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Is the creeping segment of the San Andreas Fault intrinsically weaker ?

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This contribution concentrates on the three segments of the San Andreas Fault which are located along the border of the Sierra Nevada microplate. All of them are orthogonal to the regional maximum horizontal stress and bordered by the same ophiolitic "mélange". However, the three segments possess very different earthquake regime. The central one which runs from Parkfield to San Juan Bautista (150 km) is creeping aseismically while the two other segments are able to generate destructive earthquakes in San Francisco and Los Angeles. A question arises from those observations: what factor controls the apparent contrasting behavior of the fault along strike? Using an elasto-plastic mechanical model for fault zone (eg. Rice and Rudniki), we compute the evolution of stress both within and outside the fault zone as it plays and show that displacement on mis-oriented (i.e. weak) faults causes strain hardening by rotation of the principal stresses within the gouge zone. This is an effective mechanism for 1) the fault to appear geologically weaker then the laboratory friction of the material 2) the existence of high deviatoric stress around the "weak faults" and, if the fault is sufficiently weak (0.3/0.4) it allows stable creep to occur. By the mean of regional thermo-mechanical models, we show that the variation of regime along strike may may result from the long term regional geodynamic setting which are transmitted to the fault through the elastic flexure of the lithosphere rather then by the variation of intrinsic frictional parameters. Hence, combining an adequate model for faults and long term regional geodynamic models provides an alternative explanation to the apparent weakness of the SAF, the high level of stress outside the fault and the contrasting mechanical behavior along strike. This model is compatible with the hydrostatic gradient and the lack of Helium anomaly observed at SAFOD and does not require the friction

to be close to zero, reconciling laboratory measurement and geological observations.