An interseismic Global Positioning System velocity field for the central California coast region and preliminary deformation models

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Abstract

The central California coast, from north of Point Piedras Blancas (36°N) southward to Point Arguello (34.6°N) and west of the Rinconada and East Huasna faults, is a structurally complex region cut by several subparallel, late Quaternary faults. Studies of the way in which strain is partitioned across the Central California Coast Region (CCCR) have concluded that observed deformation patterns arise from transpression due to the clockwise rotation of the Transverse Ranges (McLaren and Savage, BSSA 2001) or, alternatively, the westward transfer of right lateral strike slip motion in a left-stepping fashion across the region (Hardebeck, BSSA 2010). Despite relatively low rates of deformation inferred from geologic studies of the CCCR, the occurrence of the 2003 M_w 6.5 San Simeon earthquake southeast of Point Piedras Blancas highlights the need to better understand the ongoing patterns of deformation here as a means for assessing the seismic hazard.

Geodetic data can be used to elucidate how strain is currently partitioned between shear parallel to the San Andreas Fault (SAF) and contraction within the CCCR, and on what structures active deformation is occurring. We have compiled a new, spatially dense secular velocity field for the CCCR derived from Global Positioning System (GPS) measurements. We leveraged the EarthScope Plate Boundary Observatory (PBO) permanent GPS network and existing survey-mode GPS (SGPS) data available in archives. To this we added newly-collected SGPS observations and data from nine semi-permanent GPS (SPGPS) sites established by USGS to improve spatial coverage and obtain well-constrained velocities in a short amount of time. Using time series analysis techniques that incorporate the white and colored noise typically present in GPS time series (Langbein, JGR 2004), we estimated secular rates. We accounted for the effects of the 2003 M_w 6.5 San Simeon and 2004 M_w 6 Parkfield earthquakes by excluding data likely to be affected from the analysis and reassessing the uncertainties on estimated rates. Notably, the postseismic signal following the San Simeon event is considerably longer-lived than reported in earlier papers making it difficult to estimate secular rates for sites in the affected region.

We have used the resulting secular velocities, in combination with velocities from the Southern California Earthquake Center Crustal Motion Map v.4 and the Plate Boundary Observatory velocity field, to constrain block models of deformation for central and southern California. We follow the approach of McCaffrey (2005) using his *defnode* software to solve for the rotation of fault-bounded blocks, fault slip rates, and internal strain within blocks. Preliminary results show that while significant internal strain occurs in the Salinian block (which extends west from the SAF to the coast in central California) this is largely due to displacement patterns observed near the junction of the SAF and the Garlock fault. The data do not require substantial slip on the Rinconada fault or, alternatively, a fault bounding the eastern edge of the CCCR; estimated slip rates are ~2 mm/yr and <1 mm/yr respectively. The data also do not

suggest that significant internal strain is occurring within the CCCR. Ongoing work is focused on exploring different block geometries in an effort to better constrain slip rates on the Hosgri and San Andreas faults. These results will contribute to development of a coherent regional tectonic model and help characterize the potential seismic sources in the region.

References

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