POLY3D MODELING METHOD:

The program Poly3D is a three dimensional Boundary Element Method (BEM) modeling code (Thomas, 1993). For this study, the BEM code is used to simulate the three-dimensional active faulting near the San Gorgonio Pass inside a linear elastic half-space. The triangular elements used in Poly3D are ideal for complex geometries characteristic of the active faults in the San Gorgonio Pass region. Fine meshes of triangular Poly3D elements have previously been used to simulate geologic deformation in the Los Angeles Basin (Griffith and Cooke, 2004; Griffith and Cooke, 2005; Cooke and Marshall, 2006; Meigs et al, 2008) and in the Ventura Basin (Marshall et al., in press). Within our models, the average diameter of elements along the San Andreas and San Jacinto faults is ~5 km and the element diameter decreases to ~2.5 km along the complex fault segments within the San Gorgonio Pass. The detail of this mesh permits accurate simulation of fault irregularities larger than 10 km.

MODEL CONFIGURATIONS

We use Poly3D to simulate two different model configurations of active faulting along the San Andreas and San Jacinto faults within the San Gorgonio Pass region. The models include the Mojave segment and the Coachella Valley segment of the San Andreas fault, as well as the San Jacinto Valley strand and the Anza segment of the San Jacinto fault. The San Gorgonio Pass region is comprised a complex array of formerly and presently active faults. For this model we focused on faults that exhibit significant recent activity. For example, the western portion of the mapped San Gorgonio thrust was not included in the model due to lack of recent activity. The San Bernardino strand of the San Andreas fault was included in the model because
paleoseismicity shows this fault to be one of the major strands through the pass (Weldon and Sieh, 1985; McGill et al., 2007; McGill et al., 2002; Orozco, 2004). Subtle pressure ridges and hanging walls near the southern most surface trace of the San Bernardino strand suggest that the fault merges with the eastern portion of the San Gorgonio thrust (Yule and Sieh, 2003). Within the model, the San Gorgonio thrust has a north dip of 45-70°, and merges to the east with the Garnet Hill strand of the San Andreas Fault. The Garnet Hill strand dips to the north at 55-85°, and parallels the Banning strand. Both the Garnet hill and the Banning faults are believed to be active north of Palm Springs. For simplicity, we only include the Garnet Hill strand to represent deformation on both of these active parallel fault strands. Seismicity indicates that the Garnet Hill strand of the San Andreas fault extends from the San Gorgonio thrust to the Coachella Valley segment of the San Andreas fault even though geologic mapping does not show a surface trace intersection between the two faults (Langenheim et al., 2005). All of the three-dimensional faults included in the models have been smoothed at depth to remove any small irregularities observed along the fault trace at the Earth’s surface that are unlikely to extend to significant depths.

Though the San Jacinto is made up of many en echelon faults (Sharp 1975), our models consider the fault to be continuous and connected. Delineating the San Jacinto fault into individual echelon strands may decrease the strike-slip rates on the San Jacinto fault but is not expected to substantially change the slip rates along the San Andreas fault strands within the San Gorgonio Pass region.

MODEL SET UP
We insert a broad, horizontal detachment at a depth of 35 km to decouple crustal
deformation from the modeled half space (Figure A1). This depth is chosen to match the imaged
depth of the Mohorovičić discontinuity in this region (Magistrale et al., 2000). The active
segments of the southern San Andreas and San Jacinto Faults are extended through the crust to
this freely-slipping horizontal detachment. By allowing the faults to slip freely throughout the
crust in response to tectonic boundary conditions, our geologic models simulate both
interseismic and coseismic deformation. The results of three-dimensional models of faulting
above a deep seated horizontal detachment match well the geologic deformation in southern

As N52°W right-lateral displacement is prescribed on the distal edges of the detachment,
the shear-traction-free segments of the San Andreas and San Jacinto faults interact with each
other and slip freely without opening. The edges of the detachment are far (>300 km) from the
San Gorgonio Pass study area in each direction to minimize edge effects in the model results.
Each distal edge of the detachment is forced to slip in a right lateral sense at the overall plate
tectonic rate of 45 mm/yr (e.g. Bennett et al., 1999). Strike slip is prescribed at the distal tips of
the Mojave (35 mm/yr) and Coachella Valley (25 mm/yr) segments of the San Andreas fault, as
well as the Anza (10 mm/yr) segment of the San Jacinto fault (Figure A1). This minimizes the
edge effect caused by the finite faults used in the models. The eastern California shear zone,
which is believed to accommodate the difference between the 45 mm/yr plate motion and the 35
mm/yr right-lateral slip accommodated on the San Andreas at Cajon Pass (Bennett et al., 1999),
is not explicitly incorporated in the models. Instead, the difference in slip rate is accommodated
within the models by broad zones of distributed deformation between the San Andreas fault and
the far edges of the model where plate motions are applied.
Figure DR1. Schematic drawing of the loading of the models. The edges of the 35 km deep
detachment as well as the distal tips of the primary faults have prescribed slip. The slip on the
detachment is decreased incrementally as each section nears the strike-slip fault until slip on the
section adjacent to the fault matches the prescribed slip on the fault tip. Away from the model
boundaries all faults slip and interact in response to the loading at the edges.

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