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SCEC-SURE Intern, 2004

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Developing an integrated rock mechanics-seismological database, field guide, and model for exhumed seismogenic faults in southern California

Purpose

The purpose of this project is to present a working field guide that gives light on different aspects of active and exhumed faults in southern California. The field guide will be designed to complement understandings of fault geology for seismologists and geophysicists, but is not limited to these disciplines. Users may range from undergraduates to advanced researchers.

This project will have two products. The first is a summary of information from the different sites in a database format and the second is a draft of a paper that will summarize and interpret the results found in part one. The end product will be made available in print, CD and linked to the SCEC website.

Each Site Will Include:

· Location of site and clear directions

· Basic geological and seismological information

· Rock type

· Exhumation amount

· Fault history

· Understanding of fault geometry

· Segmentation

· References to key papers on rocks or seismology of the site

Each Site May Also Include:

· Physical characteristics: density of fractures, small

faults, and location of fault core

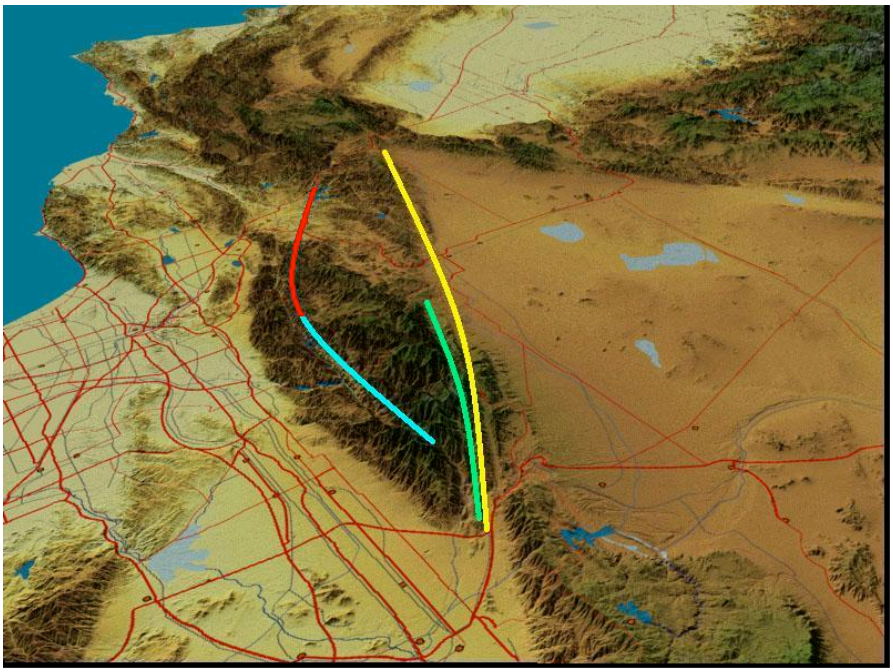
· Chemical characterization: mineralogy, whole-rock

chemistry, and isotopic analyses

· Particle size distribution

Locations to be used

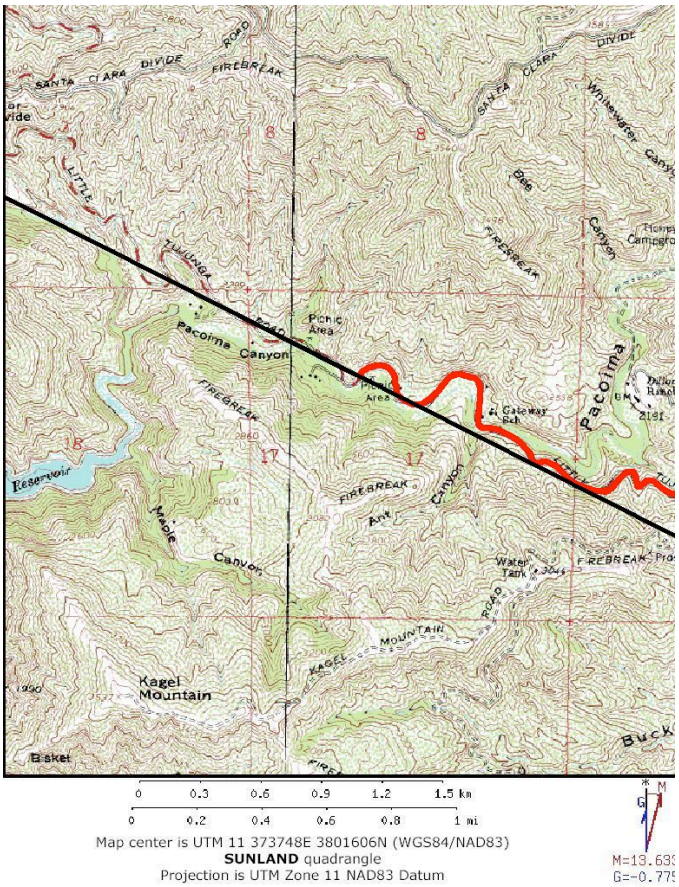
San Andreas Fault
Blue Cut
Wrightwood-Apple valley road cuts
Palmdale
Lake Hughes
Punchbowl Fault
Blue Cut
Lone Pine Canyon
Devil's Punchbowl State Park
North Branch San Gabriel Fault
Coldwater Canyon
San Gabriel River
Bear Creek
Devils Canyon
San Gabriel Fault
Big Tujunga Canyon
Little Tujunga Canyon
Clamshell-Sawpit Fault
NW San Bernardino Mountains-Silverwood Lake area



Little Tujunga

Introduction

This site was examned by Anderson et al. (1983) who characterized the mineralogy and grain size of fault zone rocks. Motion on the San Gabriel fault occurred ~12-4 ma and has a right lateral slip between 42-45km.



Directions

1. "Earthquake Country" picnic site on Little Tunjunga Rd. (next to 945 red highway sign.)
2. Park at sign and hike 30 feet up trail to fault.
3. Fault is on your left.

GPS: 0372834, 3802234. Elevation: 2176 feet

Discussion

This is a nice exposure juxtaposing biotite gneiss against white quartz monzanite/granite. The fault core is well defined with a sharp contact. It is a dark ultracataclasite around 4 cm thick. Distinct igneous and metamorphic protoliths on either side of the fault are cataclastically deformed, but show relatively little mineralogic alteration to within several meters of the fault core. The cataclasite at this site consists of 10-15% subangular porphyroclasts of feldspar, quartz, and lesser amounts of epidote, biotite, magnetite, and actinolitedispersed in a aphanitic, dark-colored matrix.

Bear Creek

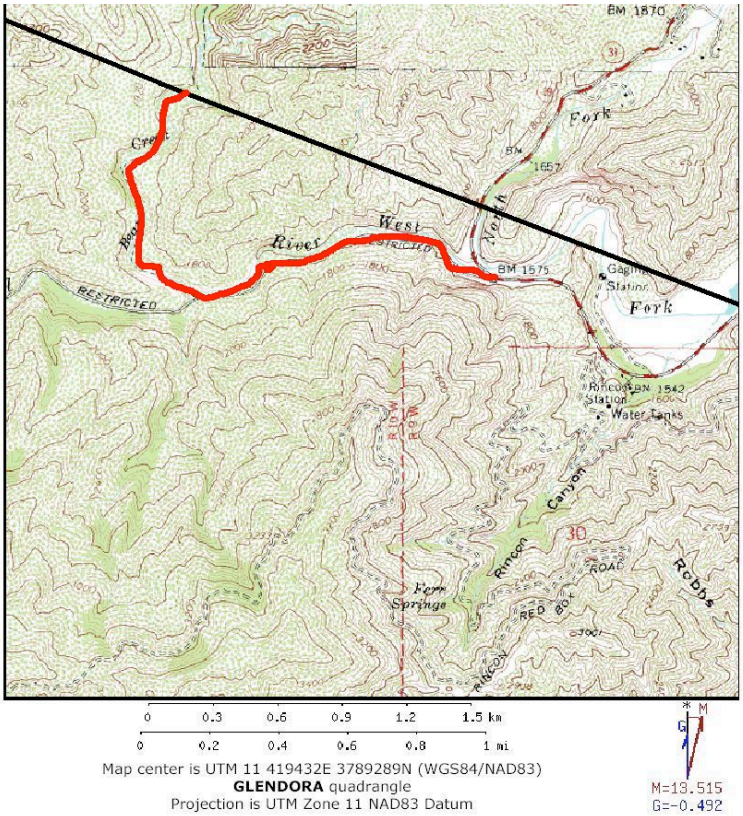
Introduction

This is one of the localities described in Chester et al. (1993) and Evans & Chester (1995). This shows the structure of the fault a- 10-20cm thick ultracataclasite zone within a ~1m foliated cataclasite. There is ~100m thick damage zone. These features have been observed along the fault to the west. Chester et al. (1993) and Wilson et al. (2003). Motion on the North Branch San Gabriel fault occurred ~12-5ma and has a right lateral slip of 22km.

Directions

1. Drive up Highway 39 from Azusa to a parking lot at the West Fork of the San Gabriel River

2. Park either at larger parking lot just past the gated trail head and walk across the bridge or park at much smaller lot just before gate. It is usaually better to visit the site on a weekday and when the weather is warm.



GPS at gate 1 , Zone 11s: 0420009, 3789235 Elevation: 1555 Feet

3. Hike west on paved trail towards Bear Creek

4. At the 1 mile marker swing left and go underneath a bridge.

5. Continue to hike north along the creek. Be prepared to cross the creek at high water levels. Your feet may get wet!

6. Just past the 6th stream crossing 2 , go through a campground towards a boulder stream drainage. There is a wilderness sign in-between the 5th and 6th stream crossings.

7. Fault is exposed on left (west) at mouth of drainage

GPS of Fault: 0418479, 3790138 Elevation: 1726 feet

Discussion

The fault at this location contains a distinct igneous and metamorphic protolith on either side of the fault that are cataclastically deformed but show relatively little mineralogic alteration to within several meters of the fault core. The protolith to the north consists of granite and granodiorite and the protolith to the south consists of dorite and granite. There is a single fault core that is located near the center of the damaged zone. The fault core becomes thicker as it approaches the ground in the outcrop. Many small faults are located around the fault core. The measured fracture density and mineralogic alteration increased dramatically in foliated cataclasite (5). Protocataclasites from the damage zone and cataclasites form the fault core have fractal particle-size distribution with a fractual dimension of 1.6 to 1.8 in a planar section.

The mineralogy of the ultracataclasite in the fault core is composed of very fine-grained illite/smectite, montmorillonite, and laumontite. To the south of the fault plagioclase-pyroxene-biotite-hornblende gneiss interlayered with a plagioclase-K-feldspar-quartz hornblende-biotite granite. Granitic rocks to the north are quartz-K-feldspar (+/- plagioclase) biotite granite and monzonite porphyry and massive granite; the granodiorite to the north is a feldspar-quartz-biotite (+/- hornblende) gneiss.

Work in Progress

This project is not complete and work will continue until December of 2004 by Joe Jacobs and Jim Evans. The list of sites is not complete, as sites may be added or subtracted, as the authors and contributors deem necessary. Information used is susceptible to this editing as well. Added contributions of sites and/or data are welcome!

References

1. Anderson, Osborne, & Palmer. Cataclastic Rocks of the San Gabriel Fault-An Expression of Deformation at deeper Crustal Levels in the San Andreas Fault Zone. Tectonophysics, 98, 209-251, (1983).

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3. Oakeshott. Geology and Mineral Deposits of San Fernando Quadrangle Los Angeles County, Califorina. California Division of Mines, Bulletin 172, 147pp., (1958).

4. Chester, Chester, Kirschner, Schulz, and Evans. Structure of Large-Displacement, Strike-Slip Fault Zones in the Brittle Continental Crust. Rheology and Deformation of the Lithosphere at Continental Margins 223-260, (2004).

5. Chester, Evans, & Biegel. Internal Structure and Weaking Mechanisms of the San Andreans Fault. Journel of Geophysical Research, 98, 771-786, (1993).