We study the source process of the Kiholo Bay earthquake (Mw 6.7), which occurred beneath the NW part of the Island of Hawaii on October 15, 2006, and static stress drops of small earthquakes that occurred in 2006 and 2007 around the main shock including aftershocks. Relocated aftershocks define an E-W trending plane that dips to the south, in good agreement with one of the nodal planes given by the Global CMT solution. Waveform inversion is performed with multiple time windows to investigate the rupture speed and the slip distribution of the main shock. Waveforms of an aftershock with Mw 5.2 are used to calculate empirical Green’s functions. Rupture speeds faster than 3.0 km/s yielded almost the same slip distribution in the corresponding time periods, suggesting that the rupture speed of the main shock was faster than 63% of the shear wave velocity. We also find that the rupture propagated unilaterally to the west, in agreement with the location of the main shock epicenter near the eastern edge of the aftershock zone. Most aftershocks are located on the edges of patches with a large slip (asperities) and some also occur inside the patches. Finally, we estimate static stress drops of 39 earthquakes (2.5 < M < 3.5) that occurred in 2006 and 2007 near the source region of the Kiholo Bay earthquake. Static stress drops range from 0.12 to 8.6 MPa and aftershocks around large slip patches of the main shock are likely to have larger stress drops.