Variation in Aseismic Slip and Fault Normal Strain Along the Creeping Section of the San Andreas Fault from Geodetic Data

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Most of the relative motion between the Pacific and North American plates in central California is accommodated by strike slip along the San Andreas fault system. However, a small amount of convergence is accommodated by compressional structures in the California Coast Ranges on both sides of the fault. Recent examples of such activity are the Coalinga and the 2003 San Simeon earthquakes. Along the central San Andreas fault (CSAF), from San Juan Bautista to Parkfield, almost all the slip in the brittle upper crust is accommodated aseismically. We use GPS and trilateration data to resolve both the distribution of aseismic slip along the CSAF, and the deformation across adjacent, secondary fault structures. In 2003 and 2004, we conducted several GPS surveys along the CSAF. We resurveyed 15 stations of the San Benito triangulation and trilateration network, which extends 40 km to the northeast of the creeping segment. We combine these measurements with old electronic distance meter (EDM) measurements and data from a GPS campaign in 1998. We also occupied 13 sites along the creeping segment, for which previous data exist in the Southern California Earthquake Center (SCEC) archive.

These dense GPS measurements, along with data from permanent GPS stations in the area, allow us to constrain the regional strain distribution. Strain rates are very small on the crustal blocks adjacent to the creeping segment, with less than 2 mm/yr of contraction. We model the measured displacement field with rectangular dislocations in an isotropic, homogeneous and elastic half-space. Geodetic data indicates a slip rate of 32 mm/yr and shallower creep rate of 29 mm/yr along the central portion of the CSAF. The deficit between the deep and shallow slip rates is small.

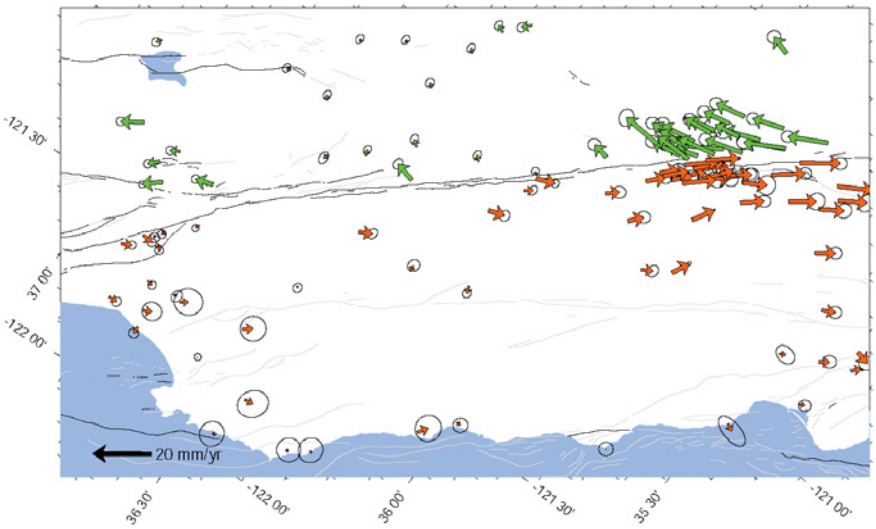

Figure 1. GPS velocity field. The sites on the SW of the CSAF in red are shown with respect to the Pacific plate and those in green to the NE with respect to the Sierra Nevada Great Valley block. In this figure we are removing a block offset along the SAF of about 34 mm/yr. This representation accentuates the off-fault deformation.

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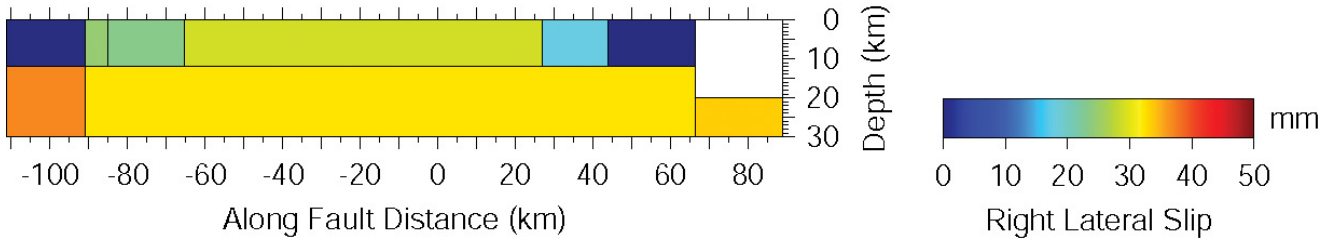

Figure 2. The distributed slip inversion along the CSAF.