Role of Geometric Complexity and Secondary Faults on Deformation in the San Gorgonio Pass

Justin Herbert and Michele Cooke
University of Massachusetts Amherst
Scott Marshall
Appalachian State University
Model Mismatch to Geologic Observations

Cooke and Dair (2011)

Herbert and Cooke (in press)

SGPT Average Normal Slip Rate = $1.2 \pm 0.1$ mm/yr

SGPT Average LL Slip Rate = $<0.1$ mm/yr
Crafton Hills Missing From CFM

View southwest from Morton Peak

Slip Rates  GPS Velocities  Conclusions
Inactive Segments of the Banning Strand of the SAF

Yule and Sieh (2003)
• Strain driven
  – Range of tectonic boundary conditions
• Linear-elastic material
• Faults are discretized with triangular elements
  – allows complex fault topology
  – follows the SCEC CFM
  *with modifications
SGPT Average Normal Slip Rate = $1.2 \pm 0.1 \text{ mm/yr}$
Match to Slip Rates Improves

Dip-Slip Rates

With Crafton Hills

SGPT Average Normal Slip Rate = $0.6 \pm 0.9$ mm/yr
Strike-Slip Rates

**Match to Slip Rates Improves**

*SGPT Average RL Slip Rate = 0.7 ± 1.24 mm/yr*

25a - 3 ka (Banning)
25b – 100 ka (Banning)
Can a model that matches slip rates also match GPS?

Slip Rates

GPS Velocities

Conclusions
Interseismic Models

Slip Rates  GPS Velocities  Conclusions
CHFS affects slip rate but not affect interseismic surface velocities
Do Slower Slip Rates Match Better?

Slip Rates

- Herbert & Cooke (in press)
- Becker et al. (2005)
- Loveless & Meade (2011)
- Meade & Hager (2005)

GPS Velocities

Conclusions
Revising the secondary faults provides better match to geologic slip rates.

Interseismic GPS station velocities are relatively insensitive to secondary faults that do impact slip rates.

Slip rates inferred from other GPS studies with simpler geometries have greater residuals when applied to our model – our model slip rates match both geologic observations and GPS velocities.

Data gaps:
- reverse slip rates on San Bernardino strand of the SAF
- slip rates on Garnet Hill
- Other secondary fault geometries

Discussion: What level of fault complexity is important for rupture?