LIDAR AND GEOPHYSICAL MAPPING OF THE RODGERS CREEK-HEALDSBURG FAULT THROUGH SANTA ROSA, CALIFORNIA

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ABSTRACT

Airborne lidar topography reveals for the first time the complex trace of the Rodgers Creek-Healdsburg fault (RCHF) through Santa Rosa, the largest city in the northern San Francisco Bay area. Vertical deformation of the Santa Rosa Creek floodplain, expressed as small (< 1-m-high) scarps, results in a 0.4-km-wide pull-apart basin beneath the urban cover that is part of a broader 1-km-wide right-releasing bend in the fault. Subsurface structures interpreted from high-resolution gravity, aeromagnetic, seismic-reflection and geotechnical data provide context for the complex surface pattern of faulting and for the distribution of seismicity and possibly for spatial variation in creep behavior. We identify a small (~1-km wide) dense, magnetic basement body subjacent to the pull-apart basin that we interpret as a strong asperity, likely part of a larger locked patch of the fault to the south. A local increase in frictional resistance to slip associated with the rock body appears to explain 1) development of the pull-apart basin above where the RCHF intersects the body, 2) seismicity localized around the north end of the body, notably the 1969 M 5.6 and 5.7 Santa Rosa earthquakes and aftershocks, and 3) creep rates that are higher north of Santa Rosa than to the south on the Rodgers Creek fault. A major earthquake ($M \geq 6.7$) on the RCHF is considered relatively likely in the coming decades, and an earthquake associated with the inferred asperity could generate high-frequency ground motions in the Cotati basin beneath Santa Rosa, already known to produce amplified and damaging shaking from historical earthquakes.