Geometry and Morphology of Cracks in Saprock: Implications for Ground Shaking

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Lying between the Elsinore and San Jacinto faults is a band of precariously balanced rocks first identified by J. Brune and colleagues. Peak accelerations during ground shaking events on the San Jacinto and Elsinore faults were shown by these investigators to reach minimal values about midway between the two faults. As a result ellipsoidal plutonic blocks (corestones), balanced on narrow pedestals of saprock connected to underlying bedrock, remain intact and extend above the land surface. In contrast, such precariously balanced rocks are generally absent at closer proximities to the faults, apparently a result of being knocked down during past ground shaking events. Several recent numerical models show that surrounding large-slip strike-slip fault zones is a large flower-like envelope of damaged rock. Along the fault, this zone is generally narrow at depths but then widens significantly when traced to shallower depths reaching up to 10+ km at the land surface. Work by G.H. Girty, C. Replogle, and M. Maroun has shown that volumetric strains of saprock surrounding corestones within the band of precariously balanced rocks varies from ~0% to ~15%. However, at the few locations that have been studied adjacent to the Elsinore fault, volumetric strains range from ~26% to ~38%. Crack density analysis of saprock within ~17 km of the fault traces indicate that the formation of open and sealed cracks are likely a result of ground shaking. While there is a pronounced visible fracture fabric at each site, the microscopic open and sealed crack systems studied during this investigation show different orientations and thus are a result of a separate stress field. Data obtained during this study support the hypothesis that ground shaking due to fault rupturing is of sufficient strength to crack saprock and that microscopic open and sealed cracks may be indicators of such ground shaking intensity.