2018 AGU Fall Meeting: EP51D-1857

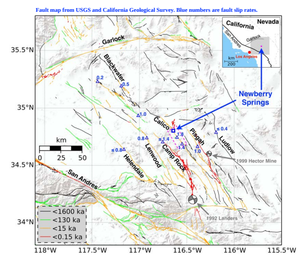
Geological slip rate estimate for the Calico Fault at Newberry Springs, California: new age constraints from optically stimulated luminescence dating

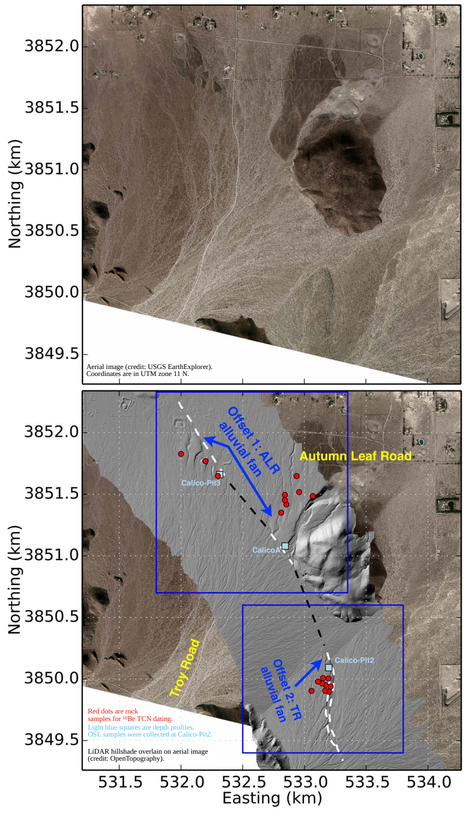
Paula M. Figueiredo[1], Craig Rasmussen[2], Surui Xie[3], Paul H Wetmore[3], Lewis A Owen[1], Timothy H Dixon[3]

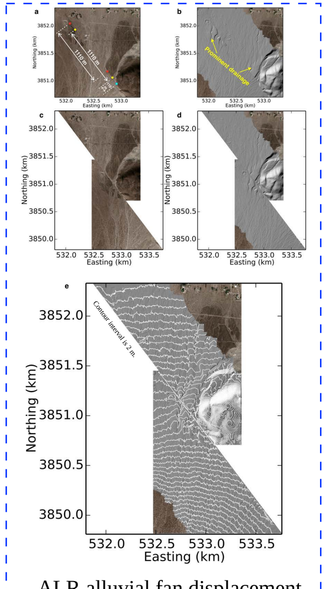
1. Department of Geology, University of Cincinnati, Cincinnati, OH, USA 2. Department of Soil, Water and Environmental Science, University of Arizona, Tucson, AZ, USA 3. School of Geosciences, University of South Florida, Tampa, FL, USA Correspondence: PMF <figueipm@ucmail.uc.edu>

Abstract:

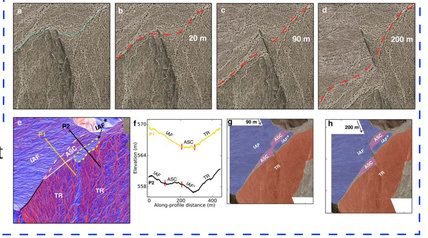
- Soil chronostratigraphy of an alluvial fan (TR alluvial fan) offset by the Calico Fault at Newberry Springs California suggests a Holocene to latest Pleistocene age.
- ^{10}Be terrestrial cosmogenic nuclide (TCN) concentrations of a depth profile from the TR alluvial fan show no exponential decrease with depth, while ^{10}Be dating of rock samples on the alluvial fan surface shows a high degree of scatter (11–250 ka), suggesting a complex deposition-erosion history.
- Optically stimulated luminescence (OSL) dating was used to constrain the age of the TR alluvial fan, yielding ages range from 5.0±0.4 ka to 5.8±0.4 ka.
- The young age from OSL dating is consistent with a slip rate that is higher than previous estimates for the Calico Fault in the Eastern California Shear Zone.



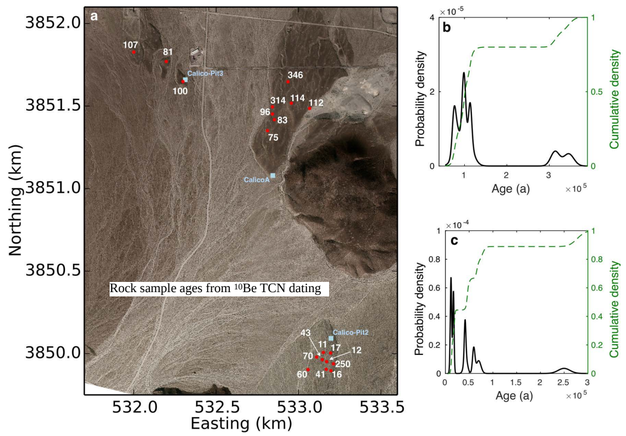


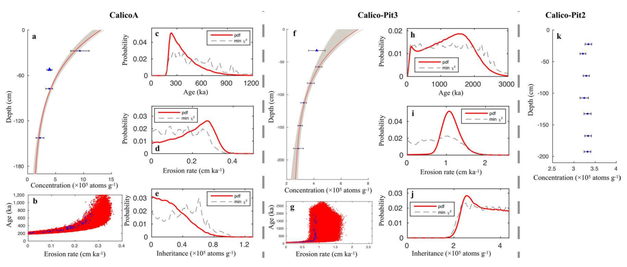


ALR alluvial fan displacement estimate: 1110±110 m.



TR alluvial fan displacement estimate: <200 m.
200/90/20/… ?



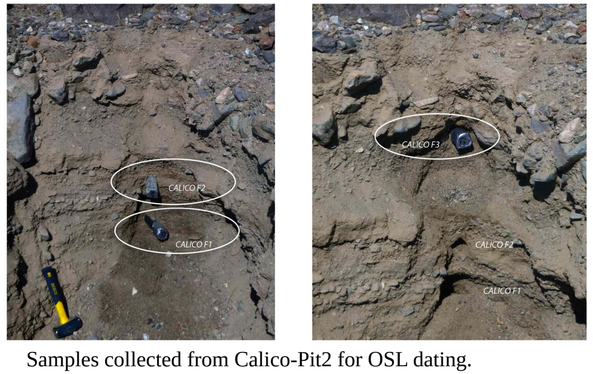


Depth profiles

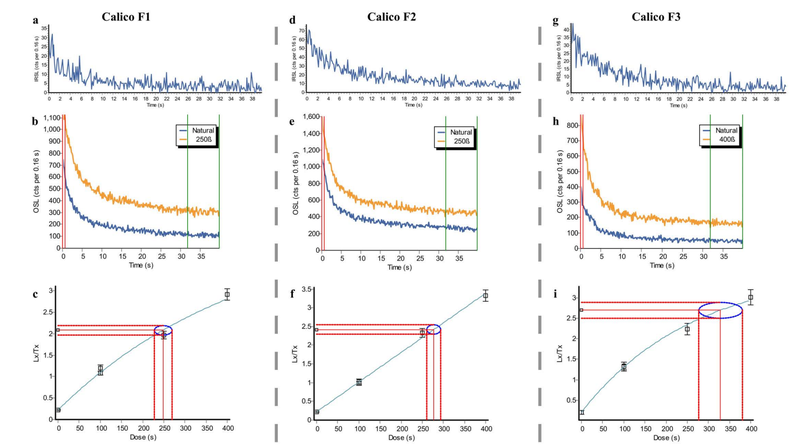
^{10}Be TCN dating

1) ALR alluvial fan: rock samples yields a oldest age of 346±24 ka (from a erosional resistant quartz sample). Depth profiles show broad ranges of ages, but both show obvious exponential decrease along depth.
2) TR alluvial fan: rock samples show a wide range of ages (11-250 ka), and inheritance saturation is shown in the depth profile.
3) Considering surface stony rubble packing, carbonate rind thickness, and soil chronostratigraphy, 346±24 ka is used as the preferred age for the ALR alluvial fan, resulting in a 3.2±0.4 mm/yr fault slip rate. TR alluvial fan should have a much younger age, and is subject to complex deposition-erosion history.

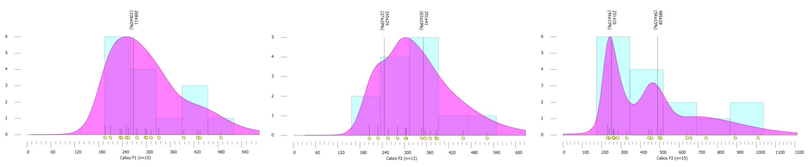
Therefore, we collected several samples from Calico-Pit2 and use OSL dating to estimate an independent age for the TR alluvial fan.



Samples collected from Calico-Pit2 for OSL dating.



ISRL test for feldspar. (top) typical OSL shine down curves (middle), regenerative curves (bottom) and for each dated sample.



Equivalent doses for each sample, plotted as histograms (number of aliquots) and probability against equivalent dose (Gy).

Summary table of OSL dating results from extracted from sediment, sample locations, radioisotopes concentrations, moisture contents, total dose-rates, D_E estimates and optical ages. More detail in Xie et al. (2018).

Sample number	Location (°N/°W)	Altitude (m asl)	Depth (cm)	U (ppm)	Th (ppm)	K (%)	Rb (ppm)	Cosmic (Gy/ka)	Dose-rate (Gy/ka)	n_t	n	Dispersion D_E (%)	Average equivalent dose (Gy)	OSL Age (ka)
Calico F1	34.7925/116.6371	596	75	2.5	14.5	2.8	110	0.21±0.02	4.395±0.24	24	15	19	25.46±1.0	5.8±0.4
Calico F2	34.7925/116.6371	596	55	2.1	14.1	3.0	118	0.22±0.02	4.447±0.25	24	13	21	23.27±2.7	5.2±0.7
Calico F3	34.7925/116.6371	596	33	2.3	14.9	3.1	120	0.22±0.02	4.731±0.26	32	15	40	23.84±1.5	**5.0±0.4**

Conclusions:

1) OSL dating yields a Holocene age for the TR alluvial fan, and the fan sediments were deposited in a short period of time (shallow sample and deep sample are different in ages by <1 ka).
2) For the young TR alluvial fan, inheritance can change apparent ages of ^{10}Be TCN dating results significantly, and should be quantified in estimating the true exposure age.
3) Although the complexity of the TR alluvial fan prevents us to estimate a robust displacement, the young OSL age suggests a faster slip rate than previous studies.

References

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Xie et al. (2018) A new geological slip rate estimate for the Calico Fault, eastern California: Implications for geodetic versus geologic rate estimates in the Eastern California Shear Zone. *Int. Geol. Rev.*

Acknowledgements

This research was supported by USGS-NEHRP grant G16AP00102 and G16AP00103. We acknowledge Amelia Nachbor of the University of South Florida for help with the field work, and Antonio Luna for help with some sample preparation. Sarah Hammer and Kat Rivers at the University of Cincinnati are also thanked for help in sample preparation. We thank OpenTopography for providing LiDAR raster data, and USGS for providing high resolution aerial imagery. This research benefits from comments by Mike Oskin and David Katopody.