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3D MECHANICAL MODELING OF NORTHERN CALIFORNIA FAULT SYSTEM

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Northern California's tectonic is characterized by a fault system in which the main trace of the San Andreas fault is associated to two en échelon fault systems: the Maacama and Roger Creek, that are the northward continuations of the Calaveras and Hayward faults in the Bay Area. Geological evidences, along with principal stresses orientations, suggest that this fault system behaves mechanically differently than the southern segments, and show that its frictional strength is slightly higher than in the south. In this study we investigate the influence of thermal and rheological parameters and the geometry of the fault system on stress orientations and long term velocities.
We model the fault system in a cross-section view, from Pt. Arena to the West to 180 km inland, assuming there is no stress or strain variation along strike in this area. A simplified three-dimensional (3-D) model was built with a finite element code (ADELI3D). Heat flow measurements, seismicity distribution, and surface velocities were used to constrain the thermal structure of the crust and internal fault friction. The rheology of the lithosphere is composed of a frictional upper crust and a viscoelastic lower crust. Fault zones are modeled using low effective friction with respect to the surrounding crust. The lithosphere is supported by hydrostatic pressure at its base (representing the asthenosphere).
We present experiments of the long term deformation of the fault system in northern California by adjusting the thermal field, the fault system geometry, and the fault rheology that control the resulting velocity and stress fields. The different hypotheses we have tested included a stratified or laterally varying temperature field, and dipping or vertical faults for the Maacama and Bartlett Spring fault system. Preliminary experiments show a rotation of the orientation of the maximum horizontal compression, SH, from 65-75° outside the fault zone to 45° inside. A strong lateral heat flow variation predicts that SH is oriented at a higher angle to the fault, while modeling the fault

system to the East as dipping planes creates a lateral asymmetry of the distribution of the orientation of SH, and increases its angle to the fault between the different fault systems at depth. Adjusting the internal friction in the different fault zones, to fit the velocity field given by GPS measurements, will allow to differentiate which one of these tests best predicts the mechanical behavior of Northern California's fault system.