Geophysical Research Abstracts
Vol. 15, EGU2013-5086, 2013
EGU General Assembly 2013

Provenance of alluvial fan deposits to constrain the mid-term offsets along a strike-slip active fault: the Elsinore fault in the Coyote Mountains, Imperial Valley, California.

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The lateral variation in rates along a fault and its constancy along time is a matter of discussion. To give light to this discussion, short, mid and long term offset distribution along a fault is needed. Many studies analyze the short-term offset distribution along a strike-slip fault that can be obtained by the analysis of offset features imprinted in the morphology of the near-fault area. We present an example on how to obtain the mid- to long-term offset values based on the composition of alluvial fans that are offset by the fault. The study area is on the southern tip of the Elsinore fault, which controls the mountain front of the Coyote Mountains (California). The Elsinore-Laguna Salada fault is part of the San Andreas fault (SAF) system, extending 250 km from the Los Angeles Basin southeastward into the Gulf of California, in Mexico. The slip-rate on the southern Elsinore fault is believed to be moderate based on recent InSAR observations, although a recent study near Fossil Canyon (southern Coyote Mountains) suggests a rate in the range of 1-2 mm/yr. For this study we processed the airborne LiDAR dataset (EarthScope Southern & Eastern California, SoCal) to map short to mid-term alluvial offsets. We reprocessed the point clouds to produce DEMs with 0.5m and 0.25m grids and we varied the insolation angles to illuminate the various fault strands and the offset features. We identified numerous offset features, such as rills, channel bars, channel walls, alluvial fans, beheaded channels and small erosional basins that varied in displacement from 1 to 350 m. For the mid- to long-term offsets of the alluvial fans we benefited from the diverse petrological composition of their sources. Moreover, we recognized that older alluvium, which is offset by greater amounts, is in some cases buried beneath younger alluvial fan deposits and separated by buried soils. To determine the source canyon of various alluvial elements, we quantified the clast assemblage of each source basin and each alluvial fan on both sides of the fault. To accomplish this, we used a portable grid and classified more than 300 clasts at each of more than 90 sites along the fault. We found a very good fit between displaced alluvial fan elements and their inferred source canyons, but a poor match with the alluvium from neighboring canyons, which allows us to resolve the long-term offset. Planned dating of the pedogenic carbonate associated with these buried soils will allow the resolution of the mid- to long-term slip rates over multiple time frames to test the constancy of fault slip rate during the late Quaternary, as well as to test the lateral variations in rate along the fault.