Effect of the Main Shock Slip on Aftershocks: The 2006 Kiholo Bay, Hawai‘i, Earthquake Sequence

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We studied source parameters of the Kiholo Bay earthquake (Mw 6.7), which occurred beneath the NW part of the Island of Hawai‘i on October 15, 2006, and small earthquakes around the main shock including aftershocks. We first relocated the aftershocks to determine the fault plane from the two nodal planes. The relocated cloud of aftershocks has an E-W trend and dips to the south, which corresponds to one of the nodal planes given by the Global CMT solution. We then carried out a waveform inversion with multiple time windows for investigating the rupture speed and the slip distribution of the main shock. We used waveforms from a M5.0 aftershock as empirical Green’s functions. We found that the rupture propagated unilaterally to the west with a rupture speed greater than 3.0 km/s (63% of the shear wave velocity). This is consistent with the fact that aftershocks also distributed predominantly to the west of the main shock hypocenter. Most aftershocks were located on the edge of patches with a large slip (asperities). We also estimated static stress drops of 39 earthquakes (M2.5 to M3.5) that occurred in 2006 and 2007 near the source region of the Kiholo Bay earthquake. Static stress drops ranged from 0.12 to 8.6 MPa, with aftershocks around asperities of the main shock exhibiting larger stress drops.