

Shallow bulk yielding above buried sections of the 2021 Mw7.4 Maduo, Tibet, rupture

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Abstract

Surface deformation associated with continental earthquake ruptures includes localized deformation on the faults, as well as deformation in the surrounding medium through distributed and/or diffuse processes. However, the role of the diffuse part of the surface deformation to the overall rupture process, as well as its underlying physical mechanisms are not yet well understood. In this study, we compute high-resolution near-fault displacement maps from optical image correlations for the 2021/05/21 Mw7.4 Maduo, Tibet, strike-slip earthquake, and measure the contributions of the different deformation components to the surface deformations for that event. Results show that surface slip along primary faults accommodates, on average, only ~25% of the total surface deformation. Majority of the surface coseismic deformation is in fact accommodated by diffuse deformation, especially in the epicentral area where no surface slip was observed. In fact, the contribution of the diffuse deformation increases as localized deformation on the fault decreases. Localized deformation also decreases with decreasing total surface displacement. These observations highlight a gradual localization of the surface coseismic deformation, from regions of diffuse low (0.1-0.3%) strain, to regions of highly localized (>1 %) strain, with increasing coseismic displacement. Using simple two-dimensional mechanical models we show that diffuse deformation may correspond to elastoplastic bulk yielding, accounting for the deficit in shallow fault slip in the regions of surface rupture gap.