

Gallery of Geology—Prehistoric earthquake ruptures on the Hubbell Spring fault and implications for seismic hazards south of Albuquerque

The Hubbell Spring fault is near the eastern margin of the Albuquerque–Belen Basin in the central Rio Grande rift, and is one of the most active faults in the region, with a cumulative average late Quaternary slip rate of approximately 0.2 mm/yr (0.08 inch/yr; Olig et al. 2004). Typical of many intrabasin faults, the Hubbell Spring fault geometry is complex, with at least two dominant west-dipping splays (western and central) extending for over 40 km (25 mi) south of Albuquerque. To better understand the earthquake potential of the Hubbell Spring fault, we conducted a paleoseismic (prehistoric earthquake) investigation at the Carrizo Spring site on the previously untrenched central Hubbell Spring fault (Olig et al. 2004). Our study included mapping, scarp profiling, trenching (Fig. 1), drilling (Fig. 2), and luminescence analyses (Fig. 3). The project was conducted by URS Corporation in cooperation with the New Mexico Bureau of Geology and Mineral Resources, with field assistance provided by University of New Mexico graduate students. It was funded by the U.S.



FIGURE 1—Looking east at the Carrizo Spring trench across the central Hubbell Spring fault. Bosque Peak of the Manzano Mountains is in the background. Photo by Susan Olig.



Geological Survey through the National Earthquake Hazards Reduction Program (NEHRP). We found structural, stratigraphic, and pedologic evidence for the occurrence of at least four, and probably five, large earthquakes since deposition of piedmont deposits on the Llano de Manzano surface about 83.6 ± 6.0 ka. All of these events included warping across a broad deformation zone, whereas the three largest events also included discrete slip across five fault zones. Behavior appears surprisingly noncharacteristic (i.e., earthquake size was highly variable), and preferred vertical displacements per event ranged from 0.4 to 3.7 m (1.3 to 12 ft). Ages from luminescence analyses indicate that the timing of the four largest surface-deforming events on the central Hubbell Spring fault overlaps with the timing of the four youngest faulting events on the western fault (as previously determined by Personius and Mahan 2003), suggesting that coseismic rupture of the central and western faults accounts for over 96% of the total late Quaternary strain on the fault system. However, the smallest warping event on the central fault does not appear to correlate to any events on the western fault, indicating that independent rupture of the central fault also does occasionally occur. Preferred estimates of recurrence intervals appear relatively consistent for the past three complete seismic cycles of coseismic rupture (17 ky, 27 ky, and 14 ky). In comparison, slip rates surprisingly vary by an order of magnitude, ranging from 0.04 mm/yr to nearly 0.5 mm/yr. This is due to noncharacteristic behavior, a finding that may have significant implications for seismic hazards elsewhere in the rift because this type of behavior results in higher proba-

FIGURE 2—Bruce Allen and David Love using the New Mexico Bureau of Geology and Mineral Resources drill rig to drill borehole B1 on the downthrown side of the central Hubbell Spring fault. Photo by Susan Olig.

bilistic hazard estimates (see Wong et al. this issue). Additional investigation is needed to determine how activity on the Hubbell Spring fault may relate to other nearby faults along the eastern rift margin, including the Palace–Pipeline fault to the west, the Manzano fault to the east, and unnamed faults on the Llano de Manzano to the south. URS Corporation recently received another NEHRP award to map Quaternary fault scarps and reconnoiter for possible trench sites on the southern Llano de Manzano.

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FIGURE 3—Steven Forman collecting luminescence samples from Unit 4 in the Carrizo Spring trench. Photo by Susan Olig.

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