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Aseismic slip and fault-normal strain along the creeping section of the San Andreas fault

F. Rolandone (1), R. Bürgmann (2), D.C. Agnew (3), I.A. Johanson (4), D.C. Templeton (2), M.A. d'Alessio (5), S.J. Titus(6), C. DeMets (6), B. Tikoff (6)

(1) Laboratoire de Tectonique, UMR7072, Université Pierre et Marie Curie, France (rolandon@ccr.jussieu.fr), (2) Berkeley Seismological Laboratory, UC Berkeley, CA, USA, (3) IGPP, Scripps Institution of Oceanography, UC San Diego, La Jolla, CA, USA, (4) U.S. Geological Survey, Menlo Park, CA, USA, (5) Earthquake Research Institute, Tokyo University, Japan, (6) Department of Geology and Geophysics, University of Wisconsin, USA,

In central California, most of the relative motion between the Pacific plate and the Sierra Nevada Great Valley microplate is accommodated by strike slip along the San Andreas fault, with a small amount of convergent and transcurrent motion accommodated by active thrust faults and folds in the California Coast Ranges on both sides of the San Andreas. Uniquely, along 170 km of the central San Andreas fault (CSAF), from San Juan Bautista to Parkfield, almost all the slip in the brittle upper crust is accommodated aseismically. The CSAF accommodates up to 32 mm/yr of its shallow slip as creep. We use GPS data to resolve both the distribution of aseismic slip along the CSAF, and the deformation across adjacent, secondary fault structures. Comparison of EDM data from between 1959 and 1983 with GPS data between 1998 and 2004 implies that, except for small-scale transients, the fault motion has been steady over the last 40 years. We combine GPS data from several networks to obtain site velocities at 42 points along the CSAF, with enough spatial density that we can constrain the regional strain distribution. Shear strain rates are less than 0.083 ± 0.010 μstrain/yr adjacent to the creeping SAF, with 1-4.5 mm/yr of contraction across the Coast Ranges. Dislocation modeling of the geodetic data gives a deep, long-term slip rate of 31-35 mm/yr and a shallow (0-12 km) creep rate of 28 mm/yr along the central portion of the CSAF, consistent with near-field surface creep measurements. The lower shallow slip rate may be due to the effect of partial locking along the CSAF or reflect reduced

creep rates late in the earthquake cycle of the adjoining SAF rupture zones.