AWARD NUMBER: 00HQGR0074

Interpretation of Precarious Rock and Overturned Transformer Evidence for Ground Shaking in the M=7.6 Kern County Earthquake: an Analog for Disastrous Shaking from a Major Thrust Fault in the Los Angeles Basin

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We have developed a methodology for using objects overturned by earthquakes to place constraints on ground motion. We use precariously balanced rocks and overturned transformers in the vicinity of the White Wolf fault, to provide estimates of ground motion during the 1952 Kern County earthquake. Preliminary estimates of ground motion on the footwall give peak accelerations of about 0.3 g at about 10 km and 0.5 g at less than 1 km from the fault trace. In the case of the hanging wall, there is evidence of intense ground shattering and lack of precarious rocks, consistent with the intense hanging wall accelerations suggested by the foam rubber modeling, numerical modeling and previous thrust fault earthquakes. There is clear evidence of rupture directivity in ground motions on the hanging wall side of the fault. For the northeast part of the fault, in the direction of rupture propagation, no precarious or semi-precarious rocks are found at distances less than 15 km from the outcrop of the fault. At a distance of about 20 km, near the town of Tehachapi, rocks that may be close to semi precarious begin to appear (estimated toppling accelerations of about 0.5g). On the other hand for the central part of the fault, closer to the epicenter, and expected to be less affected by directivity, semi-precarious rocks begin to appear at a distance of about 10 km from the fault trace. The effects of rupture directivity on the hanging wall are also clear in the numerical simulations. On the southwest part of the fault, which is covered by sediments, evidence from the overturning and damage of numerous transformers tends to support the significant transfer of energy from the hanging wall to the footwall. Transformers near the projected fault outcrop have been damaged or overturned on both the hanging-wall and footwall sides of the fault. Numerical prediction of the minimum amplitude of a full-sine pulse of acceleration that could have toppled one of the transformers suggests a minimum peak amplitude of about 0.5 g at 1.5 hz, consistent with Intensity VIII estimated for this region.