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HAYWARD, CALAVERAS AND MISSION FAULT SUBSURFACE SLIP FROM JOINT ANALYSIS OF MICROEARTHQUAKE RECURRENCE AND SPACE GEODESY

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TECHNICAL ABSTRACT

This project addresses the seismic potential and natural hazard presented by the Hayward, Calaveras and Mission faults (HF, CF and MF, respectively) to the San Francisco Bay area through the use of fault creep and space-based technology (i.e. GPS and differential radar interferometry (InSAR)) combined with high-resolution observations of microearthquake activity on the faults. This research provides detailed information on the magnitude of subsurface aseismic fault slip and it's variation in space and time. Results directly contribute to reducing losses from earthquakes in the San Francisco Bay area by contributing reliable estimates of earthquake potential (size and slip-deficit accumulation rates of locked fault segments) along three major fault segments.

Imaging distributed slip on subsurface faults from surface displacements is a difficult task, plagued by limits in the spatial resolution of the surface displacements and ambiguities in the depth resolution of slip variations. The ability to derive even just a few point measurements of fault slip at depth adds invaluable constraints on the spatial distribution and magnitude of aseismic slip along fault surfaces. Therefore, inversions aided by such constraints can significantly sharpen the resolution of locked patches along the Hayward (HF), Calaveras (CF) and Mission (MF) faults. Subsurface slip-rate estimates from sequences of characteristically repeating microearthquakes (CS) can be integrated with surface and space based geodetic measurements in inversions in a straightforward manner. We have successfully applied joint geodetic and repeating earthquake techniques to the northern HIF using INSAR, GPS, creep and NCSN archival data *(Burgmann et al.,* 2000). And we have expanded our analysis to image the deep slip behavior of the entire East Bay fault system. Using the newly released double-difference earthquake relocation code hypoDD, we also resolve the relative seismic structure of these East-Bay faults in much greater detail, which provides important information about the sub-surface fault geometry, especially in the Mission stepover region linking the HF

and CF. We now have CS slip rate estimates for a 100 krn extent of the HF-MF-CF system. The preliminary slip rate estimates appear consistent with independent deformation measurements and can resolve accelerated slip transients, such as following the 1984 Morgan Hill earthquake along the CF. No CS events are found along the northern CF and at depths > 5 km along the southern HF. A mapping of aseismic fault slip at depth and through time is currently being developed based on the joint inversion of all available data.