Title: Interplay of Seismic and Aseismic Slip on the San Andreas Fault Near San Juan Bautista, Central California

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Abstract:
The central creeping section of the San Andreas fault (SAF) from Parkfield in the south to San Juan Bautista (SJB) in the north is creeping aseismically and separates the locked portions of the fault that rupture in great earthquakes. The transition between creeping and locked fault sections is a preferential zone of earthquake nucleation, where frictional heterogeneity leads to a complicated relationship of seismic and aseismic slip. The location in a locking transition, numerous moderate-sized local earthquakes, a historic record of aseismic slip transients, and dense instrumentation near SJB make it an excellent natural laboratory to study the interplay of seismic and aseismic slip. Here we combine seismic and geodetic observations from 1993-2021 to study aseismic slip transients and their relationship to moderate-sized local earthquakes and explore a number of fundamental questions: What is the relationship between shallow and deep slip? What are the scales and patterns of spatiotemporal changes in creep rate along this locking transition? What is the largest earthquake we can expect in the region? We look at detailed spatial changes in earthquake statistics and repeating earthquakes and find an anomalous region potentially indicative of increased locking. We also explore spatiotemporal changes in frequency content of earthquakes that may illuminate variable frictional fault properties. We then combine these seismic observations with geodetic (i.e., cGPS, InSAR, creepmeters, borehole strainmeters) data to confirm apparent changes in creep rates and model aseismic slip transients. Further, we are installing new creepmeter pairs to capture propagation velocity of creep events along the SAF to better evaluate changes in creep rates along the fault. Studying the interplay of seismic and aseismic slip in this well-instrumented region may provide insights into other tectonic environments, particularly the offshore portion of subduction zones, where direct observations are limited.

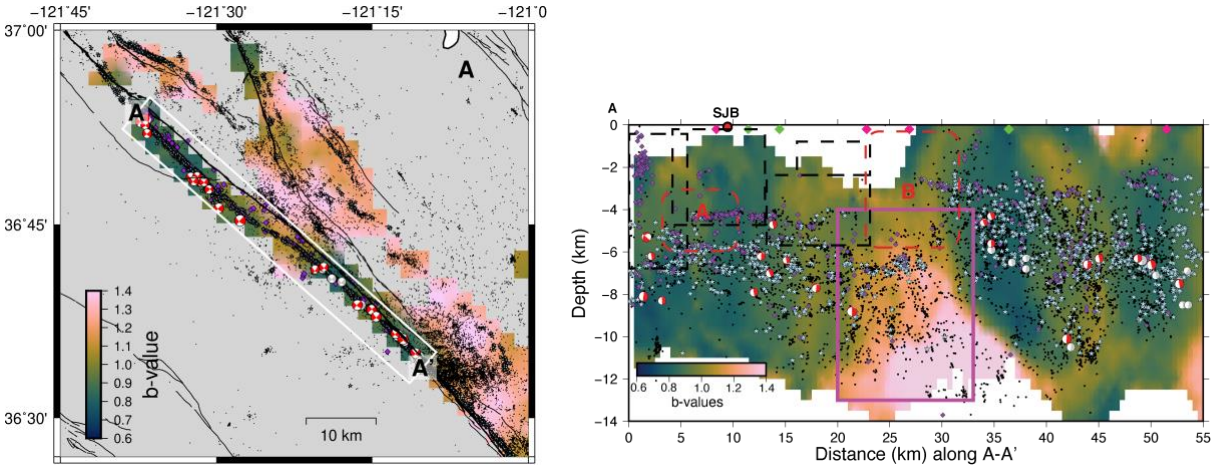

Figure 1. b-value map (left) and cross-section (right) near SJB. Repeating earthquakes (Taira, 2022; light blue stars), lower frequency earthquakes (purple stars), all seismicity (black), moderate-sized local earthquakes (M>4.5; focal mechanisms), and creepmeters (pink and green diamonds) are also included. Study area outlined in white. Left: Historical slow slip regions are shown by black dashed lines. Two areas of potential locked patches are outlined by red dashed lines (Johanson & Bürgmann, 2005). Anomalous region with relatively high b-value indicated by the magenta box.