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A new perspective on the generation of the 2016 M6.7 Kaohsiung earthquake, southwestern Taiwan

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In order to investigate the likely generation mechanism of the 2016 M6.7 Kaohsiung earthquake, a large number of high-quality travel times from P- and S-wave source-receiver pairs are used jointly in this study to invert three-dimensional (3-D) seismic velocity (Vp, Vs) and Poisson's ratio structures at high resolution. We also calculated crack density, saturate fracture, and bulk-sound velocity from our inverted Vp, Vs, and σgodels. In this way, multi-geophysical parameter imaging revealed that the 2016 Kaohsiung earthquake occurred along a distinctive edge portion exhibiting high-to-low variations in these parameters in both horizontal and vertical directions across the hypocenter. We consider that a slow velocity and high-σ body that has high ε and somewhat high ζ anomalies above the hypocenter under the Coastal Plain represents fluids contained in the young fold-and-thrust belt associated with the passive Asian continental margin in southwestern Taiwan. Intriguing, a continuous low Vp and Vs zone with high Poisson's ratio, crack density and saturate fracturegnomalies across the Laonung and Chishan faults is also clearly imaged in the northwestern upper crust beneath the Coastal Plain and Western Foothills as far as the southeastern lower crust under the Central Range. We therefore propose that this southeastern extending weakened zone was mainly the result of a fluid intrusion either from the young fold-and-thrust belt the shallow crust or the subducted Eurasian continental (EC) plate in the lower crust and uppermost mantle. We suggest that fluid intrusion into the upper Oligocene to Pleistocene shallow marine and clastic shelf units of the Eurasian continental crust and/or the relatively thin uppermost part of the transitional Pleistocene-Holocene foreland due to the subduction of the EC plate along the deformation front played a key role in earthquake generation in southwestern Taiwan. Such fluid penetration would reduce Vp, and Vs while increasing Poisson's ratio and saturate fracture across the source area, leading to mechanical strength failure of the rock matrix in the relative weakened and brittle seismogenic layer and triggering the 2016 earthquake.