# INVESTIGATING STRESS DROP VARIATIONS OF MAJOR SAN ANDREAS FAULT EARTHQUAKES OVER THE LAST 1000 YEARS

Teira Solis and Bridget Smith-Konter
Department of Geological Sciences, University of Texas at El Paso, El Paso, TX 79968
tsolis2@miners.utep.edu

The periodic earthquake cycle model provides a simplified representation of stress accumulation on a fault throughout the interseismic period and a predictable coseismic stress drop that results from each earthquake. There is a large body of evidence, however, indicating that repeating earthquakes on a single fault segment are not periodic in time, nor do they generate equivalent amounts of coseismic slip or stress drop. Static stress drop is typically estimated using the ratio of the coseismic fault slip to an appropriate scale length (fault length, fault depth, or the square root of the fault area) over which the slip occurred [*Kanamori*, 1994]. 3-D earthquake cycle models also show that stress accumulation and static stress drop are a complex function of space and time. Stress concentrations can vary spatially, particularly near locations of complex fault geometry and interacting fault segments. Stress accumulation rates can also be considered quasi-static during an interseismic period, where the loading rate may change as a function of time.

In this study we investigate how earthquake cycle stress varies as a function of time and space using static stress drop estimates based on paleoseismic slip measurements and a 3-D crustal deformation model. Here we focus on the Wrightwood paleoseismic site, located along the Mojave segment of the San Andreas fault. We use published slip estimates from 8 paleo-events [*Weldon et al.,* 2004] and fault locking depths derived from regional GPS data [*Smith-Konter et al.,* 2011] to calculate the sequence of stress drops at Wrightwood over the last 1000 years. Using a 3-D Maxwell viscoelastic crustal deformation model, we also simulate 8 earthquake cycles of interseismic stress accumulation, coseismic stress drop, and postseismic stress relaxation at Wrightwood from the same paleoseismic dataset, assuming a constant slip rate of 33 mm/yr and a stress drop to zero for each event. Resulting paleoseismic-derived stress drops range from 1.5-14.6 MPa (std 4.5 MPa) while model-derived stress drops are much lower, ranging from 0.5-2.2 MPa (std 0.6 MPa). In the model, the stress field is distributed along the fault depth and is influenced by postseismic relaxation and neighboring fault interactions, which may contribute to the stress drop differences. Furthermore, unusually large paleoseismic slip estimates (for example, 7 m in 1563 following a 49 year earthquake cycle) yield large paleoseismic stress drop anomalies. To better approximate the paleoseismic stress drops and investigate the implications of such variations at Wrightwood, we develop a suite of models with slip rates that are adjusted over each earthquake cycle to match the recorded paleoseismic offsets. Future work will be aimed at applying this method to several other fault segments of the SAF with a rich paleoseismic history.