[PS]Internal Architecture Of the Proto-Kern Canyon Fault At Engineer's Point, Lake Isabella Dam Site, Kern County, California*

Zachary S. Martindale[1], Graham D.M. Andrews[1], Sarah R. Brown[1], William C. Krugh[1], and Junhua Guo[1]

Search and Discovery Article #51168 (2015)**
Posted October 13, 2015

*Adapted from poster presentation given at Pacific Section AAPG, SEG and SEPM Joint Technical Conference, Oxnard, California, May 3-5, 2015

[1]California State University, Bakersfield, CA, USA (zacharymartindale@yahoo.com)

Abstract

The core of the Cretaceous (?) proto-Kern Canyon Fault (KCF) is exposed continuously for 1.25 km along Engineers Point at Lake Isabella, Kern County, California. The proto-KCF is notable for (1) its long and complex history within, and perhaps preceding the Sierra Nevada batholith, and (2) hosting the Quaternary Kern Canyon Fault, an active fault that threatens the integrity of the Lake Isabella auxiliary dam and surrounding communities. We are investigating the internal architecture of the proto-KCF to explore its control on the likely behavior of the modern KCF. The proto-KCF is developed in the Alta Sierra biotite-granodiorite pluton. A traverse across Engineers Point, perpendicular to the proto-KCF trace, reveals gradational increases in fracture density, fracture length, bulk alteration, and decreases in fracture spacing and grain size toward the fault core. Mapping of the fault core reveals two prominent and laterally extensive zones: (1) continuous foliated blastomylonitic granodiorite with steeply dipping, anastomosing shear bands and minor mylonite planes, and (2) foliated orange and green fault breccia with intergranular gouge, strong C/S fabric, and a central gouge plane. The fault breccia zone is intruded by a lensoidal, post-deformation dacite dike, probably ca. 105 - 102 Ma (Nadin and Saleeby, 2008) and is weakly overprinted by a set of crosscutting spaced, short, brittle fractures, often coated in calcite, which we infer to be genetically related to the modern KCF. We present our structural and lithological data that will be supported by mineralogical and geochemical analyses

Reference Cited

Nadin, E.S., and J.B. Saleeby, 2008, Disruption of regional primary structure of the Sierra Nevada batholith by the Kern Canyon fault system, California: Geological Society of America Special Paper 438, p. 429-454.

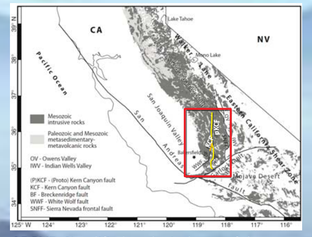
T23C-4686

Internal architecture of the proto-Kern Canyon Fault at Engineer's Point, Lake Isabella Dam site, Kern County, California

Zachary S Martindale[1,2], Graham DM Andrews[1], Sarah R Brown[1], William C Krugh[1], Junhua Guo[1]

[1] CSU Bakersfield, [2] NSF-CSUB-CREST

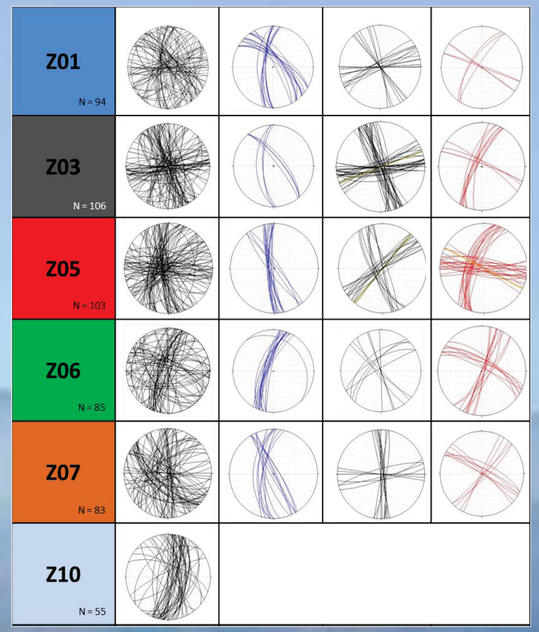
The core of the Cretaceous (?) proto-Kern Canyon Fault (KCF) is exposed continuously for 1.25 km along Engineer's Point at Lake Isabella, Kern County, California. The proto-KCF is notable for (1) its long and complex history within, and perhaps preceding the Sierra Nevada batholith, and (2) hosting the Quaternary Kern Canyon Fault, an active fault that threatens the integrity of the Lake Isabella auxiliary dam and surrounding communities. We present our preliminary structural and lithological data that are supported by mineralogical and geochemical analyses.



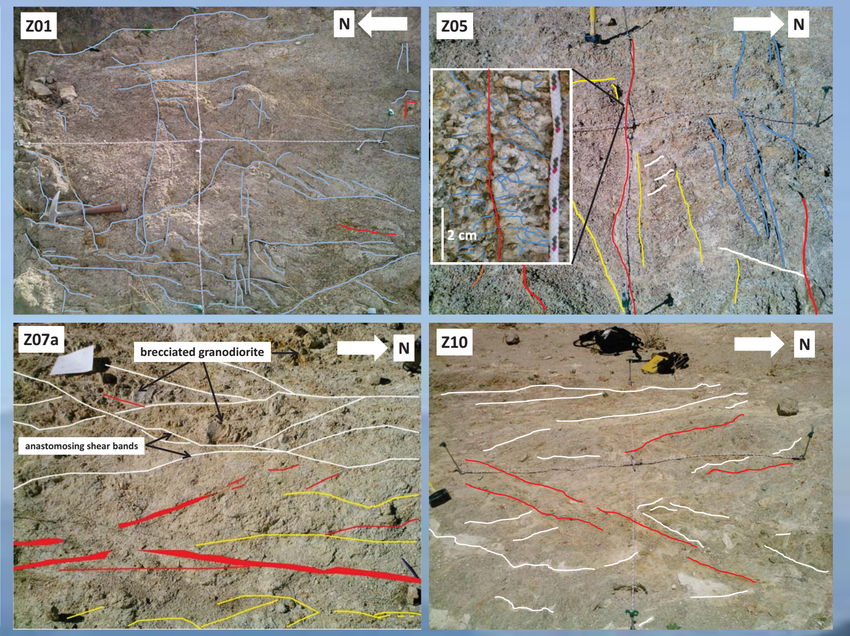
ABOVE: Simplified geological map of the southern Sierra Nevada, California. The proto-Kern Canyon fault and Kern Canyon fault are shown. Adapted from Nadin & Saleeby (2010).

ABOVE: Plan view of Engineer's Point and the Lake Isabella dams – the main dam is on the left (west) and the auxiliary dam is on the right.

ABOVE: Oblique view north across the Lake Isabella town site and valley. The valley is the hangingwall to the KCF (red line); Engineer's Point is the northern end of the footwall uplift. **The KCF passes below the auxiliary dam.**

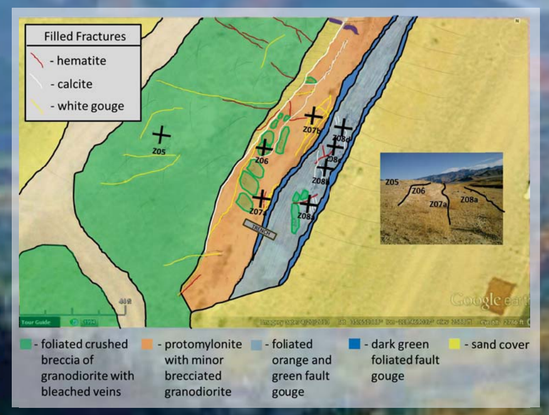


ABOVE: Summary of fracture geometries from Z01 (far edge of the damage zone) to Z10 (fault core). Where possible, distinctive conjugate fracture sets are show.



ABOVE: Fracture maps from structural sample sites at Engineer's Point. Open fractures are **blue**, calcite-filled fractures are **white**, hematite-filled fractures are **red**, and gouge-filled fractures are **yellow**. The sampling quadrant is present in the image of site Z10.

- foliated orange and green fault gouge
- protomylonite with minor boudinaged brecciated granodiorite
- foliated crushed breccia of granodiorite with bleached veins
- densely fractured, non-foliated biotite granodiorite (avg. fracture spacing < 3 cm)
- non-foliated biotite granodiorite with minor fracturing (avg. fracture spacing > 3 cm)
- mylonite of pKCF
- ultramylonite of pKCF
- rhyolite
- sand cover

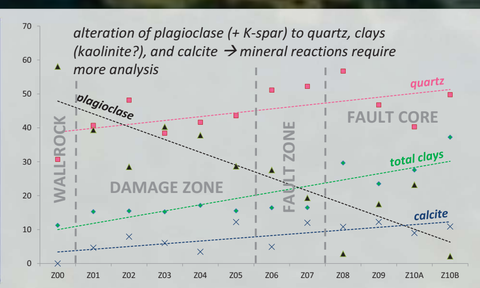


LEFT & ABOVE: Geologic maps of Engineer's Point showing different fault rock lithologies and the locations of sampling and structural analyses sites.

The proto-Kern Canyon fault zone is lithologically diverse, and different lithologies appear to be juxtaposed against each other by macroscopic anastomosing faults.

The Kern Canyon fault is exposed within the pKCF fault zone as planar or gently curviplanar, smooth, near vertical slickensided and calcite-coated faults.

zone		sample station	lithologies	mineralogy	structural station	dominant structural trends	fracture density (#/m²)	fracture length (cm)	interpretation
fault zone	fault core	Z08 – Z10	foliated gouge, mylonite, ultramylonite	qtz, chl, mica, calc, +/- plag	Z10		14		core of the proto-Kern Canyon fault and host of the Kern Canyon fault; cross-cut by calcite-filled fractures and laterally continuous planar fault splays
	fault zone	Z06 – Z07	protomylonite, foliated fault breccia		Z07		530		proto-Kern Canyon fault zone transitional into the damage zone; anastomosing fractures and brittle-ductile shears in host granodiorite; cataclastic disaggregation of granodiorite blocks;
					Z06		494		
damage zone		Z01 – Z05	non-foliated fault breccia	qtz, plag, mica, chl, calc	Z05		676		wide proto-Kern Canyon fault damage zone of progressively more fractured and altered granodiorite with occasional brittle-ductile shears zones; diverse fracture trends are interpreted as anastomosing NNE-trending pKCF fractures and abundant E-W and NNW-SSE Riedel shears; no evidence of NNE-trending Kern Canyon fault brittle fractures or faults;
					Z03		862		
					Z01		630		
wall rock		Z00	granodiorite	plag, qtz, kspar, mica	Z00	n/a	n/a	n/a	isotropic plutonic wall rock – negligible hydrothermal alteration and spaced, mutually perpendicular tensile fractures

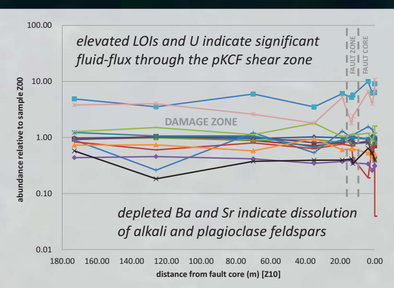


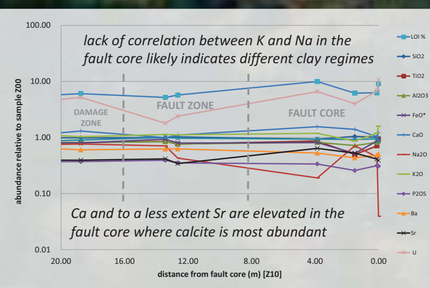
FAR LEFT: XRD spectra from samples Z00 (non-deformed granodiorite) to Z10 (fault core). Mica is probably present in all.

LEFT: Calculated abundances of key minerals and how they change across the damage and fault cones.

RIGHT: Whole rock major oxide, LOI, and select trace element gradients normalized against sample Z00.

FAR RIGHT: Normalized chemical gradients across the 20 m of the fault zone and adjacent damage zone.





Implications

- The Quaternary KCF is hosted within the fault zone and fault core, of the proto-KCF along Engineer's Point; it runs immediately beneath the western edge of the auxiliary Lake Isabella dam .
- The KCF is hosted in foliated phyllosilicate-rich cataclasites and parallel to their foliation.
- The proto-KCF fault core is the most strongly altered and hydrated part of the fault zone, and is presumably the weakest part.
- KCF faults and fractures exploit suitably orientated proto-KCF surfaces.
- KCF is likely to be weak and creep in this section.