Stress drop and asperity dimensions of repeating microearthquakes on the San Andreas fault

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The source properties and recurrence time of repeating microearthquakes give insight into the physics of earthquake rupture. We focus on characterizing microearthquake source properties along the San Andreas fault, including asperity dimensions and stress drop, using the spectral ratio method. The spectral ratio method allows us to determine the relative moment release and corner frequency of earthquakes located close to one another by removing common propagation-related effects such as attenuation. We combine seismic data from the SAFOD pilot hole (32 geophones from 850-2000 m depth) with a regional network (12 near-surface boreholes, typically 250 m deep). We find stress drop for many of the microearthquakes to be fairly high, usually 2-10 MPa for events at 3 km depth. We find no systematic variation in stress drop for events from M0 to M2.5 at a given depth interval, but we do observe higher stress drops at deeper depths. We also compare several events in a repeating earthquake sequence, evaluating the changes in moment release and spectral content of each event. Using this method, along with the recurrence time between repeating events, we find that the local slip rate accelerates following the 2004 Parkfield M6 earthquake, but exponentially decays back to the pre-earthquake rate over several years. This post-earthquake recovery can help constrain the frictional properties of the fault inside and outside the repeating earthquake asperity.