Tectonic-geomorphic mapping along the northernmost San Jacinto fault zone and implications for slip distribution

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Northernmost San Jacinto fault zone (SJFZ)

Glen Helen fault

Middle San Jacinto fault

Lytle Creek fault
Methods

• Map geomorphic features related to tectonic activity
  • Aided by B4 and San Bernardino County LiDAR surveys
• Use existing consultant trench logs to locate faults in subsurface
• Identify potential paleoseismic and slip rate sites
Glen Helen fault

- 5m high scarp (southwest side up) can be followed for over 1km
- Potential slip rate site (starred location)
  - Stream channel crosses scarp
- Trenching exposed the Glen Helen fault, as well as an older, inactive fault zone
Glen Helen fault

- Offset of Holocene alluvium and modern “A” soil observed in trench 1 (Gary S. Rasmusen & Associates Inc., 1992)
Glen Helen fault

- Linear mountain front along Cajon Creek where fault is buried under alluvial fans
- Buried under terrace deposits in Cajon Creek
- 1m high uphill-facing scarps (south side up) in colluvium
- Fault is buried under terrace deposits to northwest
Middle San Jacinto fault

- Main trace is buried under recent alluvium
- Other traces are expressed as linear mountain fronts and benches
- Fault study by LOR Geotechnical Group Inc. (1994)
  - Trench 2 exposed cut layers of recent alluvium within 9.5 feet (2.9m) of the surface.
  - Detrital charcoal ages place the last surface rupture between calendar years 1380 and 1810 CE
Middle San Jacinto fault

• Splits into 3 strands

• North strand is buried under recent alluvium

• Middle strand deflects channels in old channel bar
  • 15-25m right-lateral displacement
  • Attempts to date channel bar were unsuccessful

• South strand deforms older lobes of an alluvial fan
  • Scarp is 3m high (NE side up)
  • No evidence of lateral displacement
Middle strand of SJF shows northeast side up component

- Uphill-facing scarps on northeast side of ridge

- Erosion fronts on southwest side of ridge
  - Likely initiated when northeast side up fault motion over-steepened slope
  - Erosion fronts propagate upslope
Middle San Jacinto fault

- Uphill facing scarp cuts one landslide, and is covered by several younger landslides
- Scarp extends semi continuously for 4.5 km
- Furthest NW extent of SJFZ
Lytle Creek fault

- Slip rate study by Mezger and Weldon (1983) yielded result of 2.5mm/yr
- Deflected streams in terrace deposits
- Lytle Creek fault is mostly expressed as fault benches
Analyzing distribution of geomorphic evidence

• Divide field area into 1km blocks along strike
• Count features per km block
• Classify strong vs possible evidence
  • Strong evidence: fault scarp, cut Quaternary deposit, offset stream, trench log, sag, shutter ridge
  • Possible evidence: bench, saddle, deflected stream, bedrock offset, linear mountain front
• Count strong evidence as 1, and possible evidence as 0.5
Discussion

- Middle strand San Jacinto fault displays the most geomorphic evidence of being recently active.
Discussion

- Geomorphic expression across the 3 strands of the SJFZ steadily increases to the southeast over a zone at least 20km long

- If geomorphic expression is a proxy for fault slip, this suggests slip is transferred to SJFZ gradually
Conclusions

• Geomorphic expression across the 3 strands of the SJFZ steadily increases to the southeast over a zone at least 20km long
• Middle strand SJF displays the strongest geomorphic evidence of being recently active
• Middle strand SJF had a ground rupturing earthquake between calendar years 1380 and 1810 CE (LOR Geotechnical Group Inc., 1994)
• Middle strand SJF displays northeast-side up component
Thank you!
References

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