

Copious Postseismic Slip Following the 2004 Parkfield Earthquake, Constrained by GPS and InSAR Data

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The September 28, 2004, Mw6.0 Parkfield earthquake was the long delayed fulfillment of the Parkfield Earthquake Prediction Experiment [Bakun and Lindh, 1985]. The years since the original prediction have seen the advent of space-based geodesy; both GPS and InSAR data can now be added to the wealth of information on this historic earthquake. We use these data to constrain a model of the coseismic and postseismic slip of the 2004 Parkfield earthquake. In Johanson et al. [2006], we examine the relationship between these two periods of the earthquake cycle, their relationship to aftershocks and the extent and importance of aseismic slip. We invert eight interferograms jointly with campaign and continuous GPS data for slip in the coseismic and postseismic periods of the 2004 Parkfield earthquake. The two datasets complement each other, with the InSAR providing dense sampling of motion and the GPS providing more sparse, but three dimensional, measurements of ground motion. The model assumes exponential decay of the postseismic slip with a decay time constant of 0.087 years, determined from time series modeling of continuous GPS and creepmeter data. Double-difference relocation of Parkfield aftershocks shows a prominent microseismicity streak at ~5 km depth [Thurber et al., 2006]. One interpretation of microseismicity streaks is that they occur at the boundaries of creeping and locked fault asperities [Nadeau et al., 1995]. The streak of aftershocks at 5 km depth occurs near the top of an area of high slip in Figure 1a, and could be interpreted as weakly bounding that asperity. We find a geodetic moment magnitude of Mw6.2 for a 1-day coseismic model and Mw6.1 for the entire postseismic period. A comparison of the geodetic slip models with seismic moment estimates suggests that the coseismic moment release of the Parkfield earthquake is as little as 25% of the total. This finding underscores the importance of aseismic slip in the slip budget for the Parkfield segment.

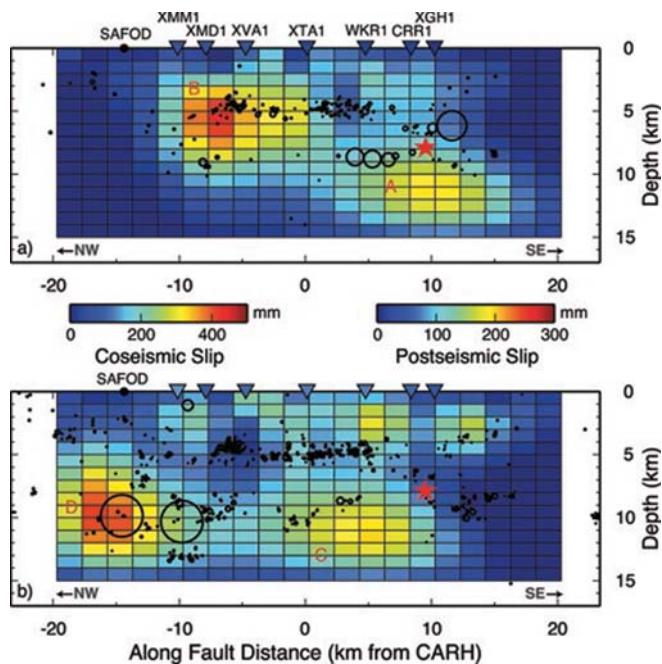


Figure 1. a) Results of inversion for a) Coseismic slip with one day of aftershocks, b) Postseismic slip with aftershocks from September 29 through November 17. Red stars mark location of earthquake hypocenter. Triangles are color-coded creepmeter displacements roughly corresponding to the coseismic and postseismic periods.

References

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