Nucleation and coseismic rupture of the 2019 M 6.4 and M 7.1 Ridgecrest, California earthquakes

*Lingsen Meng[1], Hui Huang[1], Yuqing Xie[1], Han Bao[1]

1. University of California Los Angeles

The 2019 M 6.4 and M 7.1 Ridgecrest, California earthquake sequence provides an ideal opportunity to study the seismicity evolution and coseismic rupture among multiple complex fault structures. In this study, integrated geophysical observations provide insight into the nucleation and coseismic rupture processes. Our matched-filter analysis shows a short-duration (˜31 minutes) foreshock sequence aligned in the NW-SE direction, led by an M 3.98 event before the M 6.4 earthquake. The M 7.1 event nucleated in a region of local seismicity concentration which intensified ˜ 3 hr before the M 7.1 mainshock. The M 7.1 nucleation zone is characterized by a relatively low b value of events that occurred since the M 6.4 event, possibly indicating local failure conditions approaching a critical state. Multi-array back-projections using local strong-motion stations and teleseismic broadband stations provide sharp images of the coseismic rupture process. The M 6.4 quake initiated on a 5-km-long NW-trending segment, before rupturing the primary SW-trending fault at the speed of ˜1 km/s. The Coulomb stress of M 6.4 event promoted the M 7.1 mainshock by unclamping the NW portion of the fault. The M 7.1 quake extends bilaterally for 10 km and 25 km, on the NW and SE portion of the fault, respectively, at the speed of 1 - 1.5 km/s. The rupture path agrees with the surface rupture trace inferred by pixel correlation of the Sentinel-2 optical images. We observed a temporary rupture slowdown at t = 13-15 s, likely related to a geometrical barrier due to fault complexity near the intersection of the SW and NW segments.

Keywords: Ridgecrest , foreshocks, Earthquake