Slip Behavior of Faults through Several Earthquake Cycles
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Abstract

How repeatable are consecutive ruptures of a fault? The answer to this fundamentally important question in earthquake science will depend largely on the recovery of reliable records of serial fault rupture. Unfortunately, high-quality records are extremely rare. Our recent 3-D excavations at a site along the San Andreas fault reveals a record of several repeated offsets at a single location. At this site along the Carrizo segment of the San Andreas fault, small channels cross the fault at a high angle. Upstream from the fault, a solitary source channel cuts a Pleistocene alluvial fan. On the downstream side, several small channels are offset dextrally from the source channel and have been sequentially abandoned. This configuration has enabled us to determine the slip associated with the past several ruptures. We opened a latticework of trenches across the offset channels on both sides of the fault. The trenches downstream from the fault show several single channels, partially infilled by fluvial and colluvial debris. The trenches across the upstream part of the channel exposed a set of nested channels. The elevations, shapes, stratigraphy and ages of these nested channels allow us to correlate them with particular, singular channels across the fault, downstream. These excavations allow us to locate accurately the offset channel pairs and determine the amounts of motion. The dextral slips associated with the latest 2 events are 7.9 ± 0.1m, and 7.6 ± 0.5 m. Two previous offsets are 5-6 m and 1 -2 m, respectively. Curiously, the combined magnitude of the 3rd and 4th events back is also about 7 m. This work provides a new opportunity to re-examine various earthquake recurrence models. It appears that at this locality the San Andreas fault has a predilection to slip 7 to 8 meters per event.