique 3D map view of CFM 5.3 fault surfaces looking down-dip of revised Lytle Creek fault.

What do earthquake nodal planes reveal?

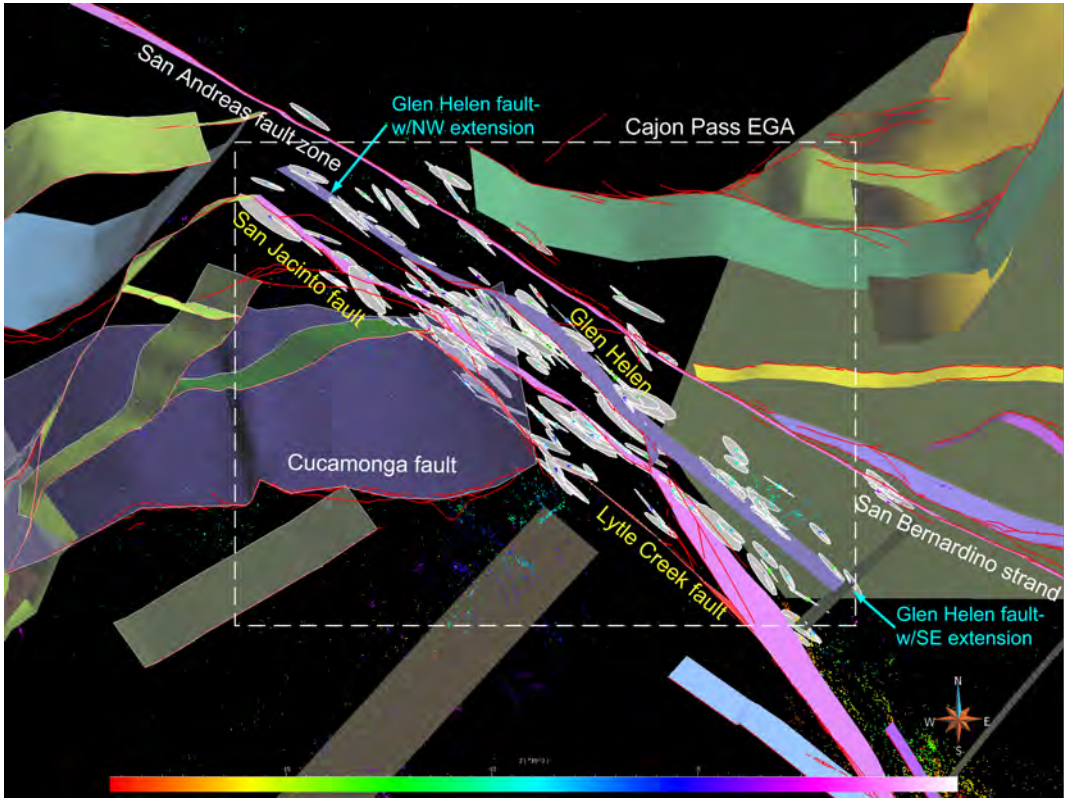
Preferred nodal planes that exhibit predominant strikes parallel or nearly parallel to SAF or SJF and predominant steep dips

Nodal planes define a blind, NW-extension to Glen Helen fault beyond its mapped surface trace (yellow diamond)

New, updated CFM 5.3 NW-extended Glen Helen fault representation

Nodal planes also define a possible blind, SE-extension to Glen Helen fault

New, updated CFM 5.3 SE-extended Glen Helen fault representation



Oblique 3D map view of CFM 5.3 fault surfaces looking down-dip of revised Lytle Creek fault. Relocated hypocenters and revised focal mechanism nodal planes from Hauksson et al., 2012+updates. Hypocenters color-coded by focal depth (color bar).

High-resolution seismic reflection line between the San Jacinto and San Andreas faults (Catching et al., 2008)

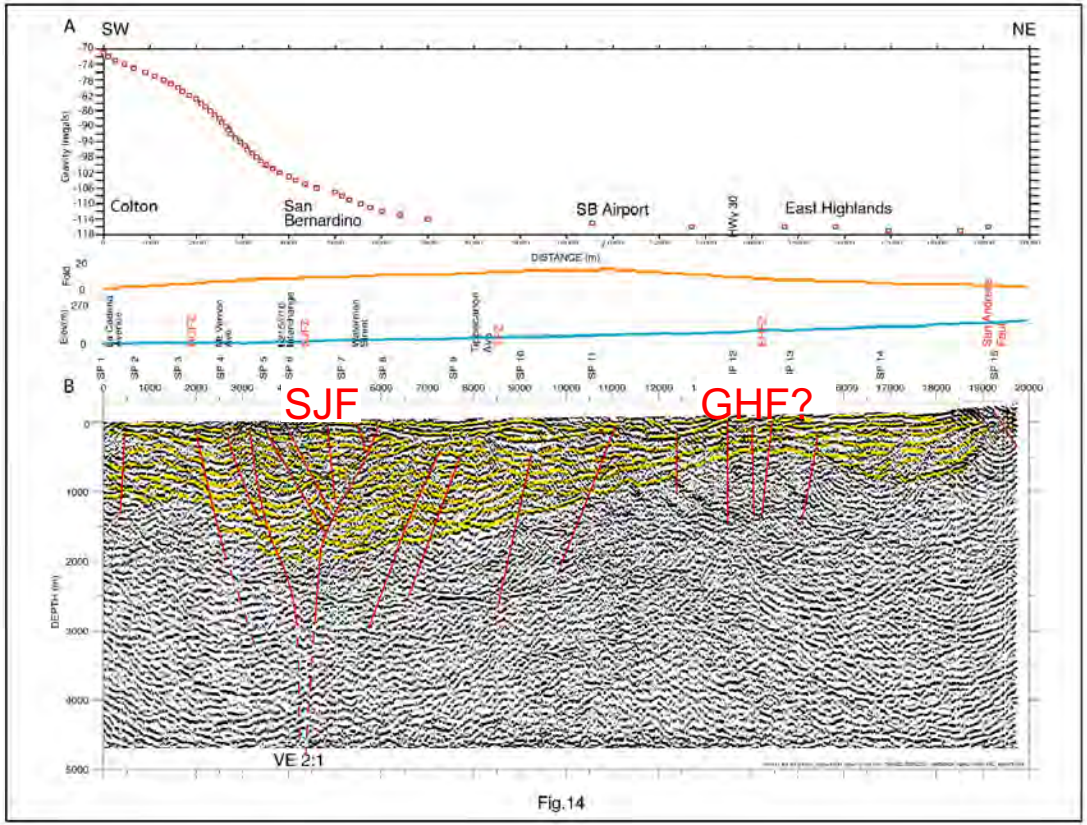


Fig.14

Summary

- Relocated hypocenters and nodal planes can be used to independently evaluate, update and improve CFM 3D fault representations.
- In Cajon Pass, predominant nodal planes are parallel or nearly parallel to either the SAF and SJF and are steeply dipping.
- Nodal planes define a wide, sub-vertical viscoelastic zone of distributed right-lateral shear.
- This implies major active faults (SAF vs SJF, GHF) are near-vertical to steeply dipping, are sub-parallel, and do not tend to merge at depth.
- Nodal planes also define blind, NW and SE extensions to the Glen Helen fault beyond its mapped surface trace, which have been subsequently used to generate updated CFM 3D fault surfaces for version 5.3.