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The search for creep on the faults of northern California

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Shallow aseismic fault creep is a behaviour exhibited by very few faults in the world. Instead of the stick-slip frictional regime that most faults follow, creeping faults move, steadily or episodically, throughout the interseismic period of the earthquake cycle. Creep effectively reduces the fault surface area capable of rupture in earthquakes, and thus knowledge of its extent is critical for the correct assessment of seismic hazard. In addition, by comparing the geographical locations of creeping fault areas with mapped lithologies, we may be able to better understand the underlying causes or mechanisms.

We present here the results of our ongoing research into the distribution of creeping fault areas in northern California, where the majority of reported cases are located. We map the surface deformation field of the plate boundary system south and north of the San Francisco Bay Area using persistent scatterer InSAR, which provides a dense spatial coverage of surface deformation measurements across the region, and 'ground truth' these, where possible, with additional surface deformation measurements from GPS. In so doing, we identify deformation consistent with right-lateral shallow creep on sections of five major faults (the Hayward, Calaveras, San Andreas, Rodgers Creek and Concord faults). On the Hayward fault, we are able to map both the extent and distribution of creep rates at depth, constraining the location of a locked zone that is presumably the source of major earthquakes on the fault. We are not able to identify a consistent lithological control for the creep behaviour.