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# High-resolution imaging of earthquake rupture process for Hayward microearthquakes

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The Hayward fault (HF) in the San Francisco Bay Area is one of the major strands of the San Andreas fault system, extending for about 70 km. Crustal deformation along the HF is characterized by a wide variety of fault slip behaviors from aseismic creep to stick-slip earthquake including a Mw∼6.8 earthquake in 1868. The high stress drop earthquakes have been observed near a geodetically-imaged locked zone that might be responsible for past and future M > 6.7 HF earthquakes, which suggests the stronger fault zone material associated with this locked zone. To further explore the spatial heterogeneities of stress drop, we determine finite-fault rupture models for Hayward microearthquakes (3 < M < 4) by using an empirical Green's function approach (Mori & Hartzell, 1990, BSSA). We make use of high-quality borehole seismograms from the Hayward Fault Network (HFN). The HFN is an array of borehole instrumentation deployed along the HF, with the aim of improving monitoring of spatial and temporal evolution of microseismicity. The stations are typically equipped with three-component geophones and accelerometers at a depth of 30-200 m. The HFN was initially deployed with 10 borehole stations in 1995-1996, and the 20 stations are currently in operation. Recently two borehole sites were installed by the Plate Boundary Observatory, which improves the azimuthal coverage for the finite-fault modeling. Our analysis finds a variety of slip distributions from the Hayward microearthquakes that includes multiple subevents, strong directivity, and high stress drop. One of the high stress drop earthquakes is the 2011 Mw 4.0 Berkeley event. The location of this event is about 5 km distance from the geodetically-imaged locked zone. The estimated peak stress drop is about 150 MPa while the stress drop averaged over the asperity is about 30 MPa. Our result indicates the strong small patch with the rupture area that is able to sustain shear stress up to the order of 100 MPa.